Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/canadianengineer23toro

I

855 (17)

THE
CANADIAN ENGINEER

ESTABLISHED 1893

Issued Weekly in the interests of the Civil, Mechanical, Structural, Electrical, Marine and Mining Engineer, the Surveyor, the Manufacturer, and the Contractor.

Index to Volume (16) 23

JANUARY-JUNE, (1909) 1912

The volume of editorial matter has increased to such an extent that it has been found necessary to issue indexes every six months. Henceforth a new index will appear in June and December.

104738
9/9/10

THE CANADIAN ENGINEER
Head Office, 62 Church St., TORONTO
MONTREAL WINNIPEG

THE CANADIAN ENGINEER

ESTABLISHED 1893

Index to Volume 23

JULY—DECEMBER 1912

129269
16/9/13.

AUTHORS.

PAGE
Allison, L. R. W. 849
Arnold, H. W. 456
Barnes, Prof. H. T. 887
Bell, H. Poynter 765
Beyer, W. O. 275
Blanchard, Arthur H. 607, 642
Borden, H. P. 663
Borrowman, George 530
Bright, D. M. 695
Brush, Wm. W. 108
Burr, Edward 349
Busse, Arthur 377
Caldwell, F. C. 621
Cannon, L. A. 383
Clarke, E. A. S. 229
Clark, H. G. 744
Crosby, W. W. 380
Cowan, H. W. 523
Cunningham, C. H. 403
Darlington Frederick 411
Dawson, A. S. 192, 225
Doane, F. W. W. 374, 396, 736
Douglas, W. H. 320
Dunn, Gano 362
Earl, Frank B. 424
Eckardt, H. M. P. 123
Edholm, C. L. 167
Edholm, L. M. 633, 834
Embrey, Geo. 245
Fell, G. Noble 488
Fitzgerald, F. A. J. 143
Fleming, R. 916
Franklin, Milton W. 215
Fremont, G. 325
Fuller, Geo. W. 526
Ganz, A. F. 116
Goodday, Leonard 793
Grace, Sergius P. 385, 414
Haldeman, B. Antrim 457
Hardinge, H. W. 547
Harts, Wm. W. 473
Harvey, W. S. 777
Hatton, Mr. 840
Hatt, W. K. 701
Hazen, Allen 613
Hedley, James 700
Hesser, W. G. 627
High, S. Y. 259
Hoadley, Dr. Geo. A. 340
Hood, S. Bingham 155, 169
Howe, Henry M. 496
Howell, Wm. A. 899
Hunter, James 315
Hyde, Edward P. 559
Jackes, L. B. 751, 809
Jackson, Dr. D. D. 359
James, E. A. 595, 601
Jones, Chas. J. 681

PAGE
Jones, L. M. 101
Jones, T. Harry 829
Kanolt, C. W. 348
Kelly, Thos. J. 174
Kindle, E. M. 235
Lawrence, S. E. 347
Lederer, Dr. Arthur 669
Lewis, Nelson P. 239
Lewis, S. R. 360
Lowes, T. 493
Lyon, Henry L. 126
McCormick, R. S. 290
McDonald, Hunter 283
McLean, W. A. 603
McPherson, A. J. 759
Macdonald, J. A. 799
Mann, Howard E. 867
Martin, W. A. 272, 308
Meade, T. De Courcy 635
Mitchell, C. H. 911
Ogden, Henry N. 890
Owen, James 344
Pannell, E. V. 181
Parks, Prof. W. A. 745
Pegg, H. V. 448
Peters, F. H. 639
Phelps, Geo. 757
Polk, A. C. 513
Potter, Alex. 137
Race, Joseph 255, 407
Randall, Theodore A. 631
Rankin, Norman S. 435
Reid, F. R. 159, 177
Ritter, Hans K. 593
Ross, D. H. 219
Ruthrauff, Harry 343
Sample, Wm. C. 725
Saunders, Wm. L. 146
Skinner, John F. 479
Simmen, Paul J. 460
Smith, C. A. 299
Smith, Prof. Leonard S. 326
Snypp, Chas. E. 490
Spencer, A. D. 298
Sterling, E. A. 428, 749
Still, Alfred 569, 652
Sutherland, C. C. 371
Tinker, G. H. 805
Tissington, F. 141, 206, 246, 281, 741
Tyrrell, H. G. 197
Van Trump, Isaac 872
von Emperger, Dr. E. 279
Walker, W. R. 122
Whinery, S. 703
Whipple, Geo. C. 610
Whitten, W. H. 676
Wickle, J. R. 257
Wilcocks, Sir Wm. 545
Wiles, C. W. 314
Worcester, T. A. 311

PAGE
Worrell, M. L. 333
Wynne-Roberts, R. O. 881

BOOK REVIEWS.

Analysis of Metallurgical and Engineering Materials. H. Wysor. 810
Artistic Bridge Design. H. G. Tyrrell 686
Bandbook for Highway Engineers. W. G. Harger and E. A. Bonney. 688
Bleaching and Dyeing of Vegetable, Fibrous Material. J. Hubner 933
Boundaries and Landmarks. A. C. Mulford 932
Building Stones and Clay-Products. Heinrich Ries 932
Central Heating Station. B. T. Gifford 688
Concrete Highways 688
Concrete Workers Reference Books. A. A. Houghton 398
Cooking of Coal at Low Temperature, with a Preliminary Study of the By-products. S. W. Parr and H. L. Olin 811
Design of Mine Structures, The. M. S. Ketchum 130
Design of Steel Mill Buildings. M. S. Ketchum 689
Dewey Decimal System of Classification Applied to the Engineering Industries, An Extension of the. By L. P. Brackenridge and G. A. Goodenough 930
Diary of a Roundhouse Foreman. T. S. Reilly 398
Differential and Integral Calculus. Lorrain S. Hurlburt 812
Elements of Drawing. G. F. Blessing and L. A. Darling 811
Energy and Velocity Diagrams of Large Gas Engines. P. L. Joslyn 688
Engineering Directory, 1912 131
Engineering for Land Drainage. C. G. Elliott 813
Farm Gas Engines, H. R. Brate 131
Fourth National Conference Proceedings 932
Heat Treatment of Tool Steel. H. Brearly 130
Indicator Handbook, Part 2. Chas. N. Pickworth 931
Light: Its Use and Misuse 812
Machine Design. H. D. Hess 689
Materials and Construction. J. A. Pratt 531

*Illustrated.

7N
C34
V.23

PAGE
Materials Used in Sizing. W. F. A. Ermen 688
Measurement of High Temperatures. Burgess and Le Chotelier 130
"Mechanical World" Pocket Diary and Year Book for 1913 812
Metallography of Iron and Steel. T. R. Loudon and A. Sauveur 810
Metallography of Iron and Steel. Albert Sauveur 686
Metropolitan Water Board. A. C. Houston 398
Modern Gasoline Automobile, its Construction, Operation, Maintenance and Repair. V. M. Pagé... 812
Modern Illumination Theory and Practice. H. C. Horstmann and V. H. Tousley 131
Modern Organization. Chas. DeLano Hine 687
Modern Sanitary Engineering. G. Thomson 813
Official Good Roads Year Book of the United States. J. E. Pennybacker 812
Preliminary Studies in Bridge Design. Reg. Ryves 531
Principles of Structural Mechanics. P. J. Waldram 130
Problems in Engineering. S. G. Turner 131
Properties and Design of Reinforced Concrete. Nathaniel Martin 812
Pumping and Water Power. F. A. Bradley 399
Raising the Wreck of the U. S. Battleship "Maine" 531
Reinforced Concrete Construction. M. T. Cannell 130
Reinforced Concrete Construction. G. A. Hool 398
Reference Book for Statistical Calculations. F. Ruff 398
Smoley's Tables. C. Smoley 933
Some Facts About Treating Railroad Ties. W. F. Goltra 812
Steel Sheet Piling Tables and Data on the Properties and Uses of Sections 811
Street Paving and Paving Material. G. W. Tillson 932
Strength of Materials. M. Merriman 811
Successful Homes and How to Build Them. Chas. E. White 932
Text Book of Physics 689
Text Book on Roads and Pavements. F. T. Spalding 933
Theory of Structures. R. W. Angus 687
Transit Theodolite, and Other Instruments Mechanically Considered. H. W. Valle 131
Transmission Line Construction. R. A. Lundquist 930
Treatise on the Design and Construction of Roofs. R. C. Ricker 931
Tunneling: A Practical Treatise. Chas. Prelini 688
Water Supply and Drainage. C. E. Housden 931
Webster's New International Dictionary 399

CONTRACTS.

Bank, Medicine Hat ....No. 4—68
Bank Building, Vancouver ....No. 15—68
Breakwater, etc., Beaverton ..No. 18—66
Breakwater, Goderich ....No. 20—66
Breakwater, Victoria, B.C. ....No. 17—66
Bridge, Calgary ....No. 6—68
Bridge and Dam, Georgetown..No. 6—68
Bridge and Dam, Moose Jaw..No. 11—68
Bridge, Edmonton ....No. 24—66
Bridge, St. John, N.B. ......No. 24—66
C. N. Railway, B.C. ....No. 7—68
Car Barns, Moose Jaw ......No. 15—68
PAGE
Centrifugal Pump, Niagara Falls ....No. 18—66
College, Guelph ....No. 15—68
Cranes ....No. 17—70
Culverts, C.P.R. ....No. 9—68
Custom House, Montreal .....No. 13—68
Dam, Jordan River, B.C........No. 9—70
Destructor Plant, Roumania ...No. 21—68
Dredging, Port Stanley ......No. 19—66
Drill Hall, Lindsay ....No. 15—68
Electric Lighting System, Canora, Sask. ....No. 8—68
Electric Light Plant, Harriston, Ont. ....No. 19—66
Electric Plant, Cape Breton, N.S. ....No. 24—76
Elevator, Port Arthur ....No. 8—68
Elevator, Port Colborne ......No. 14—68
Fire Service Waterworks, Winnipeg. ....No. 9—70
Foundry extension, National Iron Works Co., Ashbridge's Bay..No. 20—66
Gasholder and steel tank, Outremont. ....No. 10—68
Gas Plant and Gasometer, Edmonton. ....No. 13—68
Grading, Port Mann, B.C. ....No. 3—68
Grain House, Fort William, Ont. ....No. 5—68
Hospital, New Westminster, B.C. ....No. 8—68
Hudson Bay Railway ....No. 15—68
Meters, Winnipeg ....No. 7—70
Pavements and Sewer, North Toronto ....No. 6—68
Paving, Lethbridge ....No. 1—70
Paving, New Westminster, B.C. ....No. 1—70
Paving, St. John, N.B. ....No. 3—68
Paving, Vancouver, B. C. .... No. 6—68, No. 8—70
Paving, Westmount ....No. 7—70
Piers for Bridge, C.N.R., Swan River ....No. 9—68
Pipe for Water Main, Toronto..No. 9—68
Pipe Laying, Edmonds, B.C.....No. 14—68
Post Office, Lethbridge ....No. 10—68
Pumps, Motor-driven ....No. 17—66
Railway, B.C. ....No. 14—68
Retaining Wall, Smith's Falls..No. 14—68
Retaining Wall and Wharf, Owen Sound ....No. 3—68
School Buildings, S. Vancouver..No. 7—70
School, North Toronto ....No. 15—68
School, Malvern, Toronto ......No. 16—66
School, Oaklands, Victoria .....No. 10—68
School, Pape Ave., Toronto.....No. 4—68
School, Regina ....No. 19—66
School, Transcona ....No. 15—68
Sewage Pumps, Montreal .....No. 17—70
Sewers, Montreal ....No. 7—68
Sewers, Outfall and Reinforced Concrete Pipe, New Westminster.No. 20—66
Sewers, St. John, N.B. ....No. 8—70
Sidewalk, Eastview ....No. 8—68
Sidewalks, Tp. of York ....No. 8—70
Steel Wire, Victoria ....No. 11—68
Substructures, Eight Bridges, Vancouver ....No. 9—70
Switchboards, Moose Jaw .....No. 8—68
Tank, Dunnville ....No. 21—65
Treasury Vaults, Ottawa ......No. 2—68
Trunk Sewer, Weston, Ont. ....No. 3—68
Veterinary College, Toronto ...No. 14—68
Warehouse, Moose Jaw ......No. 9—68
Warehouse, Regina ....No. 18—66
Warehouse and Machine Shop, Vancouver ....No. 19—66
Warehouse, Vancouver ....No. 9—70
Warehouse, Winnipeg ....No. 2—68
Water Meters, Winnipeg ......No. 9—70
Water and Sewer System, Bassano ....No. 17—66
Water-wheel Generator, Shawinigan Falls, Quebec ....No. 2—68
Waterworks, Port Alberni, B.C. ....No. 14—68
PAGE
Wharf, Brockville ....No. 20—66
Wharf, Murray Bay, Que.....No. 11—68

PERSONAL AND OBITUARY.

Adams, Dr. F. D. 785
Allaire, Alexander* 629
Allen, M. J. K. 133, 369
Andrews, Dr. W. W. 693
Angus, Harry 693
Arnot, Peter (Ob.) 630
Barclay, W. J. (Ob.) 938
Barlow, Dr. A. E. 535
Bateman, G. C. 599
Batho, W. T. 502
Beam, L. O. 693
Beaubien, De Gaspe 163
Beemer, H. J. (Ob.) 267
Bell, H. P. 723
Bell, Jas. A. 335
Berger, A. H. 567
Bell, W. H. 501
Bigelow, C. H. 755
Black, Alex. L. 267
Blanchard, Arthur H. 847
Bogue, Virgil G. 847
Bow, Malcolm R. 199
Brock, R. W. 693
Brown, R. D. 567
Butler, M. J. 693
Cariss, C. C. 847
Chadwick, R. E.* 693
Chausse, A. 755
Childs, J. T. 535
Chisholm, J. 199
Clarke, C. N. 661
Clark, F. G. 401
Clough, Col. 755
Cochrane, Hon. Frank 133
Cockburn, L. S. 567
Cody, Frank L. 535
Cohoe, W. P. 723
Coderre, Hon. Louis 785
Colclough, Richard 907
Coleman, L. G. 133
Conlon, F. T. (Ob.) 200
Cousins, E. L.* 785, 847
Craddock, Geo. 786
Cunningham, J. H. 629
Curry, Nathaniel 817
Dallyn, F. A. 723
Daly, R. A. 629, 693
Darwin Sir Geo. H. (Ob.) 907
Davis, A. W. 661
Deacon, T. R. 907
Dickerson, J. T. 199
Dillabough, J. V. 369
Dill, C. W. 199
Dix, Harry 723
Drayton, H. L. 133, 164
Dudgeon, John 369
Dunford, Chas. L. 817
Dunham, C. A. 723
Durban, C. 693
Durley, R. J. 723
Elmendorf, W. J. 723
Englehart, J. L. ....No. 25—68
Estey, Dr. A. S. 369
Evans, G. I. 629
Evans, W. F.* 433
Ewing, W. Colin 785
Fisk, W. H. 235
Flaherty, A. E. 785
Forde, J. P. 937
Fraser, Alan 199
Fuller, R. J. 723
Gilmour, J. D. 369
Going, A. S. 907
Goby, F. A. 199
Grimmer, G. S. 369
Hale, Samuel 369
Hall, Wm. 817
Halstead, Geo. (Ob.) 434
Hamilton, E. M. 629
Handcock, C. B. 877
Hare, Alman 501

*Illustrated.

PAGE
Hartwell, Harry 369
Hastings, M. B. 755
Hazen, Allen 336
Hedley, Robt. D. 723
Hett, S. 235
Heyerdahl, Thv. 817
Hill, H. Russell 301
Hume, Peter H. (Ob.) 724
Hunt, Capt. R. W.* 877
Hutcheson, Major J. E. 199
Irwin, James 133
Jeffreys, W. Rees 133
Jenison, E. S. 567
Johnson, Arthur N. 937
Kennedy, Wm. 599
Kensit, H. E. M. 401
Kindle, E. M. 235
Kling, Leroy A. 401
Koester, Frank 629
Kribbs, Gordon 907
Kronk, C. C. 693
Lamb, R. B. 567
Lea, R. S. 267, 785
Leonard, C. W. (Ob.) 817, 848
Lewis, R. G. 369
Linton, A. P. 133
Longley, F. F. 301
Lyall, Peter (Ob.) 786
McDonald, Duncan 235
McDougall, D. H. 723
McGill, John 907
McGuigan, F. H. 370
McIntyre, D. M. 755, *817
Macallum, A. F. 817
Mackay, W. M. 817
MacLachlan, J. S. 817
MacMurchy, J. A. 755
Mailloux, C. O. 661
Mason, Wm. McG. 336
Merchant, Dr. F. W. 629
Mill, J. G. 465
Milne, James 235, 402
Munro, Dr. Wm. B. 629
Murray, E. W. 133
Murray, R. H. 465
Murray, T. Aird 723
Near, W. P. 937
Nichols, William H. 661
Oborn, S. M. 847
Okxvik, Geo. 401
Olmstead, Fred. L. 535
Owen, Joseph 847, 877
Pack, R. F. 465, 501, 817
Phillips, H. G. 133
Porter, S. P. 401
Powell, W. W. 301
Proctor, E. M. 402
Race, Joseph 466
Redfern, C. R. 433
Ridout and Maybee 301
Roberts, D. I. 937
Robertson, F. A. 785
Rogers, Hon. Robt. 847
Rombough, W. R. (Ob.) 534
Rooke-Croowell, John 937
Rosevear, A. E. 785, 907
Rust, C. H. 301
Salisbury, H. G. 661
Sara, R. A. 817
Scott, G. H. 629
Scott, W. H. 301
Seurot, Paul 755
Shanley, J. M. (Ob.) 847
Shaw, W. R. 755
Shields, J. D. 629
Slichter, C. C. 401
Smith, Cecil B. (Ob.) 165
Smith, Francis P. 937
Snow, Walter B. 501
Sothmann, P. W. 199
Stavert, W. E. 817
Stephens, Lieut.-Col. G. W. 693
Stewart, Louis B. 599
Stewart, W. A. 755
Still, Alfred 235
Stokes, Ralph 567
Street, L. J. 401

PAGE
Sykes, F. H. 661
Sylvester, G. 907
Thomson, Leslie R. 502
Thomson, T. K. 755
Todd, J. R. 336
Turnbull, J. M. 661
Tye, W. F. 629
Wagner, John P. 629
Walker, Jas. 847
Ward, C. W. 465
Waterman, C. M. 568
Watson, J. W. 817
Welch, Patrick 600
Wenger, E. L. 567
White, David 785
White, Supt. 907
Williamson, S. B. 907
Wood, J. L. 501
Woodman, A. D. 536
Worthington, W. R.* 629, 661
Wright, C. H. C. 433
Wright, Geo. W. 629
Wynne-Roberts, R. O. 133, 465, 694
Young, A. L. No. 24—70
Zavitz, Prof. C. A. 755

EDITORIAL.

Accidents and Safety Precautions 707
American Road Congress 550
Bloor Street Viaduct 287
Bridge for Vancouver Island 120
Calling of Tenders 451
Canada's Fire Losses 321
Canada and the Nickel Supply 616
"Canadian Engineer" in Montreal 119
Canadian Highway Association 452
Canadian Public Health Association Convention 451
Cement, Shipment of 740
Chicago's Illusive Sewage Disposal Method 187
City Government by Commission 583
Coal-Dust Explosions 321
Commission Form of Government, The 419
Concrete Sidewalks 517
Consulting Engineers Wanted 120
Control of Our Rivers, The 389
Design of Irrigation Works 549
Development of Montreal Port 390
Double-Deck Street Car 389
Faculty of Applied Science and Engineering of the University of Toronto 221
Fuel Oil, Use of, on British Columbia Coast 739
Great Lakes and Sewage Disposal 584
Great Lakes and Typhoid, The 483
Highway Bridges 187
Hudson Bay Route, The 483
Internal Combustion Engine and the Gas Producer 152
International Geological Congress 151
International Joint Commission and Sewage Pollution of Boundary Waters 801
International Roads Congress of 1913 119
Jordan River Development of the Vancouver Island Power Company 801
Long Distance Power Transmission 355
Long Sault Development Co. and St. Lawrence Power Co.'s Proposed Works 645
Mathematics and the Engineer 678
Material for Road Aggregate 355
Medical Health Officer and the Engineer, The 485
Montreal Harbor 549
Montreal Harbor Commission 678
Municipal Engineer, The 615
New Commissioner of the Dominion Railway Board 120
Nickel Supply of Canada 616
Operating Results of a Double-Deck Street Car 549
PAGE
Ottawa Water Supply 253
Panama Canal Bill 390
Panama Canal Excavation 452
Peat Fuel, Utilization of 646
Proposed Rules and Regulations for Inside Work 185
Proposed Works of the Long Sault Development Company and the St. Lawrence Power Company 645
Protection of Canal Lock Gates 707
Railway Business for May 253
Road Board of Great Britain 770
Road Improvements 518
Road Maintenance 831
Roadmaking in Saskatchewan, Experiments in 646
St. John River Improvement 770
Sewage Disposal in Alberta 891
Sewage Disposal and the Great Lakes 584
Sewage Disposal Scheme, Another 288
Sewage Disposal and Water Pollution 677
Sewage Works, Supervision of 740
Smith, Cecil B. 151
Tearing Up Street Paving 831
Technical Schools 832
Toronto City Architect's Department 420
Toronto Harbor Improvements 769
Toronto and Pure Water 861
Toronto and Her Six Million Dollar Water By-law 892
Toronto's Water By-law 923
United States Railroads in Canada 222
Use of Fuel Oil on British Columbia Coast 739
Water Powers of Canada 861
Water Sterilization 287
Winnipeg Water 517, 769
York County Good Roads 923

GENERAL.

Abitibi Pulp Limits Sold 395
Accidents in Building with Reinforced Concrete 279
Acetylene Gas 624
Adams-Hydraulics, Ltd. No. 20—70
Additions to Factory of Victor-Balata and Textile Belting Company Easton, Pa. No. 23—70
Administration of the Highway Improvement Vote in Saskatchewan. 106
Aerial Trolley Car* 834
Alberta, Peace River & Eastern Railway No. 21—70
Algae and Their Relation to Public Water Supplies 469
Algoma Central and Hudson Bay Railway, and Algoma Eastern Railway, Construction of* 290
Alternating Current Generators by British Manufacturers No. 1—92
Aluminum and Electro-Metallurgy in France 404
Aluminum Overhead Conductors* 296
American Association of Manufacturers of Sand-Lime Products 937
American Mining Congress 692
American Road Builders' Association 684, 867
American Road-Builders' Association Convention 267, 500
American Road Congress 595
American Shipbuilding Company's Canadian Plant 661
American Society of Municipal Improvements 816
American Test of Wire Rope 284
Androscoggin Pulp Co., So. Windham Mt.* [illegible]
Angus Shops of the Canadian Pacific Railway 618
Appeal for Sick Children's Hospital 878
Application of Concrete to Underground Work* 842

*Illustrated.

PAGE

Application of Diesel Engines to Land and Marine Work* 695
Apprentices on C. P. R. 437
Arches, Calculations for the Strength of* 793
Arch, Reinforced Concrete, North Toronto* 601
Aspinwall Filtration Plant, Repairing 859
Association of Railway Electrical Engineers, Convention of* 535
Astronomical Observations for Azimuth on Dominion Land Surveys*. 799
Australian Dam, A New 428
Australian Transcontinental Railway 714
Automatic Stop and Cab-Signal System 487
Awakening of Canadian Irrigationists* 435
Bank [illegible], Notes on 141, 206, 246, 281
Bank of Toronto's New Offices*.... 809
Bearing Power of Moist Blue Clay.. 768
Beauharnois Electric Co., The 449
Bed-Plate, The Casting of a Large.. 430
Bench-Marks, Edmonton* 371
Biaschina Electric Power Station, 10,000 h.p. Turbines* 699
Big Bend Water Power Development of Feather River, Cal.* 709
Bituminous Materials, Construction of Surfaces With 642
Bituminous Pavements, Effect of Traffic on 872
Bituminous Road Surfaces 282
Blast Furnace, A New Thin-Lined*. 406
Blowers Designed for Turbine Drive, A New Line of* 285
Boat, A Large Reinforced Concrete 242
Bonus for the Production of Quicksilver 196
"Booster" Pump of the Great Western Railway Works, at Swindon*. 562
Box Car Door, New Type of* 185
Brantford Concrete Pavements* ... 829
Breakwater for Victoria, B.C., New* 391
Brick Machinery, Recent Improvements in* ......No. 9—92
Brick Roads: Material, Construction and Maintenance* 631
Brick, Tests of 366
Bridge Design, Originality in* 197
Bridges, Highway 751
Bridge, History of an Old Iron 543
Bridge at Methuen, Mass., An Attractive Concrete* 764
Bridge, Portland, Ore., Electrical Equipment of the Hawthorne Ave.* 909
Bridge Renewals* 393
Bridges, Steel Highway 574
Bridge Timbers, Tests of Long Leaf Pine 766
Bridge at Trail, B.C.* 467
Briquetting [illegible] Coal 589
British Columbia 136
B. C. Electric Railway 433
British Columbia's Lumber Industry 118
British Columbia Mines 644
British Columbia's [illegible] Outlook 197
British Columbia's Railways 189
British Engineering Enterprise in Canada 199
British [illegible] 731
[illegible] ...... [illegible]
[illegible] ...... [illegible]
[illegible] ...... [illegible]
[illegible] 15
[illegible] ...... [illegible]
Calculations for Strength of Arches* [illegible]
Calgary Municipal Street Railway Report ...... [illegible]
Calgary's New University .. [illegible]

PAGE

Canada's Cement Industry, Importance of 935
Canada Foundry Co.'s Mixer* 692
Canada's Iron Trade and Competition 828
Canada Metal Company's Products ......No. 13—88
Canada's New Industry 198
Canada's Pacific Coast ......No. 6—72
Canada Southern Railway Bond Issue 901
Canadian Canal Traffic 495
Canadian Car and Foundry Report. 900
Canadian Coal and Coke Co...No. 26—78
Canadian Draughtsmen and Engineers 741
Canadian Engineers and Draughtsmen. (Letter to Editor) 803, 866, 925
Canadian Fairbanks-Morse to Build Tractor Factory 401
Canadian Forestry Association Convention 256, 309, 500
Canadian Gas Association, 5th Annual Meeting 401
Canadian Irrigationists* 435
Canadian Mining Institute (Ottawa Branch) Meeting 937
Canadian National Exhibition 455
Canadian Niagara Power Company. 234
Canadian Northern's Annual Report 808
Canadian Northern Makes Offer to London 895
C. N. Railway's Transcontinental Line 150
C. N. R. and Vancouver 433
Canadian Pacific East-bound Rates and Empty Car Mileage 714
Canadian Pacific's Expansion 397
Canadian Pacific Liners 886
C. P. R. Bridge 780
C. P. R. Earnings in August ..No. 13—72
C. P. R. Hotel, Vancouver 105
C.P.R. Passenger Terminal and Office Facilities, Vancouver, B.C. 175
Canadian Pacific Railway in Washington 525
Canadian Pacific Stock 254
Canadian Ports on the Pacific* 585
Canadian Public Health Association Programme 464
Canadian Railway Club ......No. 21—70
Canadian Road Systems 603
Canadian Society of Civil Engineers 723, 877, 907
Canadian Society of Civil Engineers' New Home* 804
Canadian Society of Civil Engineers' (Toronto Branch) Excursion 501
Canadian Street Railway Association 599
Canadian Tamarack, Cause of the Destruction of 845
Canal Boat, Novel ......No. 8—72
Cantilever Forms for Concrete Retaining Walls* 174
Car Door, New Type of Box* 185
Car Heaters, Tests of 110
Carillon, Power Possibilities at 369
Cars for London and Lake Erie Railway and Transportation Co. 798
Cast-Iron Water Pipe Lines for Leakage, Testing 551
Cement Duty Back Again 752
Cement Gun, Methods and Costs of Applying Stucco With 431
Cement Production 361
Cement Rebates for Bulk Shipment of ......No. 21—7[illegible]
Cement Sidewalk Tools ......No. 1[illegible]—9[illegible]
Central Station Electric Power for [illegible] 111
[illegible] ......No. 11—86
Characteristics of Copper and Aluminum Overhead Line Conductors* 181
[illegible] River Power 134
Chemical Wood Pulp ...... [illegible]
Chemistry of Sewage Purification 659
Chimney [illegible] Brick and Steel* 61[illegible]

PAGE

China Clay Production in Devon and Cornwall, England 777
Civic Improvement and Town Planning 911
Chlorination at Cleveland, Ohio 359
Chlorination Plant, Toronto* 135
Chlorine, Treatment of Water With . 407
Chlorine for Water and Sewage Sterilization, The Production of 255
Cinder Concrete, Some Observations on the Disintegration of 530
City Electric Railways, Special Trackwork for* 519
City Planning Bills; How They Are to be Paid 239
Clays, Classification of ......No. 18—70
Clay, Lateral Pressure in, from Superimposed Loads* 743
Clay, Methods of Testing* 328
Cleaning of Water Mains 396
Clock, Largest in Canada 365
Coal for Panama Canal Ships 609
Coal of the United States 901
Coal in West Indies 800
C. O. Bartlett & Snow Company.No. 16—70
Coke Supply of Canada 634
Collection and Disposal of Municipal Wastes 651
Collieries, Pacific Coast ......No. 25—76
Comparative Strength and Resistance of Various Tie Timbers* ... 318
Compensating Grades for Curvature 438
Compressed Air Storage in Rock*.. 857
Concrete, Application of, to Underground Work* 842
Concrete Bridge at Methuen, Mass.* 764
Concrete for the Bloor Street Viaduct (Letter to Editor) 289
Concrete, Improved Device for Delivering* 905
Concrete Mixing, A Record in* 692
Concrete Monoliths 506
Concrete Pavements, Brantford* ... 829
Concrete, Physical Properties of .. 541
Concrete, Placing with a Movable Steel Tower* 422
Concrete Plant of a Four-Story Machine Shop Job* 128
Concrete Plant, A Well-Planned*.. 125
Concrete Poles, The Strength of... 431
Concrete, The Spouting of 388
Concrete Substructural Water-Proofing 257
Concrete Water Barrels as Applied to Fire Protection of Railway Bridges, Experiments on 283
Concrete, Weight of 732
Concreting in Cold Weather 153
Construction of Algoma Central & Hudson Bay Railway, and Algoma Eastern Railway* 290
Construction of Concrete Lined Water Tunnel 896
Construction of Distribution Systems for Outlying Systems and Smaller Plants* 155, 169
Construction of South Main Pier of Quebec Bridge* 663
Construction of Surfaces With Bituminous Materials 642
Construction of a West African Railway* 835
Construction of Wood Stave Pipe ... 650
Consumers' Gas Company's Report ......No. 19—70
Continuous Settling Basin, Value of* 137
Contract Obligations in the Steel Trade 229
Converter, A Large 321
Cooperage Industry, Canada's .. 143
Copper Camp, Phoenix, B.C. No. 17—74
Copper Sulphate, Purification of ... 127
Copper-Sulphate in Purifying Water Supplies, The Use of 245
Coquitlam, Buntzen Hydro Electric Power Development* . 677
Corrosion of Iron and Steel Pipe 734

(Continued)

PAGE

Corrugated Iron, Heat Transmission Through* 667
Costs of American Pig Iron 518
Cost of Driving Steel Sheet Piling. 738
Cost of Pumping Water 515
Cost of Steam Power Plants 148
Costs, Subway and Bridge 899
Cost of Water Softening by Lime... 679
Cotton Ropes, Life of 351
Creosote Wood Block Pavement, New Specifications for 259
Creosoting Cross-Ties 633
Cross-Arms Tests 426
Cross-Ties Used by Railways 218
Culture in Education of Engineers.. 146
Current Meter Rating Station* 639
Current River, Port Arthur, Reinforced Concrete Arch 101
Curvature, Compensating Grades for 438
Curves in Track and Grade Resistance* 228
Cylinder Performance of Reciprocating Steam Engines* 444
Dallas Road, Victoria, B.C., Protection of Foreshore at* 851
Dam, Spillway Caisson 617
Deaths in Factories 584
Defiance Tick Mitten Co., Toledo, Ohio, Factory* 360
Diesel Engines, Application of, to Land and Marine Work* 695
Diesel Engine from the User's Standpoint 921
Diesel Marine Oil-Engines, Development of 875
Deodorizing Sewer Air at Winnipeg. 522
Depreciation and Sinking Funds 299
Description of Modern Street Railway Track Construction* 513
Design and Construction of Smokestacks* 471
Design of Girder and Truss Spans and Trestle Work in Structural Steel 509
Design of Turntables for Heavy Locomotives 778
Designing Brick and Steel Chimneys* 647
Destruction of Concrete Track Foundation* 357
Destruction of Refuse, Report on.. 394
Development of Diesel Marine Oil-Engines 875
Development and Status of the Wood Preserving Industry in America.. 749
Diesel Engines, A New British Factory for 582
Diesel Oil Locomotive 432
Disintegration of Cinder Concrete, Some Observations on 530
Disposal of Sewage Sludge 442
Distribution Systems for Outlying Systems and Smaller Plants, Construction of* 155, 169
District Heating Business 298
Dock, "Duke of Connaught," Montreal* 543
Dominion Land Surveys, Astronomical Observations for Azimuth on*. 799
Dominion Tar & Chemical Co.'s Plant* 794
Double-Track Tunnel in Japan* 712
Drainage Schemes in Saskatchewan. 693
Drainage System Over 3,000 Years Old 468
Dredges, Emergency Welding of Broken Parts of 347
Drilling Holes in Plates at Panama Canal* 147
"Duke of Connaught" Dock, Montreal* 324
Dunmurry Sewerage Scheme, The.. 315
Durability of Grouted Granite Pavements 899
Dust Suppression and Road Construction* 424
Economics of Power Transmission Lines* 652

PAGE

Edmonton Bench-Marks* 371
Education of Engineers, Culture in.. 146
Effect of Safe Water Supplies on Typhoid Fever Rate 855
Effect of Traffic on Bituminous Pavements 872
Efficiencies of a Hydro-Electric System 623
Efficiency in Education 340
Effluents from Trickling Filters, Treatment of 606
Electrical Development Company to Enter United States ....No. 25—76
Electrical Engineering, Its Relation to Other Professions 362
Electrical Equipment of Hawthorne Ave. Bridge, Portland, Ore.* 909
Electrical Insulating Condulets. No. 16—70
Electrical Meeting in Montreal.... 785
Electrical Sewage Disposal Plant*.. 167
Electrical Supply of Montreal 780
Electric Cables, Improved ......No. 8—92
Electric Equipment of a Large Planing Mill* 627
Electric Fountain of Unique Design* 633
Electric Franchises 383
Electric Furnace as a Means of Producing Improved Steel 122
Electric-Furnace Steel, Production of 469
Electric Furnace, Thirty Years' Progress in 143
Electric Locomotive for Interurban Freight Hauling, Selection of*.... 213
Electric Power for St. John, N.B.. 163
Electric Railways, Winter Troubles on 681
Electric Smelting in Canada 782
Electricity and Reinforced Concrete 804
Electricity vs. Steam for Water Pumping 121
Electrification of Melbourne Suburban Railways 697
Electrification of Steam Railway... 619
Electrolysis from Stray Electric Currents 116
Electrolytic Action on Unreinforced Concrete 394
Electrolytic Disposition of Sewage.. 621
Electrolytic Sterilizing Plant* 507
Electro-Metallurgical Developments in Canada 522
Elementary Theory and Principles of Street Cleaning 703
Emergency Welding of Broken Parts of Dredges 347
Empress of China Sold 356
Engineering Alumni, U. of T. 908
Engineering Works in Great Britain* 272, 308
Essex, Windsor & Lake Shore Rapid Railway* 870
Estimates, Use of Charts in the Preparation of* 261
Estimators and Engineers 629
Experiments on Concrete Water Barrels as Applied to Fire Protection of Railway Bridges 283
Expert Woodsman Reports on Forest Conditions 266
Extension of an Outfall Sewer* 405
Factory Growth in Western Canada 899
J. Faessler Mfg. Co. Steel-working Tool ....No. 10—92
Fallacies and Facts Concerning Engineering Works in Great Britain* 272, 308
Feather River, Big Bend Water Power Development, Cal.* 709
Ferranti, Limited ....No. 18—76
Field Surveys for Road Construction 675
Filing Shop Drawings and Recording Progress of Work 922
Filtering Water in Four Slow Sand Plants at Philadelphia, Unit Costs of 903
Filtration at Albany, Result of 278

PAGE

Filtration Plant, Repairing the Aspinwall* 859
Fire Bricks, Melting Points of 348
Fire Hydrants, Improvements in*... 781
Fire Hydrant, The 314
Fire Loss of United States and Canada 907
Fire Tests with Glass 339
First Gold from Porcupine 532
Fixed and Travelling Sewage Distributors 244
Flanged Fittings and Flanges, Manufacturers' Standard for* 320
Flange Fittings, United States Government Hearing on ....No. 2—74
Floating Dock for Montreal, New*... 324
Floor Area Unit as a Basis for Estimating Water Consumption 108
Forest Fires, Attitude of Railways Towards 428
Forest Reserve Recommended in Prince Albert District, Sask. 722
Forest Resources and Mills of Newfoundland 376
Forestry Engineers, New 369
Forging Press, A New* 576
Form Work, Systematizing* 649
Fortier & Kilpatrick, Ltd. 234
Fountain of Unique Design* 633
Francis, W. J. (Letter to Editor)... 323
Freezing Test of Stone 833
Fuel Oil for Shipping 298
Garbage Disposal in Halifax 736
Garbage Incinerator Plant, New*... 128
Gas Garbage Burners ....No. 12—92
Gas as a Means of House Heating* 751
Gas Engine Orders, Large 905
Gasoline Railway Motor Cars*... 332
Gas Producers, The Value of Sawmill Refuse as Fuel in 490
Gas Rates in Montreal 115
Gatun Dam Spillway 616
George Washington Landmark, An Old* 754
Girder and Truss Spans and Trestle Work in Structural Steel, Design of 509
Government Ship Returns from Arctics 906
Grade Crossing Commission, Brooklyn* 725
Grade Elimination and Railroad Bridges 805
Grade Reductions on the T. & N. O. Railway* 575
Grain Elevator for Harbor Commissioners of Montreal* 537
Grain Elevator for West St. John, N.B. 295
Grain Growers Grain Company..No. 6—72
Grand River Control 372
Grand Trunk and New Haven Railways 904
Grand Trunk Pacific Affairs 328
Graphite Mining in Ceylon 373
Gravel Washing Plant* 845
Greater Vancouver's Water Supply ....No. 16—74
Grinding, Hardinge Conical Mill for* 547
Guiding Ropes on Curves* 720
Gutta Percha & Rubber Mfg. Co., Toronto, to be Reorganized..No. 25—70
Halifax Garbage Disposal 736
Hamilton City Engineer's Report ....No. 8—72
Hamilton Malleable Iron Co...No. 26—68
Hamilton Sewage Disposal Works Report 838
Harbor Commissioner Discusses Big Projects ....No. 25—78
Harbor Commissioners' Grain Elevator, Montreal* 537
Harbor Improvements at New Westminster 841
Harbor Improvements at St. John, N.B. 623
Harbor Improvement, Toronto* 771

*Illustrated

PAGE
Harbor, New Westminster 719
Hardinge Conical Mill for Fine Grinding* 547
Haulage, Novel Methods of 873
Heat and Power from Sawdust 876
Heating of Buildings, The 211
Heating and Ventilating Design ....No. 18—68
Heating and Ventilation of a Factory* 360
Heat Transmission Through Corrugated Iron* 667
Henry Hope & Sons' Factory for Canada ....No. 24—70
Hetch Hetchy Water Supply of San Francisco 844
High Tension Transmission System of Hydro-Electric Power Commission of Ontario 201, 237, 269, 303
Highway Engineering Course in Columbia University 755
Highway Engineering Education ... 607
Highway Improvement Vote in Saskatchewan 106
H.M.S. "Audacious," The Launch of 550
Hollinger Financial Statement 814
Hoops for Water Tanks 332
House Heating by Gas* 751
How to Obtain Efficiency from Pressure Filters 523
Humphrey Pumps for London Water Supply* 879
Hydro-Electric Plant of the Sherbrooke Railway & Power Co. at Sherbrooke, P.Q.* 823
Hydro-Electric Power Commission of Ontario, High Tension Transmission System of* 201, 237, 269, 303
Hydro-Electric Power Development, The Coquitlam-Buntzen* 577
Hydro-Electric Station at Gatun Spillway* 231
Hygiene of the Steel Trade 388
Hypochlorite Sterilization at Kansas City, Mo.* 259
Icebergs, Rise of Temperature Associated with the Melting of* 887
Ice Troubles at Buffalo 126
Illuminating Engineering Society, 6th Annual Convention 289
Illumination, A New System of, to Avoid Glare by Diffusion* 593
Imhoff Sewage Tank, Operating Results of 681
Imhoff Tanks 890
[illegible] 817
Improved Device for Delivering Concrete* 905
[illegible] ....No. 7—92
Improved Steel Produced by Electric Furnace 122
Improvements in Acetylene Gas Generators 624
Increased Production of Structural Materials 900
[illegible] 101
Industrial Accidents 775
[illegible] 534
Intake Pipe at Montreal [illegible] 847
International Association for Testing Materials, Address to the Sixth Congress 196
International Geological Congress 163
International [illegible] Company and Canada 529
International Road Congress 917
[illegible] of [illegible] in Reinforced Concrete Paper Mill* 163
Iron Ore Production 935
Iron Ore Supply of [illegible] 878
Iron and Steel Tariff 485
Irrigation Lessons from the Old World 545
Irrigation Projects of the C. P. R. Company in Alberta* 192, 225
Jordan River Development, Vancouver Island Power Company*..787, 819
Kerosene Fuel, Experiments With... 889
King Edward Highway 657
Laboratories, New Engineering 764
Lake Erie & Northern Railway Company 328
Lamps, Competition for Miners'... 880
Landmark, An Old George Washington* 754
Lateral Pressure in Clay from Superimposed Loads* 743
Lateral Pressure of Liquid Concrete* 450
Laying a Deep Sewer in Bad Ground* 757
Lift Bridge, Large Rolling 365
Light Compression Members....715, 728
Light Compression Members (Letters to Editor) 832, 925
Lignite and Its Uses 881
Liquid Concrete, Lateral Pressure of* 450
Livingstone Channel, Detroit River, Completion of 700
Loading Assumptions for Structural Design* 849
Lock at the Soo 698
Lock Gate Construction ......No. 3—80
Lock Gates on Panama Canal 206
Locomotives, Common Standard ... 936
Lock Tie Brick Co., B.C........... 442
Locomotive Cylinder Oilers ...No. 15—86
Locomotive, A New* 127
Locomotive, New Type of Mine*.. 610
Losses Caused by Engine Sparks ....No. 2—72
Losses of Exposed Steam Pipes.... 658
Loss of Heat from Steam Pipes 782
Louisville Planing Mill Electrical Equipment* 627
Luitwieler Pumping Engine Co. ... 454
Machine Tools ....No. 11—92
Mackenzie-Mann Get Dominion Power Company 132
Magazines and Thaw Houses for Explosives 317
Main Drainage System of City of Toronto* 733
Maintenance and Repair of New York State Highways in 1911.... 853
Maintenance of Roads and Pavements 344
Manitoba Association of Architects. 599
Manitoba's Fire Losses .....No. 9—74
Manufactures in Canada 346
Manufacturers' Standard for Flanged Fittings and Flanges* 320
Massey-Harris Company and the Gasoline Engine ....No. 12—92
Material in Modern Industrial Plants, Transportation of* 456
Measurement of Actual Stresses in Reinforced-Concrete Structure*... 701
Mechanical Consideration of Transmission Systems* 311
Memphis Union Stock Yards 535
Mercury Mills, Ltd. ....No. 26—68
Merger of Bridge Companies in Montreal 869
Metal Culvert for Engineers .No. 2—92
Metals in Ontario, Production of... 925
Mesta Machine Company, Pittsburg, Pa. 430
Meters at Decatur, Effect of Installing 343
Methods of Research 559
Methods of Testing Clay* 329
Mine Locomotive, New Type of*.. 610
Mineral Output, Ontario's Large.. 776
Mineral Production in British Columbia 533
Mineral Wealth ....No. 9—74
Mining in New Brunswick 529
Modern Street Railway Track Construction, Description of* ... 413
Montreal Fire and Water .... [illegible]
Montreal Tramways Company ...237, 532
Montreal's Water Department 776
Moose Jaw Municipal Heating Plant, Report of 358
Motor Car Suitable for Contractors or Inspectors ....No. 13—88
Motor Trucks in Road Construction and Maintenance, Use of 605
Moving-Platform Subway Line 224
Municipal Improvements at Fargo, N.D., Keeping Records of 592
Municipal Opera House 501
Municipal Power Plant for Grand Mere, Que. 567
Municipal Telephone Ownership ... 421
National Steel Car Company 535
National Association of Cement Users 756
National Bridge and Dominion Bridge Companies Amalgamation ....No. 26—76
Natural Gas Belt in Western Canada 674
Natural Gas as Public Utility, Calgary 747
New Haven-Grand Trunk Deal..No. 26—70
New Type of Sewer Pipe* 591
New System of Illumination to Avoid Glare by Diffusion* 593
New Westminster's Harbor 719
New York Leather Belting Co..No. 23—76
New York State Highways, Maintenance and Repair of, in 1911...... 853
Nickel Supply 618
Nipissing Central Railway 602
Nobel Prize, The 785
Norton Company's Plant at Chippewa, Ontario* 557
Notes on Band Conveyers 141, 206, 246, 281
Oakville Viaduct and the Dynamiting of the Condemned Arch Ribs, August, 1912* 403
Oil Fuel Burners 720
Oil Macadam Construction and Surface Oiling 682
Oil-Mixed Concrete, Applications of. 563
Oil Smelting in British Columbia*.. 508
Oil Steamer, A New ....No. 24—76
Oil Tin Cans ....No. 8—72
Olin Gas Engine Company ...No. 20—70
Ontario Good Roads Association ... 816
Ontario's Mineral Production..No. 26—76
Ontario Power Company .....No. 2—80
Ontario Reforestation Act ....No. 7—82
Ontario Society of Architects 599
Ore Production in Millions 823
Ottawa Light Company's Capital Increase Sanctioned 922
Outfall Sewer, Extension of* 405
Overhead Line Conductors, Characteristics of* 181
Overhead Plant of a Modern Telephone System 387, 414
Overhead Transmission Lines, Steel Towers for* 569
Oxy-Acetylene Torch, Welding Pipe With 859
Ozone: Its Properties and Commercial Production* 217
Pacific Coast Activities of Canada.. 754
Panama Canal, The 189
Panama Canal Bill May Help Canadian Railway 393
Panama Canal Costs 841
Panama Canal Tolls 902
Panama Construction Estimates .. 590
Parliament and Transportation Interest ....No. 21—76
Passenger Terminal and Office Facilities, C.P.R., Vancouver, B.C.*... 175
Patent and Trade Marks 748
Patricia Land 698
Pavements, Durability of Grouted Granite 899
Pavement, Some Considerations in the Choice of 326

*Illustrated.

PAGE
Paving Blocks, New Appliances for Testing Stone 418
Peat, British Invention for Utilization of 910
Peat Fuel, The Utilization of 765
Peat in Gas Producers, Use of 623
Peat, The Utilization of for Power Purposes 448
Petroleum Resources of Canada 852
Pig-Iron in Electric Furnace, Production of* 306
Pig Iron and Steel 154
Pipe Bends, Large* 668
Pipe Fittings, Large* 847
Pipe Joint, An Efficient* 634
Pipe Raising at East New York, Brooklyn, N.Y.* 725
Pipe Tools No. 11—92
Piston Pile Hammer No. 21—68
Placing Concrete With a Movable Steel Tower* 422
Planer, A Large* 512
Plans for Pacific Coast No. 14—72
Plant of Dominion Tar & Chemical Co., Ltd.* 794
Plant of Thor Iron Works, Ltd.* 657
Poles and Towers, Structural Steel* 916
Poles Used in Canada, 1911 No. 18—70
Pollution of Waters 518
Ponoka Asylum Plant, Report by T. Aird Murray, To Bureau of Public Health, Sask. 893
Ponte Del Risorgimento (Letter to Editor) 153
Porcupine Power Company Plant* 482
Port Arthur Water Supply 293
Portland Stone, Durability of 605
Ports on the Pacific, Canadian* 585
Power Development in Eastern Canada 839
Power Factor, Its Influence and Value* 219
Power Plant of Mount Hood Company 542
Power Plant, Spanish River Pulp & Paper Mills, Limited* 338
Power Plant Tests 910
Power Situation in Quebec City 858
Power Sprayers No. 20—68
Precipitation, June, 1912 152
Precipitation, July, 1912 323
Precipitation, August, 1912 485
Precipitation, September, 1912 616
Precipitation, October, 1912 741
Precipitation, November, 1912 924
Precise Levelling in Canada 159, 177
Preservation of Reinforced Concrete in Sea Water 349
Preservation of Ties (Letter to Editor) 803
Pressure Filters, How to Obtain Efficiency from 523
Production of China Clay in Devon and Cornwall, England 777
Production of Chlorine for Water and Sewage Sterilization 255
Production of Pig-Iron in the Electric Furnace* 306
Progress of Transcontinentals 186
Protection of Canal Lock Gates (Letters to Editor) 802
Protection of Foreshore at Dallas Road, Victoria, B.C.* 851
Public Highways Act of Saskatchewan 124
Public Utilities and Regulation 459
Pulpwood Consumption in Canada 199
Pulpwood Production No. 10—74
Pulpwood, Railroad Rates on 661
Pumps, McEwen Bros. 285
Pumps, Non Pulsating 454
Pump, The Stereophagus, in Operation* 901
Pump Supplied the Great Western Railway Works at Swinton* 562
Punch and Shear Press* 450
Purification of Water from Hygienic Standpoint 613

PAGE
Purification of Water from Standpoints Other Than the Hygienic Aspect 526
Purification of Water by Storage 674
Quebec Bridge, Construction of South Main Pier of* 663
Quebec Light, Heat & Power Company 368
Quebec Railway, Light, Heat & Power Company 499
Quebec Water-Powers, Sale of 150
Queen's University, New Addition 666
Rail Breakages 233
Rail Corrugation, Report on* 377
Rail Corrugation, British Investigation of 731
Rail Flanges, Cross-Wise Bending Tests of 905
Rail Mills Can Handle Business 432
Rail Plateways* 488
Railroad Bridges and Grade Elimination 805
Railroad Demurrage Rates Raised No. 25—76
Railroad Earnings, 123, 191, 266, 334, 397, 495, 553, 590, 722, 752, 877
Railroad Notes 781
Railroad Rates 552
Railroads and Vancouver 833
Railways, Attitude of, Towards Forest Fires 428
Railway Development in the Kootenay 367
Railways to Development, Relation of 782
Railway Earnings, September 722
Railway Entrances to City of Ottawa, Report on 625
Railway for North-Western Canada 265
Railway and Ocean Terminals for Halifax 723
Railway Operation, Central Station Electric Power for 411
Railway Receipts and Expenses 529
Railway Receipts and Expenses for September 903
Railway Signalling and Despatching, The Simmen System of* 460
Railway Signalling Experiments 133
Railway Ties, Manufacture of 301
Reconnaissance Surveying 612
Reconstruction of an Old Retort House 867
Refractory Cement that Withstands 3,100 Degrees Fahr., A New No. 26—68
Refractory Material, Standard Specification for 331
Refuse Disposal Plants 503
Refuse Disposal and Street Cleaning 374
Refuse, Report on Destruction of 394
Regina Engineering Society 599, 755
Reinforced Concrete Arch, Current River, Port Arthur* 101
Reinforced Concrete Arch, North Toronto* 601
Reinforced Concrete Slab Bridge* 748
Reinforcing Bars, Tensile Tests of Splices of 335
Reinforcing a Bridge, Methods of 111
Relation of Electrical Engineering to Other Professions 362
Repairing of Unarmored Cables in Wet Shafts* 746
Report of Mr. Child, and Deputation of City Council After Visit to Sewage Works at Ponoka 893
Report of Committee on Sewerage and Sanitation 742
Report on Ponoka Asylum Plant by T. Aird Murray 893
Report on Water Supply and Fire-Fighting Appliances of Victoria, B.C. 874
Report of York County Highway Commissioners* 926
Research Laboratory for School of Mines, Kingston 658
Research, Methods of 559

PAGE
Retaining Wall for the C.P.R. in Toronto* 243
Retort House, Reconstruction of an Old 867
Rise of Temperature Associated with Melting of Icebergs* 887
River Improvement by Regulation and Dredging 473
Rivet Steels, New Method of Testing* 325
Roads Adapted to Local Conditions 352
Road Booklet, Can. Hwy, Asso. No. 7—80
Road Construction, Field Surveys for 675
Road Construction and Maintenance, Use of Motor Trucks in 605
Road Construction and Problem of Dust Suppression* 424
Road Construction, Problems of 380
Road Exhibition 876
Roads, Material, Construction and Maintenance of Brick* 631
Roads of Saskatchewan 759
Road Systems, Canadian 603
Road Work in Massachusetts 382
Robb Engineering Reorganization No. 14—76
Rock Ballast, Cost of 382
Roe Mac Construction 785
Rolling Stock for the C.P.R. 902
Rotary Converters, 3,000 K.W. Vertical* 342
Royal Architectural Institute 599
Royce, Limited, Orders Received by No. 26—68
St. John River, Regulation of 382
St. Mary's Portland Cement Co.'s Plant* 902
Safety Device for Protecting Lock Gates* 121
Sawmill Refuse as Fuel in Gas Producers 490
Semi-Diesel Engine No. 25—78
Sewage Disposal, Compressed-Air 905
Sewage Disposal for Country Homes* 285
Sewage Disposal Plant, An Electrical* 167
Sewage Disposal Plant for a Public Institution* 493
Sewage Distributors, Fixed and Travelling 244
Sewage, Electrolytic Disposition of. 621
Sewage Plant, A Small* 744
Sewage Purification, Chemistry of 669
Sewage Sludge, Disposal of 447
Sewage Sludge, Treatment of 795
Sewage System, Vancouver 937
Sewage Tank, Operating Results of Imhoff 684
Sewage—To What Degree Must it be Purified? 149
Sewage Treatment versus Sewage Purification 610
Sewage Works at Ponoka, Report of Mr. Child and City Council 893
Sewerage and Sanitation, Report of Committee on 742
Sewerage Scheme, The Dunmurry 315
Sewer in Bad Ground, Laying a Deep* 757
Sewer Pipe, New Type of* 591
Shawinigan Company's Earnings and Sales No. 20—76
Sherbrooke Railway & Power Company's Hydro-Electric Plant* 823
Sherbrooke Railway Report 620
Ship Detection in Fogs No. 12—80
Shope Concrete Products Co. to Locate in Moose Jaw No. 20—68
Simmen System of Railway Signalling and Despatching* 460
Sir Henry Pellatt's Residence* 805
Slab Bridge, Reinforced Concrete* 748
Sludge Accumulations at Sewer Outfalls 705
Smelting Cobalt Silver Ores by Vacuum Electric Furnace 624
Smokestacks, Design and Construction of* 471

*Illustrated

PAGE
Solder for Aluminum ....No. 11—92
South African Water Power 779
Southern Vancouver Island 516
Spanish River Pulp & Paper Mills, Ltd., Power Plant* 337
Spellerized Pipe 892
Spillway Caisson Dam 617
Spouting of Concrete 388
Stadia in Georgian Bay, District of Parry Sound 573
Stainton's, H., Letter to Editor ... 322
Standard Specification for Refractory Material 331
Standard Steel Construction Company ....No. 25—78
Statistics of Railways in U.S., For Year Ending June 30, 1912...... 316
Steam Engines, Cylinder Performance of Reciprocating* 444
Steam Railway Electrification, Aspects of 619
Steel Industry for British Columbia. Ed. 222
Steel and Iron Production in Canada 703
Steel Pipes ....No. 9—92
Steel Pipes, The Coating of 231
Steel Rails, Insuring Soundness in* 554
Steel Screw Steamer, A New ... 834
Steel Sheet Piling, Cost of Driving 738
Steel, Structural Composition and Physical Properties of 353
Steel Towers for Overhead Transmission Lines* 569
Steel Trade, Contract Obligations in 229
Stereophagus Pump in Operation* . 901
Sterilizing Plant, An Electrolytic*.. 507
Stone Ballast 525
Stones of the Maritime Provinces, Building and Ornamental 745
Storm and Surface Water Drainage in Relation to Sewage Disposal... 498
Street Car Franchises, Consolidation of 454
Street Cleaning, Elementary Theory and Principles of 703
Street Cleaning and Refuse Disposal 374
Street Encroachments in Toronto ... 706
Street Railway Construction 719
Strength of Crossarms, The 286
Strength of Wood for Pavements .. 445
Stresses, Determination of 617
Stress, Experiments on Reduction of* 784
Stresses in Reinforced-Concrete Structure, Measurement of* 701
Structural Design, Loading Assumptions for* .... [illegible]
Structural Materials and Clay Products, Production in Canada of... 264
Structural Materials, Increased Production of .... [illegible]
Structural Steel Towers and Poles .... [illegible]
Stucco, Methods and Costs of Applying With the Cement Gun .... [illegible]
[illegible] Water Mains at [illegible] and [illegible] Laying .... [illegible]
Submerged Sewer Outlet, Large*... 479
[illegible] for Bridges in Saskatchewan 533
[illegible] Gas Plants ....No. 16—[illegible]
Sulphuric Acid Industry, American 706
Surface Oiling and Constructing Oil [illegible] .... [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Telephone System, Overhead Plant [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

PAGE
Testing Concrete Bridge 915
Testing New Cast-Iron Water Pipe Lines for Leakage 551
Testing Rivet Steels, New Method of* 325
Testing Stone Paving Blocks 418
Testing Welds, New Method of 533
Tests of Brick 366
Tests for Insulated Wire 300
Tests of Long Leaf Pine Bridge Timbers 766
Tests of Tile and Concrete Wall-Sections 174
Thirty Years' Progress in the Electric Furnace 143
3,000 K.W. Vertical Rotary Converters* 342
Thor Iron Works, Ltd., Plant* 657
Tie Timbers, Comparative Strength and Resistance of* 318
Timiskaming Railway Finances 495
Tofield's Gas Supply, Edmonton Investigates 162
Tool Steel, High-Grade ....No. 15—86
Toronto Harbor Improvement* 771
Toronto Main Drainage System* ... 733
Toronto Street Railway and the City of Toronto 650
Toronto Water Chlorination Plant*. 135
Toronto's Water Filtration Project* 863
Town Planning and Civic Improvement 911
Town Planning Congress 235
Town-planning from an Engineering Aspect 720
Track Foundation, Destruction of Concrete* 357
Tracklaying on New Railway Work, Management of 508
Track Sinkage near Vancouver, B.C. 365
Trackwork for City Electric Railways, Special* 519
Traffic Recording, Standard Method of 873
Trail, B.C., Bridge* 467
Trail Location and Construction.... 796
Trans-Australian Railway, The New 390
Transmission Lines, Economics of Power* 652
Transmission Systems, Mechanical Consideration of* 311
Trans-Oceanic Telegraph Rates.No. 11—82
Transportation of Material in Modern Industrial Plants* 456
Transportation Question in Calgary. 592
Treatment of Effluents from Trickling Filters 606
Treatment of Water With Chlorine 407
Tunnel, Construction of a Concrete-Lined Water 896
Trinidad Asphalt Mining 678
Turbine-Driven Centrifugal Pumps for Waterworks Service* 275
Turbines for Rio de Janeiro 590
Turbines, 10,000 h.p. High-Pressure, for the Braschina Electric Power Station* 699
Turbine, 28,000 h.p. Zoelly Steam.. 658
Turntables for Heavy Locomotives, Design of 778
25-Cycle Current for Light (Letter to Editor) 803, 866
Typhoid Fever in Ottawa .... [illegible]
Typhoid Fever Rate, Effect of Safe Water Supplies on .... [illegible]
Underground Pipe Locating .... [illegible]
Union of Canadian Municipalities 267
Unit Costs of Filtering Water in Four Slow Sand Plants at Philadelphia 903
University of Manitoba Meeting 691
Upper Athabaska Region 714
Use of Charts in the Preparation of Estimates* 261
Utilization of Peat Fuel .... [illegible]
Utilization of Peat for Power Purposes .... [illegible]

PAGE
Utilization of Sewage Sludge 708
Vacuum Electric Furnace, Smelting Cobalt-Silver Ores by 624
Value of Coal on a Coke Basis 212
Value of a Continuous Settling Basin* 137
Vancouver Conditions ....No. 18—70
Vancouver Island Power Co., Jordan River Development* 787, 819
Vancouver's Proposed Harbor Commission 841
Ventilation of Sewers 634
Viaduct, Oakville, August, 1912*... 403
Victoria's Builders are Busy 877
Volta's Electrical Apparatus..No. 19—70
Wastes, Collection and Disposal of Municipal 651
Warehouses of New England Waste Co., Revere, Mass. 463
Water Consumption, Effect of Meters on 816
Water Consumption, Floor Area Unit as a Basis for Estimating 108
Water Filtration Project, Toronto's* 863
Water Franchises for Parish of St. Laurent ....No. 25—76
Water Mains, The Cleaning of 396
Water, New Means of Detecting Underground ....No. 11—72
Water Powers of British Columbia. 546
Water-Powers, Information Regarding 486
Water Powers, Western 852
Waterproofing Concrete 300
Water Purification ....No. 8—74
Water Purification as Endorsed by the Ontario Board of Health 411
Water Purification Plant, Fargo, N.D. 566
Water Purification Viewed from the Hygienic Standpoint 613
Water Rates 888
Water Softening by Lime, Cost of. 679
Water Storage in British Columbia.. 746
Water Supply and Fire-Fighting Appliances of Victoria, B.C., Report on 874
Water Supply for London-Large Humphrey Pumps* 879
Water Survey of Ottawa* 340
Water Turbine Chamber, New Type of* 797
Waves in Long Hydraulic Pipes and Tunnels* 112
Web Stiffeners 427
Welding Pipe with Oxy-Acetylene Torch 859
Welland Canal, New 512
West African Railway, Construction of a* 835
Winchester Cathedral, England, Repairs 406
Windsor, Essex and Lake Shore Rapid Railway 870
Winnipeg and Its Water Supply 481
Winnipeg Light & Power Department ....No. 16—74
Winter Troubles on Electric Railways 681
Wire Rope ....No. 9—92
Woods in British Columbia, Use of 567
Wood for Pavements, Strength of.. 445
Wood Paving Block 373
Wood Preserving Industry in America, The Development and Status of 749
Wood Preserving Oils, General Requirements of 692
Wood Stave Pipe, Construction of.. 650
Woodworking Machinery ....No. 11—92
Workmen's Compensation in Ontario 713
Work of Rats 866
York County Highway Commissioner's Report* 926
Zoelly Steam Turbine, 28,000 h.p. . 658
Zone System, Municipal 457

(Continued)

Volume 23. Toronto, July 4, 1912

Contents of this issue on page 119

The Canadian Engineer

An Engineering Weekly

DESCRIPTION OF REINFORCED CONCRETE ARCH OVER CURRENT RIVER, CITY OF PORT ARTHUR, ONTARIO.

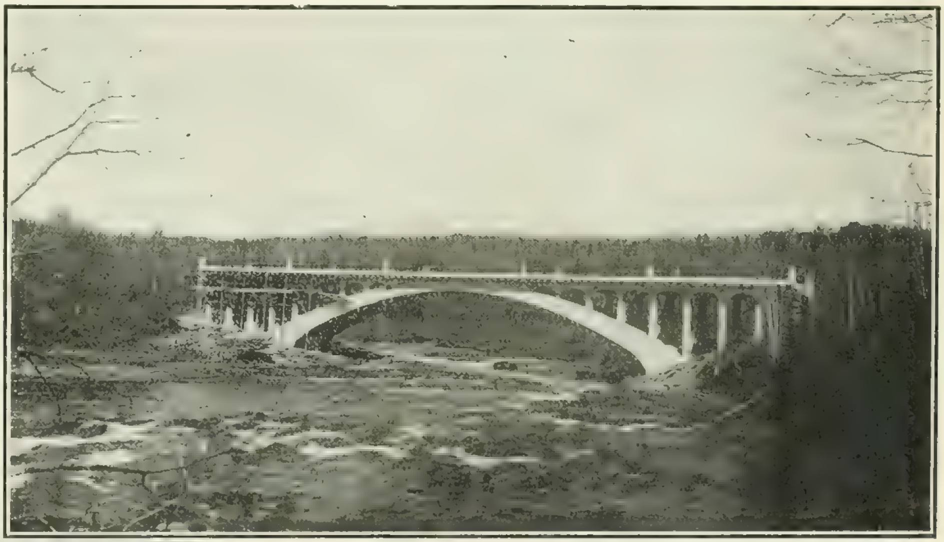
By L M. JONES, A.M. CAN. SOC. C.E., City Engineer.

The bridge to be described is situated on the line of the Black Bay Road, where it crosses Current River. This road is a government highway, and was constructed and used during the time of the construction of the Canadian Pacific Railway for hauling supplies.

The waters of Current River have been developed by the city of Port Arthur for the generating of power which is being used in the operation of its various public utilities. In connection with the development of this river there have been a number of dams constructed for the purpose of storing water and the proper regulating of the flow of the river.

On the night of May 27th, 1908, the dam at the reservoir, known as Paquette, broke away, the water carrying everything in its path, and among the structures carried away was the bridge over the river at the Black Bay Road.

The rebuilding of this bridge was delayed for some time, and a temporary crossing to the northerly side of the river was constructed about a mile down the stream, which served the purpose until the Cumberland Street bridges, previously described, were completed.



View Showing the Completed Structure.

View of Old Bridge Carried Away by Flood.

As stated before, the Black Bay Road is a government road, and the city council of Port Arthur felt that a request should be made to the government for some financial aid in the rebuilding of the bridge, the type of bridge to be more permanent than the one which was destroyed by the flood. Consequently, plans were prepared which, together with a water color sketch of the proposed bridge and surroundings, were sent to the Honorable Minister of Public Works, with the result that the city received a grant of $5,000 towards the erection of the new bridge.

General.—The character of the river banks at the location of the bridge were admirably suited to an arch of long span, the banks being composed of solid rock, which, while being a little seamy and soft at the surface, proved to be good, solid trap rock a few feet down.

As will be seen from the sketches, the elevation of the old bridge was considerably lower than that adopted for the new one. Some opposition was met with in this connection, it being feared that the bridge was too high, but as this was a proposed route for future street car traffic, and the grades of the approaches being quite satisfactory for such traffic, the opposition was overcome, and now all are highly pleased with the results.

The type of bridge selected is a two-rib, reinforced concrete arch of one hundred and thirty foot clear span
deck is supported upon reinforced concrete col
inches square; the deck extending approxima
beyond the back of the abutment on each sid
This extension was designed beyond the bac

ment so that the toe of the embankment would be well away from the action of the water. It also permits the use of a lighter structure, as there is no earth fill to add weight to the dead load.

Built in this manner, there would be no need of rip rapping the slopes, and the necessity of wing-walls and retaining walls, which, at their best are unsightly, was obviated. This type of construction also adds to the graceful appearance of the structure, and its cost, as compared with the fill required to replace it, rip rapping, and wing-walls is not much greater. It might be well to add that about an eighth of a mile down stream from the bridge is an artificial lake, while upstream from the bridge, just a few hundred feet, the river turns practically ninety degrees northward, the farthest bank from the bridge being a tree-covered bluff about one hundred and fifty feet high, which forms a good back ground for the bridge, viewing it from the reservoir. It was felt, therefore, that this type of bridge would blend with the surroundings better than having spandrel walls, wing-walls, etc., for retaining the embankment.

The intrados and extrados were both designed as para[illegible] curves, the intrados being increased at the abutment [illegible]

View Showing Covering for Finishing Walks and Surfaces During Cold Weather.

View Showing Formation of Rock Foundations.

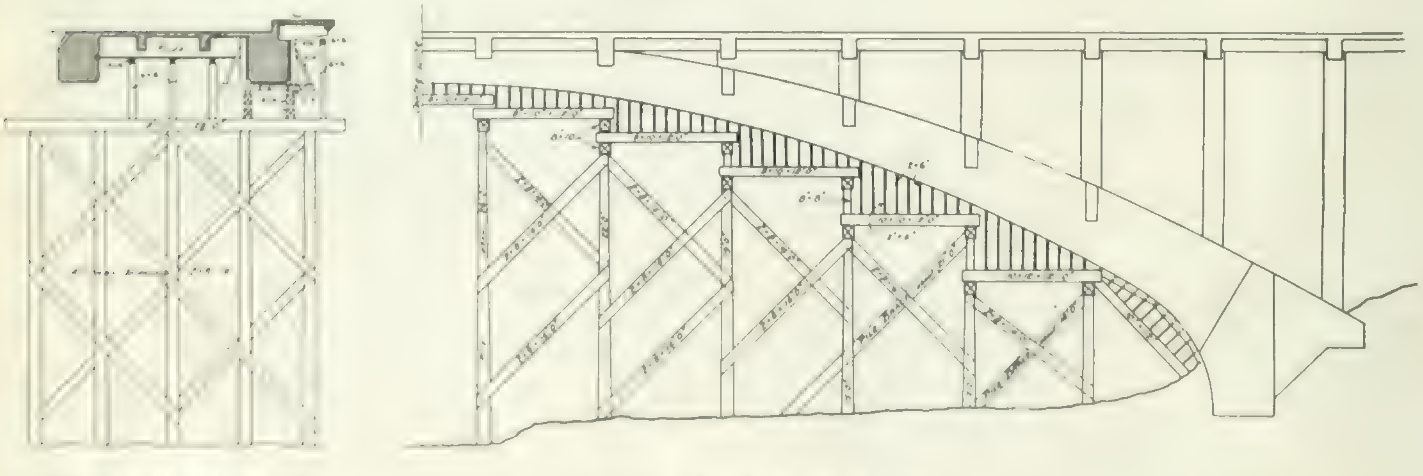
Between the ribs at the abutment a curtain wall was constructed connecting the ribs, which served as a strut and improved the appearance of the abutments from the river side.

The deck of the bridge is made of the beam and slab type, the slab being six inches in thickness. The deck was three inches higher at the centre of the bridge than at the ends, this being done to afford proper drainage of water to the outlets located at various points. The effect of this difference in height is not noticeable to the eye.

The sidewalks, which are five feet wide, are supported by cantilever beams from the columns and ribs. It will be observed that in order to obtain sufficient concrete section for the cantilevers, without allowing beams to go below the extrados of the arch, the connection between slab and curb was designed with a fillet, built in monolith, at the intersection.

The width of the bridge between curbs is sixteen feet. This does not give sufficient room for car and vehicular traffic at the same time, but as neither traffic of this kind will be heavy for the present, the width will be fully adequate for the conditions. However, when the traffic has grown to such an extent that a wider bridge will be necessary, the intention is to take off one of the sidewalks and add other ribs, thus making the roadway double the present width. From outside to outside of sidewalks the width is 26 ft. 0 in.

The railing consists of a two and one-half inch pipe, and over every fourth column a concrete post is placed into which the pipe is inserted in a loose joint.



CROSS SECTION

DETAIL OF FALSEWORK

Sketch Showing Details of Falsework.

The difference in elevation of the river banks at the approximate ground level is about twenty-four feet. The natural approach to the bridge on the southerly end is very steep, so that it was necessary to make an excavation of considerable extent to secure a five per cent. grade descending to the bridge The material, however, was necessary to make the fill on the northerly end of the bridge. The roadway descends on a two per cent. grade from the bridge on this end.

Owing to delays in the passing of the necessary money by-laws, etc., the commencement of the work was put off until late in the season. The grant of $5,000 which the government had made towards the construction of the bridge was included in the estimates for 1911, so that when everything was considered it was thought best to build the bridge in the same year. The contract was let on August 25th, and work commenced three days later; the bridge proper was completed on November 10th.

Upon enquiring, I understand that this arch, at the time of its completion, was the longest span of its type in Canada.

Design.—In the design of the bridge the calculations were based upon the following:

Ratio of modulus of elasticity of steel to that of concrete, 15.

Allowable working stress of steel in tension = 16,000 lbs. per square inch.

Allowable working stress for concrete:

(1) The extreme fibre, 750 pounds per sq. in.
(2) Direct compression, 600 pounds per sq. in.
(3) Shear, 50 pounds per sq. in.

The loads figured on were:

Live load, a thirty-ton street car, and an additional live load of 100 pounds per square foot, and a fill of gravel of approximately fourteen inches; impace figured at 50 per cent. of the live load.

Cement.—The cement used in the construction of the bridge was "Sun" brand Canadian Portland cement, tested to meet the requirements of the Canadian Society of Civil Engineers' specifications.

Sand.—The sand used was ordinary bank sand, coarse grained and sharp, containing a very small percentage of loam.

View Showing Arrangement of Plant and Runways.

View Showing Deck Forms Ready for Concrete.

Gravel.—Gravel was used in place of crushed rock, owing to the difficulty of obtaining the latter. The gravel used was lake shore gravel, similar to that previously described, ranging in size from that of a pea to one which will pass through a one-inch ring.

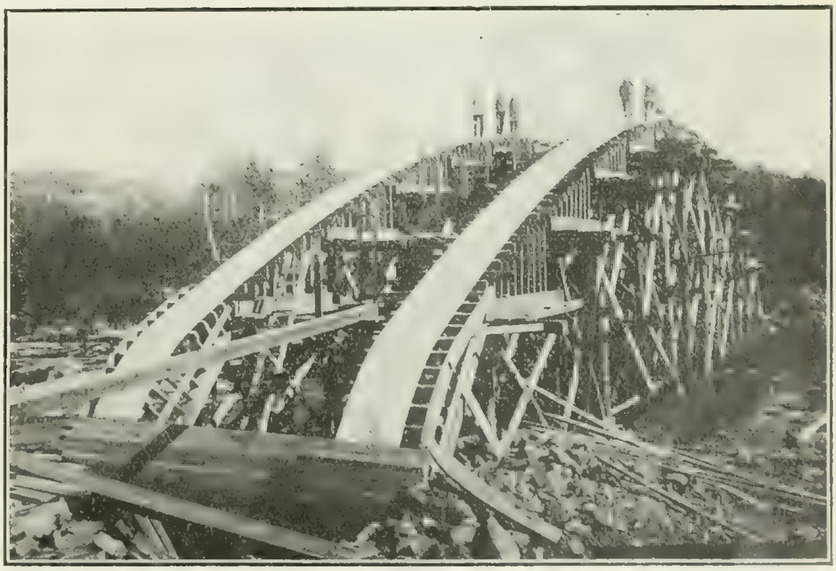
Concrete.—The concrete was all machine-mixed in the proportions of the above material as follows:

Abutments next to rock, 1:2:4; in mass, 1:3:5; ribs and struts, 1:2:4; columns, beams and slabs, 1:1½:3.

A wet mixture was used, being well spaded and worked at faces of forms, so that when the forms were removed the surface finish had scarcely a scar upon it.

In the view will be seen the arrangement of the mixing plant. All the material was delivered on the bluff and the mixer was set below, so that the charging of same was made particularly easy. A long runway was constructed, as shown, and the concrete deposited in place by means of a chute.

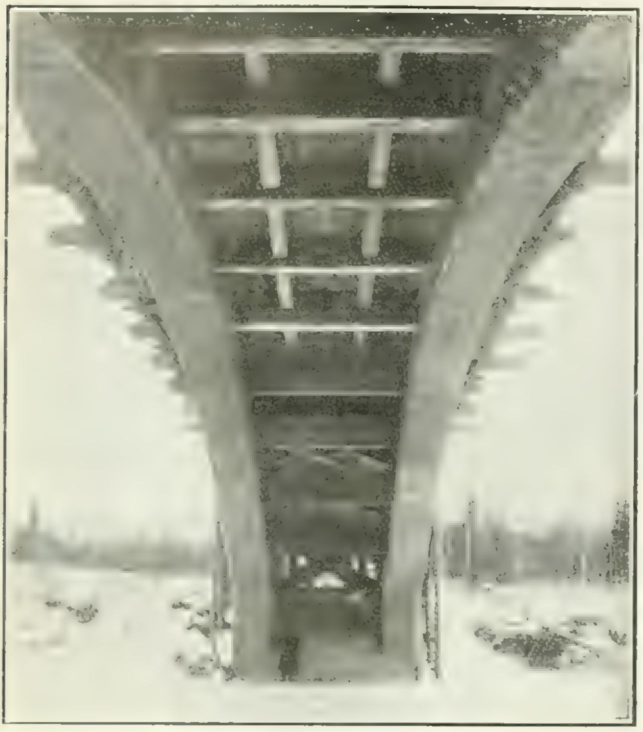
Reinforcing Steel.—The steel used in the construction is the "Kahn" system of reinforcing, furnished by the Trussed Concrete Steel Company, of Walkerville, and was purchased direct by the city and delivered f.o.b., the site of Legisla-



View Showing Forms for Ribs Ready to Put Forms for Slides In Place.

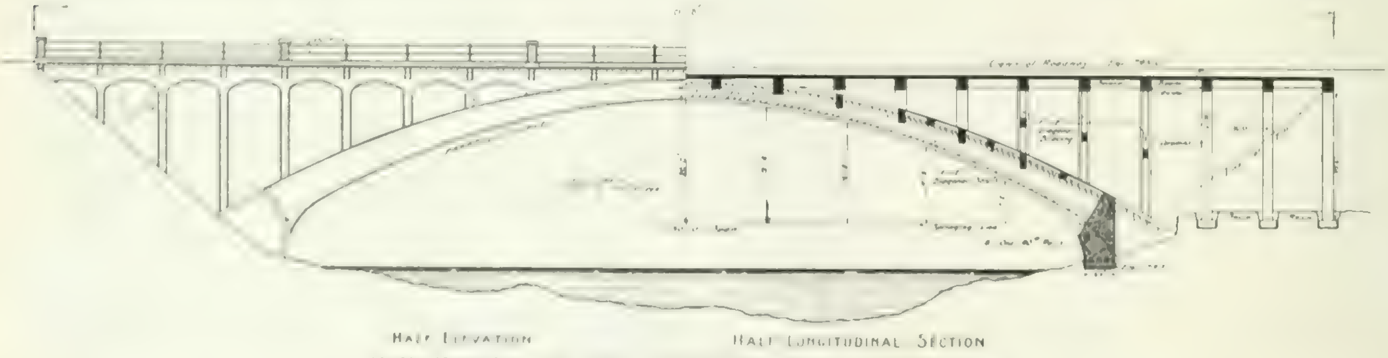
Construction.—After the necessary rock [illegible] wment Act a
for the foundations, the falsework f[illegible] nt of a Board
was commenced. The sketch [illegible] be to deal with
[illegible] y necessary to

ment of supports and formwork. The upright posts were taken out of the woods a quarter of a mile from the site of the works, and served the purpose equally as well as squared timber. After the concrete in ribs was poured it was found that the settlement in the forms at the crown of the ribs was two-hundredths of a foot. When the ribs and column footings were constructed the form work for the columns and deck were commenced, and no further concrete work was done until the forms were completed.



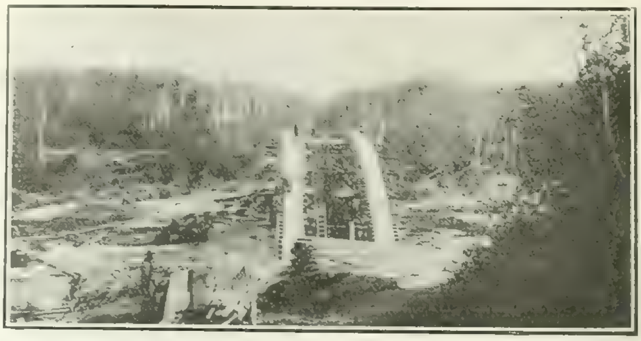
Under Side of Ribs and Deck.

In the construction of the ribs the concrete in the abutments of each rib was brought up to the chamfer and there squared off at right angles to the thrust line. Then the construction of the balance of the ribs was commenced from the same end of the two ribs, also struts and diagonals being brought up at the same time for a distance of fifteen feet along the ribs, then the same amount of work was performed on the other end. When these two first sections were completed an uplift was noticed in the forms at the crown of about eighteen-hundredths of a foot. It was feared that this [illegible] [illegible], and if it became worse it was decided that [illegible] the rib at the crown would be built to [illegible] equally at the haunches. However, this [illegible], as no further movement occurred and gradually, as the work of pouring the ribs proceeded, the framework settled back to its original location.

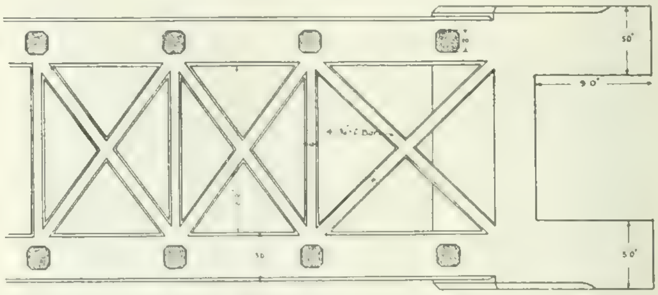


Half Elevation and Half Longitudinal Section of Bridge.

The centres under the ribs were not removed for thirty-nine days after the pouring of the concrete. Observations taken before and after their removal revealed no settlement in the bridge whatever. The forms were taken off the ribs entirely at the same time, but owing to the lateness of the season and the cold weather the forms on the columns and deck were left on all winter. It will be interesting to note that most of the surfaced finishing of sidewalks, curbs, concrete posts, etc., was done under canvas, as shown in the view. This arrangement was heated with two or three stoves, which made the performance of the work possible under the existing weather conditions.



View Showing Formwork of Ribs and General Surroundings.



Diagonal Struts and "U" Abutment.

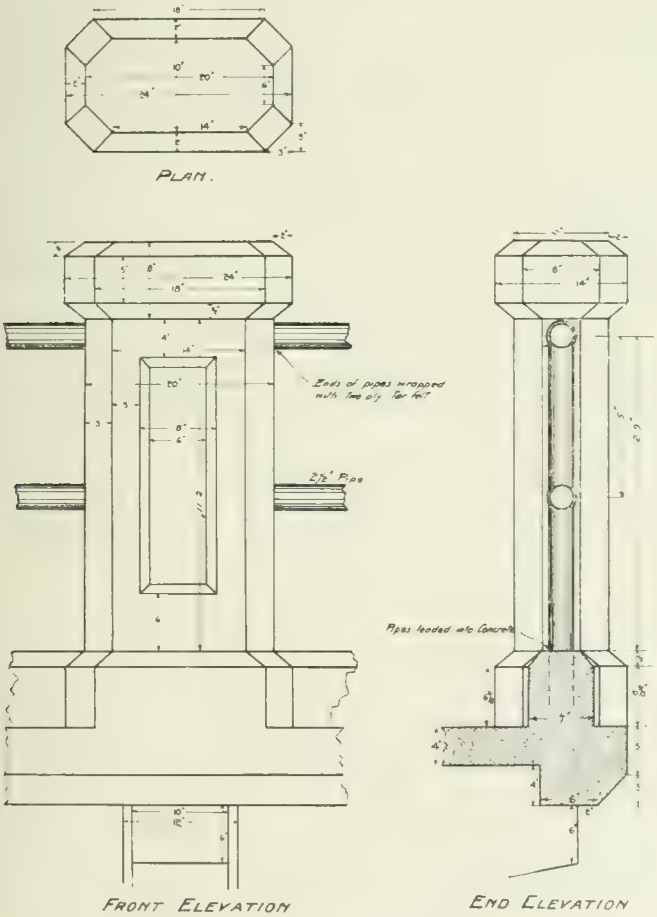
The materials for doing the work were heated by the ordinary methods. Upon the completion of the work, the exposed surfaces of the concrete were given a waterproofing coat of "Drywall," which has proved very satisfactory on other concrete structures built here.

There were three bids received for the carrying out of the work, the successful tenderers being Messrs. Seaman and Penniman, of Fort William. This firm has a wide practice in this district, and deserve to be complimented upon the successful manner in which they carried out the construction. Also, for completing the work in the short time given them.

Costs.

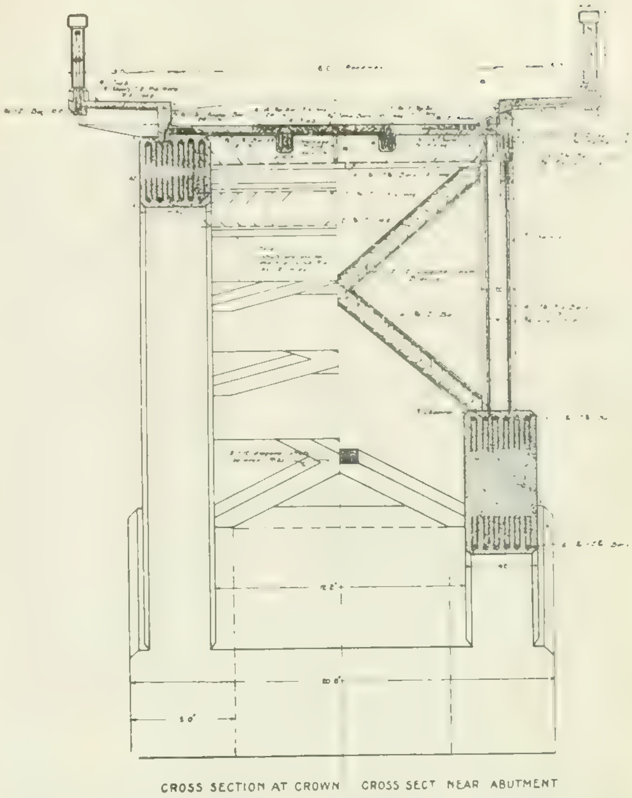
Lump sum price, as per tender		$11,000.00
Concrete in diagonal members, not included in original plan	16.5 cu. yds.	
Changing thickness of floor from 4 in. to 6 in.	23.0 cu. yds.	
Additional length of the columns	10.4 cu. yds.	
	49.9 cu. yds.	
49.9 cu. yds. at $19		948.10
Additional concrete in the abutments, 48.0 cu. yds. at $11.50		552.00
		$12,500.10
Reinforced steel		2,220.00
Freight and cartage on steel		335.37
Engineering		147.04
Advertising		225.30
Sundries		56.72
		$15,484.53

The above does not include the embankment.


PLAN.
FRONT ELEVATION
END ELEVATION
Ends of pipes wrapped with two ply tar felt
2½" Pipe
Pipes leaded into Concrete

Hand Rail Post Details.

The design and supervision of construction of the bridge was carried out by the city engineer's department, Mr. E. Elliott Henderson, assistant city engineer, preparing plans of the design, with the assistance of Mr. N. V. Wrigley. Mr. Wrigley was also inspector on the construction, and for the successful carrying out of the work they deserve a great deal of the credit.



Sections Through Bridge at Crown and Near Abutments.

THE NEW CANADIAN PACIFIC RAILWAY HOTEL IN VANCOUVER.

Contracts have been awarded for the erection of the new C.P.R. hotel in Vancouver. The work is complicated by the fact that the hotel will be erected on the site of the present building, the business of which will be carried on throughout the operations. The old building will be underpinned, and the excavations for the foundations, as well as the foundations themselves, will be completed before the actual work of demolition of the superstructure is commenced. As soon as the foundations are finished, the construction of the wing next to Opera House Lane will be rushed. This will be used in conjunction with the old building for hotel business, and as soon as the ground floor of the main wing is finished, it will be covered with a temporary roof and used. Then the old building will be torn down.

The main block will be of ten stories, and provision is made for extending the building to fifteen or sixteen stories, the matter now being the subject of negotiations with the civic authorities. The building is to be fitted up in the most sumptuous style. For instance, in the ladies' loggia on the Georgia Street side, prominent artists will be set to work to paint the walls in the Italian Renaissance style. The dining-room is planned to be the finest on the continent no less—and there will be a concert room having a seating capacity of 600, which may be used for a ballroom. On Granville Street there will be six first-class merchant shops, and a bar one hundred feet long. There will be 600 rooms in the building when it is of six stories, and 900 wh[illegible] is completed to its full height of 16 stories. Th[illegible] and power plant, for which the contract h[illegible] awarded, will cost $1,500,000.

ement Act—
nt of a Board
e to deal with
ry necessary to

THE ADMINISTRATION OF THE HIGHWAY IMPROVEMENT VOTE IN SASKATCHEWAN.

The following is an abstract of a bulletin issued by Mr. A. J. McPherson, the Chairman of the Board of Highway Commissioners of Saskatchewan.

No more distinctive features serves to mark modern conditions as compared with the past than the great development in transportation facilities. Immense sums are spent in railroad building and the highest skill employed in devising ways of improving methods in connection with railroads. The same applies to water transportation, so that within the last centry distance has been comparatively annihilated.

While it is true that transportation development has been very far-reaching in its effects and has changed the whole character of modern civilization, the development regarding highway construction in many countries where this change has taken place has not advanced to any proportionate extent, especially in rural districts. While the cost of transportation has been reduced by these modern methods to a very small amount per ton mile the cost of hauling agricultural products to the markets which have now become the towns along the railroad lines, still remains about 25 to 30 cents per ton mile. A direct saving in cost of this delivery to the markets can be effected by constructing good roads and under present conditions every cent of this saving would go into the pockets of the people.

It may be said that farmers would not gain anything by a quicker delivery to market and that they will make but a definite number of trips per day in any case and that they have to have the necessary horses for farm work so that they would not save anything by improving the roads. This is not the case, however, as farming in these days has become as systematic as any other line of business and successful farmers make every effort count the same as other successful men. Anything that will reduce the effort required to produce results such as the improvement of roads to market means an advantage in making a success of the business.

It is only a question of how much traffic exists or will be created on any road to determine the expenditure that would be warranted in improving it.

Land values adjoining are increased by the construction of good roads, land being of little intrinsic value unless the products therefrom can be transported to market in an economical manner. It is only necessary to examine the drop in land values as the distance from markets increases to realize that anything that will make them more accessible will increase the value of land. In many sections, at certain times of the year, the condition of the roads prohibits leaving the farm and the people on the farms through this lose interest in current events, become dissatisfied and are not in a position to carry on their business with an enthusiasm which is necessary to make a success of it. Bad roads react in this way so as to affect all departments of country life and im- [illegible]

General Policy.—[illegible] Department of Public Works has spent annually on the im- [illegible]

In 1906 when it was decided to carry out an improvement in some certain locality one of the local residents who was known to have ability in that kind of work was appointed to organize the local labor and do the work. The result of this system was that the improvement of roads was always considered a secondary matter and the work was attended to or not, depending on whether the appointee found time to undertake it after attending to his own business and as a result, in many cases the work was not done or the money was spent at a season of the year when the most value could not be obtained for the amount expended.

In 1907 the system of administering the vote was changed with the idea of overcoming the defects observable during 1906. Instead of local men being appointed the best men that could be selected from the list of foremen employed in 1906 were appointed as road foremen to act during the full season and to go around from place to place where it was decided to make improvements, organize the local labor and see that the work was properly done. A great improvement was noticed under this system as the season advanced. These foremen rapidly became expert at laying out the work and directing how it should be done, wasted less in misdirected efforts and the quality and style of the work throughout the province became more uniform.

The same policy with slight modifications to meet changing conditions in different years and in different parts of the country was followed in 1908 and 1909 and regarding a large part of the expenditure on roads up to the present time. Conferences of these foremen have been held, many manuals and publications regarding road matters have been distributed to them and to the local authorities and a force of skilful inspectors has been constantly kept visiting them during the progress of their work, the result being that we have now a large number of men scattered over the province in all its parts who have an excellent idea of road building and of what is necessary in this regard to meet varying local conditions.

In 1910 this policy of education was extended more directly than heretofore to the local authorities by asking them to work out their own problems and sending what assistance was possible to them in doing so. This was effected by making grants under regulations approved by the Lieutenant Governor in Council to all municipalities which had completed their organization under the Rural Municipality Act whereby the work had to conform to a certain standard and they had to collect certain information, thus ensuring a certain amount of [illegible] would be entitled to the grant. This system has produced a good effect and has given satisfaction where properly worked out.

Classification of Roads.—In determining the location of the roads where grants would be warranted the provincial authorities recognized that roads should be classified as to their importance. Those having the heaviest traffic and on which traffic from a large area would develop were classed as main roads and were considered of a provincial nature and therefore would warrant the assistance of the provincial authorities in improving and maintaining, and those which served but a small area and sparse traffic were considered local and should therefore be attended to by the local authorities.

In a new country such as Saskatchewan and where [illegible] improvements [illegible] beyond the [illegible] located on purely [illegible] long grades across marshes and sloughs, side hill roads across ravines, etc., come in this class and the provincial authorities could [illegible] from provincial funds. As a result practically all bridges of 20-ft. span and over and many culverts and small bridges have been constructed by the provincial government and in most cases the maintenance has also devolved on the provincial authorities.

Capital and Current Expenditure.—A large number of bridges deemed advisable to construct as steel bridges on concrete foundations or of reinforced concrete have been treated as permanent structures and paid for out of capital but all the road work and the majority of the bridge work has up to the present been met from the current revenue of the province. Many of these improvements are an undoubted permanent asset to the province and should be considered as capital and treated accordingly, while a great deal of work such as grading, minor improvements in filling holes, maintenance of bridges, etc., the result of which will disappear in a few years should properly be met from the current revenue.

It has been brought to the attention of the government from various sources that there is a necessity of a more rapid development regarding works which are of a more purely capital nature, and with this object in view provision has been made by legislation for meeting the cost of these improvements to the extent of $5,000,000 and it is the intention to proceed as fast as is considered advisable consistent with economy, efficiency and the resources available in the way of labor and equipment, with the prosecution of the work. This will be additional to the ordinary expenditures undertaken as in the past, but the latter will be made to cover works of a more purely maintenance character with the tendency constantly existent to spend the money in such a way as to produce permanent results.

The principle of making improvements of a permanent nature from capital expenditures has been recognized by the Legislature as regards local affairs in that The Rural Municipality Act and the Cities and Towns Act, which serve as the charters of these institutions, make provision for the issuing of debentures to cover the cost of improvements of a similar nature to be repaid within the life of the improvements.

The policy of enlisting the interest and co-operation of the local authorities in various ways and the distribution of the expenditure in accordance with principles as already outlined regarding works of a provincial nature, main roads, large bridges, etc., will be followed.

A larger sum will be available for the construction of permanent bridges and the usual vote will be supplemented by an amount sufficient to ensure that when advisable they will be constructed of steel, concrete and reinforced concrete instead of wooden structures which have a life of seven or eight years at most before they become of questionable strength.

Road Laws and Administration.—The laws relating to the construction and maintenance of public roads vary in different countries, each system being the outgrowth of many conditions peculiar to each country. Road building must vary to suit climate, physical conditions, density of population, character of traffic, etc.

When the construction of steam railways became common throughout civilization, attention was somewhat diverted from the building of common roads, but in recent years in all the most advanced countries the question of pubilc roads is receiving a great deal of attention and large sums are being expended theron.

A study of the laws and the methods of administration in the countries that are most noted for their progressive ideas on road building will show that some features are common to all, and it would almost seem that success need not be looked for unless those features receive attention.

A study of methods as adopted by progressive countries shows that it is hopeless to expect good road systems by depending on local municipal efforts. Roads are usually classified according to their importance and money is raised somewhat proportionate to the interest of the various authorities, state, provincial or local. Local authorities while having an interest in all the roads are not expected to meet the cost of constructing and maintaining important roads on which the traffic cannot be considered local and which therefore require proportionately heavier expenditure to keep in first class shape. A special effort and heavy expenditure is necessary to construct main roads and thereafter constant attention must be given to maintain them. In some cases men are constantly employed and devote their whole attention to the care and maintenance of main roads. In other cases the state or provincial authorities interest themselves in the construction while the maintenance is attended to by the local authorities. It has been shown to be folly to go to great expense in constructing good roads and then through neglect to allow them to get in bad repair. It is absolutely necessary that roads should receive almost constant attention after construction to keep them in first class shape, this being a case where "a stitch in time saves nine," without a doubt. The local authorities are in a better position to give this constant attention than the provincial authorities, being constantly on the ground, as it were, and they should recognize that this duty devolves on them.

Most countries where successful road systems have been built up maintain a central bureau for the collection and distribution of information, conducting experiments and generally acting in the advisory capacity regarding all phases of road work. Highway development in Saskatchewan has evolved naturally in accord with many of the principles outlined above and the present step being taken to provide for the construction of important improvements under capital account is entirely in accord with successful methods adopted elsewhere. These principles will be taken into consideration in the administration of any funds available for road improvement and methods worked out as seem best to suit the merits of the varying conditions throughout the province.

Class of Roads to be Built.—Up to the present there are very few places in the province where anything more than improvements to make the best possible earth road are undertaken and it is only where gravel is easily available that short stretches of gravelled road have been constructed. In some of the older towns their main streets are gravelled and are kept in very good condition, but as far as the country roads are concerned almost without exception they are simply earth roads.

There are many places throughout the province where the country has developed to a high degree and where in order to be consistent with conditions some better form of road than an earth road is wanted.

Settlement in other places has taken place rapidly, with the result that the necessary attention to the roads has not been possible and many obstructions exist and long stretches of almost or at times impassable roads prevent ready access to markets. The standard of road to be aimed at must necessarily, therefore, vary for different localities, but it is exceedingly advisable that as high a standard as possible should be set. In some localities gravel and broken stone roads should be constructed, while in others the removal or overcoming of obstructions and the construction of the best earth road possible is immediately advisable with the possibility of a better grade of construction in the near future kept constantly in view.

Co-operation of Municipalities.—In order to ensure that the necessary consideration be given the subject the [illegible] ound that
ture has made provision in The Highway Improv[illegible] us check the
copy of which is appended for the appointme[illegible] al taps, and
of Highway Commissioners whose duty it will [illegible] flow would be
the merits of the cases as they arise. It is ve[illegible] curacy in the

ensure success that the local authorities co-operate with the board in carrying out the work in accordance with the general policy above outlined. The classification of roads and the development of the system, the standard of construction and the attainment of that standard as the work proceeds, depends to a great extent on the consideration that will be given by them.

During 1910 and 1911 many of the rural municipalities have taken into consideration the roads throughout their districts that should be considered as main roads and as such entitled to have the expenditure of provincial funds in their construction and plans have been prepared showing the roads that have been decided on in this way. Municipalities will be asked to give further consideration to this matter with the object of building up complete systems of main roads through the extension of those already undertaken and the addition of connecting roads from municipality to municipality.

Municipalities should consult with adjoining municipalities as to the most advisable main roads to improve to become part of a road system that will serve the territory and the board will give every consideration to the findings of such deliberations when placed before them. Proper methods of carrying on the work will have to be evolved and such methods decided on as seem to best suit the circumstances and the local authorities can give valuable information in this regard.

What should be decided on is the most efficient and economical method and the one that will be most certain of producing desired results.

Of the latter sum a part will be used to construct permanent concrete and steel bridges, thus supplementing the vote made otherwise for this purpose during each of the last few years.

The foregoing will be sufficient to give an idea of the situation as it exists at present and an outline of the policy regarding improvements.

A short review of the matter under consideration may be set out as follows:

The government is pledged to spend $5,000,000, $1,500,000 of which it is proposed to spend in 1912.

This will be spent on improvements as follows:

1. Main roads to be decided after consultation with municipalities.

2. Main roads out of organized districts.

3. Large works such as bridges, heavy fills, side hill grades, etc., beyond the means of local authorities although not on the main roads.

The methods of carrying out the work may be classified as follows:—

1.—**Road Improvements.**—As grants to municipalities. By Highway Commission day labor. By contracts from municipalities. By contracts from the Highway Commission.

2. **Bridges.**—By contract. By Highway Commission day labor.

In addition to this the Highway Commission will investigate methods of [illegible] that may seem to offer a solution for peculiar difficulties and will distribute information to those interested that will tend to raise the standard of the work. It will be in a position to give advice wherever needed [illegible] in the place of the [illegible] of the local authorities.

[illegible]

FLOOR AREA UNIT AS A BASIS FOR ESTIMATING WATER CONSUMPTION.*

By William W. Brush.†

In 1908 the writer was placed in charge of the general design of the delivery system to carry to the five boroughs of Greater New York the 500,000,000 gallons per day which would eventually be available from the Catskill watersheds, this work being carried on by the Board of Water Supply. Studies in connection with the design of this system required a determination of the existing consumption in each borough, and in sub-divisions of each borough, as well as an estimate of probable future growth in consumption.

It was found that the measurements of flow that had been made were not sufficient in extent to give a fair basis for estimating the present consumption in the various sections of the city, and that a per capita basis for consumption was practically useless for this purpose for the borough of Manhattan, due to the fact that large areas are wholly devoted to office buildings, manufacturing and other business purposes; and also due to the rapid changes going on in the elimination of buildings previously used for residences and the substitution of office buildings, lofts and factories.

While the water consumption of both large and small communities is generally expressed as the average amount supplied "per capita," this unit is used more on account of its convenience than for its usefulness as a basis for comparison of consumption in different towns and cities. In examinations made of the per capita consumption in different sections of large cities, variations of several hundred per cent. have been shown. The highest consumption is generally found in the highest class apartment houses, and the lowest consumption in the lowest class of tenements.

To carry out the work required to satisfy factory design the Catskill delivery system some unit of consumption was necessary that did not vary to the extent of the per capita unit and that could be applied to business as well as residential sections. An investigation of the available data on which to estimate future as well as present consumption showed that the area occupied by buildings would be the fundamental basis for future consumption, especially in the borough of Manhattan, and that, other things being equal, the amount of water used in any buildings would be dependent upon the ground area covered and the number of stories in height. It was, therefore, decided to study the use of the floor area unit as a basis for estimating consumption. The floor area was to be determined by multiplying the ground area of a building by the number of stories, allowing one additional story for basement or cellar. One thousand square feet of floor area was found to be a convenient unit and one that would give a resultant consumption averaging about three times that figured on a per capita basis.

To determine the present use of water per unit of floor area, typical buildings were selected in which the supply was measured by meters, and the resultant consumption determined. There were also available measurements of various districts in Manhattan, Brooklyn and the Bronx, which were made by use of the pitometer during waste investigations carried on in 1902-03. Table I. gives the results of these measurements, as well as those taken in 1911. A reduction in consumption in 1911 of about 15 per cent.

---

[*] Abstract of paper read before American Waterworks Association at thirty-second annual convention, Louisville, Ky., June 3-8, 1912.

[†] Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, New York City

was effected by house to house inspection, while in 1902 no work had been done on water waste.

Table I.—Water Consumption in Various Districts of New York.

No. of District.	Characteristics of Occupancy.	Consumption M. G. D.	Population Resident.	Consumption Per Capita.
	Gaugings, 1902-03.			
1	Large hotels, high-class residences	1.87	8,396	223
2	East side tenements	1.44	38,906	37
3	East side tenements	5.40	90,000	60
6	Residence and high-class apartments	0.76	10,164	75
8	Business, office buildings, waterfront, shipping	9.45	11,000	860
9	First-class apartments and hotels	1.37	8,872	154
10*	East side tenements, some waterfront	20.20	218,023	93*
11	Uptown residences and medium class apartments	4.89	4,380	112
12	Upper east side tenements, waterfront, power houses and breweries	2.75	39,969	69
	Gaugings, 1911.			
1a	East side tenements, some waterfront (same as District No. 10)	11.44	230,500	50
2a	All classes	29.48	204,557	144
3a	High-class apartments and residences	22.18	186,990	118
4a	High-class apartments, residences and tenements	12.74	138,800	92
5a	East side tenements, and waterfront	8.28	84,580	98
6a	High-class apartments, residences, tenements and waterfront	14.82	173,000	86
7a	All classes	13.38	169,100	79
8a	All classes	13.66	209,393	65

---

* An error was later discovered in the measurement of flow in this district, which reduced the consumption as given by about 50 per cent.

With a variation in the per capita consumption of from 37 to 860 gallons daily, it was evident that it would be difficult to apply a per capita basis to different sections of the city to determine the consumption in such sections.

It was found upon examination that with the exception of those buildings where the consumption of water would be unusually high, such as hotels, laundries, ice plants, etc., the use of water per thousand square feet of floor area was from 150 to 300 gallons per day. This covered only those buildings used for business purposes, as under the rules of the Water Department, meters are not required in buildings used for residences. It was anticipated that apartments of the higher class would show a somewhat larger use of water per unit of floor area than would the tenement class, and that both would show a larger use than private residences.

The first computations made of consumption in districts which covered several blocks, included a high-class apartment house and hotel section in the vicinity of 80th Street, on the west side, and a low-class tenement section on the east side in the vicinity of 80th Street. The per capita consumption in these two districts was 154 gallons per day and 37 gallons per day, respectively, the high-class apartment district therefore showing a consumption, on per capita basis, of over 400 per cent. of that shown for the tenement house district. On the floor area basis, the figures for these two districts were 181 and 179 gallons per day per 1,000 sq. ft. respectively, or a variation of less than 2 per cent. between the two districts. While this close agreement in consumption for the two districts was a coincidence, it strikingly illustrates the uniformity obtained from the floor area basis as compared with the per capita basis in two residential districts where the character of population varied widely. As further studies showed the floor area basis to be a practical one, it was applied generally to the borough of Manhattan. The ground area was scaled from the atlas, and this area multiplied by the number of stories, the buildings being grouped as far as possible to reduce the labor. After the entire area of the borough of Manhattan had been determined the average consumption was computed and proved to be about 300 gallons per 1,000 sq. ft.

To determine the prospective use of water in the borough of Manhattan, the area available for building was determined, eliminating street and park areas, and the borough was divided into four groups, the average height of buildings and percentage of ground area to be built upon in each group being estimated. The future consumption per 1,000 sq. ft. of floor area was taken as 350 gallons for that section of the city below 59th Street, to provide a margin of safety in the estimates.

The experience of the past three years has shown that the floor area basis is useful also in the following work: (1) To determine what is the reasonable consumption in districts which are being surveyed by use of the pitometer, thus determining whether further investigations to detect leakage are advisable; (2) to determine consumption in individual blocks or groups of several blocks, where it is proposed to extend high service to cover districts previously supplied from low service; (3) to determine whether metered consumption indicated for large buildings is probably correct, where question has risen as to the presence of illegal connections; (4) to determine size of tap that should be granted for a new building.

The following illustrations of the use of the floor area basis in connection with gaugings of flow into districts and the use of water in buildings are of interest. In measuring the flow of water into one district in 1902-03, an error was made in the direction of flow through one of the large mains included in this district. The flow in this main, which was about 5,000,000 gallons daily, was taken as being into the district, whereas it should have been out of the district. The resultant error was, therefore, about 10,000,000 gallons daily, or about equal to the actual flow into the district. The resultant per capita consumption was 93 gallons, and was not considered to be abnormal. When the floor area unit was applied to this district it was found that the consumption per 1,000 sq. ft. was over 600 gallons per day, whereas no other district was found where the consumption had equaled 400 gallons, and few had exceeded 300 gallons. Investigation and subsequent measurements of flow in the district clearly showed the error, which was only discovered by applying the floor area unit.

The question of the presence of one or more illegal connections between the city's mains and the piping system of one of the large hotels was brought up. It was found that to measure the flow in the street mains and thus check the meters in the buildings would necessitate several taps, and the size of the mains was such that the rate of flow would be too small to give a reasonable degree of accuracy in the readings that might be obtained. To make the necessary taps and take readings would have cost several hundred dollars and would have interfered with traffic on two of the most congested streets in the city. A comparison of the use of water in this building on the floor area basis with that of several other buildings of like character showed that the building in question used more water than any of the other buildings. The evidence, therefore, was conclusive that the full amount of water supplied was passing through the meters.

The per capita basis for estimating consumption is the most practical one for general use, and will undoubtedly continue to be the standard unit. Experience with the floor area basis in New York city has shown, however, its usefulness in waterworks operation, and it is believed that other cities than New York will find occasions where the floor area basis can be utilized to advantage.

TESTS OF CAR HEATERS.

An investigation has been made by the Cleveland Railway into the merits of various systems of heating trail cars for rush-hour service. The investigation was carried on under the supervision of T. Scullin, master mechanic of the Cleveland Railway, and J. H. Alexander, chief engineer for the City Street Railroad Commissioner of Cleveland. It was witnessed by Street Railroad Commissioner Witt and by representatives of the various car heater manufacturing companies whose apparatus was concerned in the test. An abstract of the report made as the result of this investigation follows:

"Three types of heaters were tested, namely, straight electric heaters, the forced ventilation electric heater and the forced ventilation coal heater.

"The tests were made upon three of the railway company's 900-type cars, having an over-all length of 52 ft., the front vestibule being inclosed and the rear vestibule open. Each type of heater was installed in a separate car. The tests were made with the cars end to end on a track in the shops of the railway company. Two side ventilator sashes in the front of the car and two in the rear were open during the entire test. The straight electric heater system manufactured by the Consolidated Car Heating Company was installed on car No. 909 and consisted of twenty-six heaters, installed underneath car seats, one main switch cabinet, one magnetic switch, one thermostat and one snap switch. The forced ventilation electric heater manufactured by the Peter Smith Heater Company was installed on car No. 911. It consisted of a compact electric heating unit in a sheet steel housing, equipped with a Sturtevant multivane blower, size C, direct-connected to a 2.0-volt, 8-amp series-wound, ball-bearing motor. The cold air taken from underneath the car is blown over the heating coils and distributed from a hot-[illegible] the length of the car floor. This heater is [illegible] with an [illegible] and thermostat [illegible] the temperature of the car automatically. The forced ventilation coal heater [illegible] on car No. [illegible] was [illegible] by the Peter Smith Heater Company and [illegible] heater described above except that the heat is obtained by the direct combustion of coal, the cold air being blown over the combustion chamber.

"The tests were started [illegible] on [illegible] after the cars had been standing in [illegible] building for about twenty-four hours.

"The temperatures within the car were taken by [illegible] thermometers [illegible] and at the [illegible] below the ceiling, and one in the centre of the car at about the height of the seat back. The latter temperature was considered to be representative of the temperature of the air in the portion of the car occupied by the passengers. The temperature indicated by the thermometers just under the ceiling was practically the same as that indicated by the thermometer in the centre, on the car equipped with the Consolidated heaters, and about 1 deg. to 2 deg. higher on the car equipped with the forced ventilation electric heater, while on the car equipped with the coal heater one temperature was slightly higher and one slightly lower than that in the centre of the car.

"The outside temperature considered in the test was that taken at about the height of the car windows. The temperature of the intake air to the forced ventilation heaters was about 2 deg. to 4 deg. lower than the temperature at the height of the car windows, while the temperature of the air about 3 ft. above the roof of the car was 2 deg. to 3 deg. higher. A five-hour continuous heat run was made on the three cars, an employee of the railway company being stationed in each car to take thermometer readings at a signal from the recorder. The first few readings were taken at intervals of two or three minutes, in order to obtain the curve of temperature rise of the car.

"The run on the car equipped with the coal heater was not successful, owing to the insufficient draft of the heater while in operation in the building, and another test was made subsequently on this car. In this test a fan was placed on the car roof, blowing the air over the top of the smoke-jack, which gave the draft desired.

"On this latter test more thermometers were available and they were distributed over the sides of the car to determine what effect the heat radiating from the side of the car when the car was not in motion would have upon the envelope of air close to the car body. These temperatures indicated that with the car in actual service there would be a greater radiation from the windows and a slightly greater radiation from the roof of the car.

"The tests run on the two electric heaters show that in order to maintain a temperature within the car 41.9 deg. Fahr. above the surrounding air it is necessary to expend about 10,900 watts, of 267 watts for each degree rise of temperature

"The mean temperature of Cleveland for forty years for each of the winter months was obtained from the United States Weather Bureau, and the number of degrees of heating required to maintain a temperature of 55 deg. Fahr. inside the car was determined. It was also assumed that the current must be turned on the heaters a sufficient length of time to raise the temperature to 45 deg. Fahr. before the car goes into service, also that the car remains in service two hours in the morning and two hours in the evening."

In the comparison of costs of electric and coal heaters the contract under which the Cleveland Railway purchases energy was used for determining the cost of the electric heaters. The figures follow:—

Estimated Cost of Power for Electric Heater for Trail Cars on Basis of One Car per Year.

Maximum demand at car from test (500 volts)	11.00 kw
Maximum demand at d.c. bus substation (90% efficiency of distribution)	12.23 kw
Maximum demand at generator bus (80% efficiency of transmission and conversion)	15.30 kw

12.23 kw for 2½ hours requires 8.16 kw of substation capacity, 50% overload allowed.

Investment in substation, 8.16 × $25 = $204.00 ($25 per kw of capacity installed.)

Fixed charges on substation equipment, $204 × 10% = $20.40.

(Includes 5% interest, 2.52% amortization, 1.36% taxes =9.88% or 10% used.)

Investment in distributing system is $41.70 per kw of maximum demand.	
Investment in distributing system per car, $41.70 × 12.23	$510.00
Fixed charges per car per year, $510 × 10%	51.00
Maintenance of distributing system per kw of maximum demand per year	2.00
Maintenance of distributing system per car	24.46
Consolidated car heaters require 4661 kw-hr. at car or at generator bus, 4661 ÷ .80 = 5830 at $0.0038	22.15
Substation operation and maintenance, 5190 × $0.0003	1.56
Peter Smith forced draft heater required 4172 kw-hr. at car, or 4172 ÷ .80 = 5220 kw-hr. at generator bus, 5220 × $0.0038	19.80
Substation operations and maintenance, 4640 × $0.0003	1.39

Summary of Power Cost.	Consolidated Electric Heater.	Peter Smith Electric Heater.
Demand charge for power, 13.76 kw for 6 months	$82.50	$82.50
Energy charge	22.15	19.80
Substation operation and maintenance	1.56	1.39
Fixed charge on substation	20.40	20.40
Fixed charge on distributing system	51.00	51.00
Maintenance of distributing system	24.46	24.46
	$202.07	$199.55

Peter Smith Coal Heater:	
Fixed charge, .182 kw at $16.22	$2.95
Substation operation and maintenance, 148-kw-hr. at $0.0003	.04
Energy charge, 166 kw-hr. at $0.0038	.63
Total	$3.62

In building the fire in the coal heater, the following material was used: Kindling, 1.76 lb.; ash wood, 4.25 lb.; kerosene oil, 0.312 lb.; shavings, 0.004 lb.; coal, 35.29 lb.

In the general summary, each heater was charged with interest at 5 per cent. taxes at 1.36 per cent. and repairs and maintenance at 1 cent a day. Depreciation was charged at 7 per cent. in the case of electric heaters and 10 per cent. in the case of coal heater. The latter was also charged with the following special costs per year:

Coal	$21.00
Fuel and labor of kindling fire thirty times	4.09
Labor of attendance	8.76
Removing and reinstalling heater each season	1.00
Transportation and storage in summer	.50
Value of space occupied by heater	11.16

The final figures showed that the Peter Smith coal heater to be far more economical than either electric heater.

In regard to weight and space occupied and a general summary the report says:

"The weights of the various heaters installed complete are as follows: Consolidated, 457 lb. Peter Smith electric, 350 lb.; Peter Smith coal heater, 544 lb.

"The cost of power for hauling the equipment for this trailer service amounts to 2.18 cents per pound per year. The Consolidated electric heating equipment is carried throughout the year, while with the Peter Smith forced ventilation heating equipments the heating duct alone is carried throughout the year, the heater being removed and stored during the summer season.

"Either of the electric heaters installed in a car would be placed under the seats, while the coal heater during six months of the year occupies the space of one seat in the car; the value of this space is chargeable against this heater. In order to obtain this value it was assumed that the standing capacity of the car is one-half as valuable as the seating capacity. Thus in this car, seating sixty passengers and providing standing room for sixty more, the value of one seat space is one-ninetieth of the value of the car space. On a basis of 38 miles per day for a trailer 156 days per year, the mileage per heating season is 5920, which at 17 cents per car mile operating cost amounts to $1,006.40. Therefore $11.16 is the value of the space occupied by the coal heater during the winter season.

"Each of the three types of heaters has its individual advantages. The electric heaters afford the advantage of cleanliness, convenience and ready means of obtaining automatic regulation of the car temperature. The Peter Smith electric heater has the important additional advantage of providing a forced ventilation of about 12,000 cu. ft. of fresh warm air per hour. On the Peter Smith electric heater, however, no means were provided for automatically cutting off the current of the heating unit in case of failure of the blower motor, which would probably mean a burn-out of the heating unit. Both of the electric heaters have the disadvantage of being unable to heat the car properly in extreme weather. The curves show that in zero weather it would be impossible to maintain a temperature of more than 40 deg. Fahr. inside the car. With the coal heater a rise of over 48 deg. was obtained easily without any attempt at crowding the heater. The exceptionally high cost of power for heating the tripper cars electrically at rush-hour periods of the day for the climatic conditions existing in Cleveland renders the operation of electrical heaters extremely uneconomical if not prohibitive."

METHODS OF REINFORCING A BRIDGE.

Reinforcing a bridge in such a way as to make the added material share not only in the live-load but also in the dead-load stresses was done on the Bengal-Nagpur Railway, India, according to the methods described by D. H. Remfry in a recent paper before the Institution of Civil Engineers. The bridge consisted of ten 200-ft. deck-truss spans, and two 100-ft. spans. Each span, during the reinforcing, was jacked up at six points, to take out most of the dead-load stress. The jacks were supported by falsework founded on 42-in. steel cylinders sunk in the sandy river bottom (and after using pulled and used again).

Special rivets were tried in the reinforcing, because some of the gussets furnished little room for driving additional rivets. The special rivets, of chrome-vanadium steel, had 45 per cent. greater shearing strength than mild steel, and, curiously enough, "tests seemed to indicate also that a greater bearing resistance could be relied upon in the plates when these special rivets were used, than with mild-steel rivets."

The success of the reinforcing is described in the statement: "Practically no permanent set was observable on the first passage of a train after strengthening." The deflections of the spans under live-load were 26 per cent. to 30 per cent. less than before reinforcing.

WAVES IN LONG HYDRAULIC PIPES AND TUNNELS.

The subject of surges in pipe lines is an exceedingly interesting one to the hydraulic engineer. The following contribution by Robert H. Smith appeared in a recent issue of "The Engineer," London, and will be of interest to our readers, so that we have published it in full.

During last summer the Institution of Mechanical Engineers visited the great hydro-electric works of North Switzerland. The most interesting of these is that on the Löntsch River, the supply being from the Klönthalersee, a natural lake whose storage capacity has been increased to 50 million cubic metres by the building of a dam 21 m. high. From the lake the water flows through a tunnel cut in the rock of the face of the mountain side, a distance of 4.1 kiloms., with a cross section of 4¾ square metres and a gradient of 2.17 per 1000. At the end of the tunnel there is a sort of water tower, from which the water flows through three welded steel pipes 1¼ kilom. long and of diameter varying from 1.35 to 1.2 metre, down to the power-house at 325 m. lower level.

The variation of the water taken by the turbines causes corresponding change in the flow through the tunnel. Although the linear velocity of the water is never high, the immense weight of water flowing means a huge and quite irresistible momentum, so that not only must the valves be closed and opened with great care, but it is necessary also to provide what is in effect a gigantic relief valve at the lower end of the tunnel. The above-mentioned sort of water tower serves this purpose. Rising from the end of the tunnel is a sloping shaft cut through the rock and with a small connection for its overflow to the free air at [illegible] higher level than the tunnel end. At [illegible] m. above this tunnel end is cut horizontally a long gallery which acts as a small subsidiary reservoir, into and out of which a large quantity of water can flow quickly. A second similar but larger gallery at 30 m. level above the tunnel end acts in the same way. During the deceleration of momentum in the tunnel when valves are closed, water flows up the sloping shaft and into the upper gallery, and during acceleration after the opening of the valves the extra supply to the turbines is for a time partially obtained by outflow from the lower gallery. The difference of water level between the Klönthalersee and the water in the sloping shaft is the head or driving force, which (1) overcomes frictional resistance to flow through the 4.1 kiloms. long tunnel, which resistance varies with the velocity, and (2) produces plus or minus acceleration of momentum in the water mass filling the tunnel. This head changes quickly during closing or opening of the valves owing to the filling or emptying of the galleries and sloping shaft. The result is the setting up of oscillations or waves, which continue for some time after the disturbing operation of the valves has been finished, but which are gradually damped down by the frictional resistances.

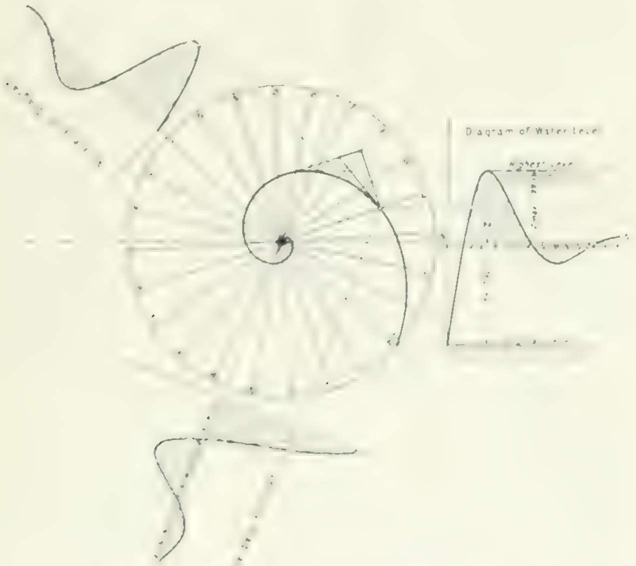


Fig. 1.—Diagram Illustrating Case 1.

Normally the lower of the two relief galleries is full, the water is level in the sloping shaft being above it. On the opening of a valve the level in the shaft sinks rapidly and the driving head increases rapidly until the level of the lower gallery is reached, when it remains practically constant for some time until this gallery is emptied—if the change in the supply goes so far as wholly to empty it. On the other hand, when valves are closed, the level being normal above the lower gallery, the level in the sloping shaft rises quickly and a quick decrease of driving head occurs until the water reaches the level of the upper gallery, when it practically remains constant, the overflow lip of the waste weir placing a limit upon this decrease of head.

All hydraulic engineers are familiar with the dangerous effects due to the acceleration and deceleration of large masses of water in long pipes. For great works like those of the Löntsch Valley it is, therefore, of great importance to arrive at a knowledge as accurate as circumstances will permit, of what occurs under conditions such as those described. Dr. Franz Prásil is the best known Swiss expert in hydraulic calculations. His excellent paper on "The Efficiency and Governing of Modern Turbines," read at the summer meeting of the Institution of Mechanical Engineers at Zürich, will be in the recollection of our readers. In Nos. 21, 23, 24 and 25 of the fifty-second volume of the Schweizer Bauzeitung, he has given a full and learned investigation of this "Water Tower Problem" of the waves or swinging motion of water in long pipes and tunnels.

It would be impossible in a single article to follow the mathematical course of Dr. Prásil's calculations, and only a small number of your readers would care to examine them so far as to judge for themselves of their correctness. It will be interesting, however, to give a brief account of their general results and of the degree of approximation to physical fact to which they pretend. Dr. Prásil starts his paper from the beginning of all things, and his first pages are devoted to arriving at the general equation for damped vibrations. We can leave this first part without further mention, because this equation is well known to electrical engineers in its relation to damped electrical oscillations. Applying it to the problem of water waves in pipes damped down by friction, and changing the letters used by Dr. Prásil to those in more familiar use by British engineers, this equation may be reduced to the following, which is its simplest general form:—

With Nomenclature.

Length of tunnel = l
Cross-section of tunnel = a
Horizontal cross-section, or water surface in water tower = A
Height of water level in water tower above water level in supply reservoir = h
Volumetric discharge of water through valves beyond water tower = q
Frictional and viscous coefficient of resistance to flow through tunnel = f
Time reckoned from beginning of disturbance due to closing or opening of valves = t
Acceleration of gravity = g

For any steady positive flow through the tunnel the head h is negative; but the wave may, and does, carry water up into the tower so as to make h positive in spite of q, the flow through the discharge valves, remaining positive, and while also the flow forwards through the tunnel remains positive. While h is positive, however, and also while it is negative up to a certain limit, deceleration takes place in the tunnel flow. During the steady flow before the disturbance commences the value of h is called h_n and the discharge flow q_n the suffix n indicating the word "normal."

The frictional resistance to the flow through the tunnel is assumed to be approximately proportional to the first power of the linear velocity, and the total head lost in the whole length of the tunnel in overcoming this resistance is taken $= f \times$ velocity. Of course, f depends upon the dimensions and the smoothness of the surface of the tunnel. For high velocities the actual resistance is more nearly proportional to the square of the velocity; but the above assumption greatly simplifies the calculation and makes only little difference in the practical result of it, while the difference is on the safe side, inasmuch as the true physical law damps down the oscillation more vigorously and more quickly than does this approximation.

It must also be mentioned that the problem is worked out on the assumption that the water surface area A remains the same at different levels in the water tower.

The fundamental general equation is:—

$$l A \frac{d^2 h}{d t^2} + g f A \frac{d h}{d t} + g a h + g f q + l \frac{d q}{d t} = 0$$

The sum of the first and last terms of this equation represent the acceleration of momentum of the mass of water in the tunnel. The sum of the second and fourth terms represents the frictional resistance. The middle term represents the driving head. Or, more definitely, these terms divided by $g a$ represent the quantities just mentioned. The first three terms are placed here consecutively in mathematical order for the variable head h; the last two in order for the variable q. These two, h and q, are the only two quantities involved which vary; and they vary independently of each other.

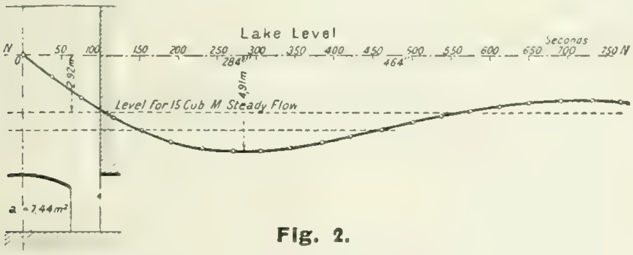


Fig. 2.

Except when the valves are wholly closed, or $q = 0$, it is not possible practically to keep q quite constant; but the first two special cases are worked out on the assumption that q does remain constant, when also the last term $l \frac{d q}{d t} = 0$. This greatly simplifies the solution and gives a very good preliminary notion of the sort of results to be expected in all cases of more complex conditions.

Before stating the results for special cases there must here be noticed what appears to the present writer to be the most serious deviation from actual physical fact embodied in Dr. Prásil's solution. This is the assumption that the whole mass of water in the whole length of the tunnel moves at each instant of time with exactly the same velocity. In a short length of pipe like that between the buckets of a reciprocating pump and its delivery air vessel, this is a very close approximation to physical fact. But in a large tunnel a couple of miles long the error is very much greater. It is so because of the air dissolved in the water. If the water contained no air it could be treated mathematically as a practically inelastic and incompressible mass; the changes of pressure would be transmitted practically instantaneously through the total length, and every part would suffer the same acceleration or deceleration at each instant of time. But under the actual changes of pressure the contained air contracts and dilates; and, in consequence of this, the changes of pressure are transmitted along the length as waves at a velocity very far from approaching "infinity" in comparison with the time period of a complete oscillation of the water velocity; and the result is that the successive periodic water velocities do not arise all along the tunnel at the same instant, but the appearance of each is retarded by an appreciable time at each place in proportion to its distance from the end where the disturbing influence has its origin. Moreover, in a long tunnel there are unavoidably many roof pockets where air gathers, and the quantity of air in each such pocket increases whenever the pressure increases, as every one knows how air is thrust out of ordinary undistilled water on any considerable pressure being applied to it. These air pockets constitute so many highly elastic cushions which must modify in no negligible degree the mathematical results based upon complete incompressibility.

Another approximation made by Dr. Prásil is to neglect the accelerations of momentum of the water in the water tower itself. It is probable that in all actual cases this is a perfectly permissible approximation having no appreciable effect upon the practical result.

Special Case I.—Dr. Prásil first solves the problem for the case of quite sudden partial closure of the discharge valves. Before the closure the water level in the water tower is h_n and the discharge flow q_n. The discharge is suddenly reduced to q, and remains at this amount during the following waves and until steady flow has been again established by frictional damping.

If 2π T (= 6.28 T) be the total period of the resulting wave—that is, the time interval between successive maximum water levels in the water tower—Dr. Prázil finds that this time is given by the equation

$$T = 2 l \sqrt{\frac{A}{g (4 a l - g f^2 A)}} .$$

It is to be noted that this time increases with the length of tunnel; that it increases with the ratio A/a of the section of the water tower to that of the tunnel; and that it is also increased by greater frictional roughness of the tunnel walls. It is to be particularly noticed that it is independent both of the previous and final flows q_n and q and also of h_n, the head previous to the closure.

After the waves produced by the sudden change of discharge have been completely damped out by the frictional resistance, the steady permanent new head of water from reservoir level to level in water tower is diminished

$$\text{from } - h_n \text{ to } - \frac{q}{q_n} . h_n .$$

The progress of the wave as expressed by the rise and fall of water level in the water tower is given by the equation

$$h = - \frac{q}{q_n} h_n + \left(1 - \frac{q}{q_n} \right) h_n \frac{a}{f A} T \frac{\sin\left(\frac{t}{T} - \beta\right)}{e^{\frac{f}{2 l} t}}$$

The second term here measures the wave motion and shows that this oscillates round the level $- \frac{q}{q_n} h_n$ to which the water in the tower quiets down. The amplitude of this wave motion is proportional to $\left(1 - \frac{q}{q_n} \right) h_n$ the difference between the original and the final head. It is also proportional to T; but as T involves f a and A it is better to consider the whole factor $\frac{a}{fA}$ T, which equals

$$\frac{2al}{f\sqrt{gA(4al - gfA)}}$$

This increases with $\frac{a}{A}$ the ratio of tunnel to tower section, increases with l the length of tunnel, and decreases as f the frictional roughness of the tunnel increases. There is a purely theoretical limit to this last decrease at dimension ratios which never occur in problems when it is useful to make these calculations. At the same limit the increase of the wave time-period with the length of tunnel would change to a decrease.

The amplitude of the wave is continuously damped down with the advance of the time t from its initiation. This gradual diminutions is measured by the division by the factor $e\,\frac{g}{2l}t$ where e is the base of natural logarithms. Dr. Prásil expresses this graphically in a diagram as the polar ordinate to a logarithmic spiral. The rate of increase of the radius of the spiral is proportional to the roughness f and inversely so to the tunnel length l.

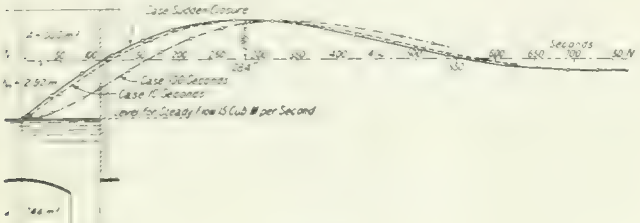


Fig. 3.

The angle β in sin $\left(\frac{t}{T} - \beta\right)$ expresses the phase of the wave motion at which it starts under the somewhat artificial assumption of instantaneous change of discharge from q_n to q. The physical meaning of β is that at time βT the water in the tower reaches, and passes above, the level to which it finally settles when the wave is completely damped out.

To calculate β the equation is

$$\sin\beta = \frac{4lgfA}{[illegible]} = \frac{f}{2al}\sqrt{gA(4al - gf^2A)},$$

and this calculation is necessary in order to find the maximum height to which the water will rise in the tower.

The maximum water level is reached at the time given by

$$[illegible]$$

[illegible]

[illegible] square metres;

[illegible]

Results:—Whole period of wave = 2π × 147 sec. = 15 min. 9 secs.

β = 41 deg. 24 min.

Time of first maximum height of wave = 6 min. 24 secs.

Height of first maximum above lake level = 1.99 m.

Depth of first minimum below lake level = 0.61 m.

Final level in water tower = level in lake.

In Fig. 1 are seen the various diagrams used to assist in and illustrate the solution of this special example.

In this example the original kinetic energy of the mass of water filling the tunnel is 4271 metre-tons. The weight of water lifted into the water tower during the rise of level to the first maximum is 2455 tons. In coming to the final level this weight does work equal to 2455 × 29.2 = 7169 metre-tons. The sum of these two quantities of energy is spent partly in lifting 2455 tons through the height 2.455 m. or 6027 metre-tons, and partly in overcoming frictional resistance to the amount of 5413 metre-tons.

Special Case II.—The second special case worked out by Dr. Prásil is that of sudden opening of the discharge valves after being wholly closed. In this case q_n = O and h_n = O. It is obvious that in consequence of inertia the flow through the tunnel will start into being gradually, and also that the discharge through the valves will increase gradually from zero. But as a first approximation Dr. Prásil works out the mathematical ploblem on the assumption that the valve discharge increases instantaneously to q and remains constant at this amount until the disturbance wave has been damped out.

The result is shown in Fig. 2. It is the precise reverse of that in special case I., it being made so by taking the final steady flow q equal to the flow corresponding to the 2.92 permanent head of water, namely, 15 cubic metres per second.

The level in the water tower sinks to the minimum level under that of the reservoirs of 4.91 m. = 2.92 + 1.99. It Galley Four—Waves In Long Hydraulic Popes And Towers subsequently rises to 2.92 — 0.61 = 2.31 m. below the same level. The following oscillations are of successively smaller range. The total time period of the wave is again 15 min. 9 sec. The angle β is again 41 deg. 24 min., corresponding to a falling passage through the final level at the time 1 min. 44 sec., the subsequent rise through the same level occurring at time 9 min. 19 sec.

Special Case III.—The third case taken is that of gradual closing of the valves so as to decrease the discharge at a uniform time rate from q_n to O in time t_c. Here

$$q = q_n\left(1 - \frac{t}{t_c}\right) \text{and} \frac{dq}{dt} = -\frac{q_n}{t_c}$$

The solution for the water level in the tower is in this case

$$\frac{h}{h_t} = \frac{1}{f}\sqrt{\frac{al}{Ag}}\,\frac{(\sin\frac{t}{T} - \beta)}{e^{[illegible]}} + t \quad [illegible]\; al - gf^2A$$

This is evidently an exactly similar solution to that given in Cases 1 and 2, except for the addition of a straight line term, namely t. Adapting the appropriate constants the same graphic construction applies, substituting an oblique straight line as the base from which to measure. Thus, if the distances along the horizontal axis in the diagram be the time t and the vertical ordinates be to a curve drawn in the same manner as in Cases 1 and 2, then the height between the curve and a straight line drawn through the origin downwards at 45 deg. will give the values of $\frac{h}{h_n}t_c$. The values of T and of β are here the same as those already given.

After the valves have completely closed the wave continues, but under changed conditions, the change being expressed mathematically by the omission from the equation of the above-mentioned straight line part, with also a change in the values of β and of the factor of the sine term. These new values depend upon the point in the above diagram, which makes the time $t = t_e$ The value of h for this point can be found algebraically from the above equation by inserting in it the value $t - t_e$.

Fig. 4 gives Dr. Prásil's diagram for the solution with the same data as taken in the illustrations of Cases 1 and 2 and for the uniform complete closure of the discharge occupying 200 sec.

He calculates the results also for complete closure in 10 sec. and in 100 sec. These three results along with Case 1 for instantaneous closure or closure in O second, form a series which well illustrate the effect of more or less rapid stoppage of the flow through the discharge valves. The more important of the practical results are brought together in the following table:—

Table of Results of Stoppage of Discharge in 0, 10, 100 and 200 Seconds.

Full flow 15 cubic metres per second.

Length of tunnel, 2.76 kilom. Section of ditto, 7.44 sq. metres.

Head from lake to water tower for full flow, 2.92 m.

Time period if wave, 15 min. 9 sec.

Full closure of valves, in sec.	0	10	100	200
Head at instant of full closure, m.	2.92	2.77	1.48	0.32
Head at lowest dip of wave, m.	0.61	0.60	0.53	0.44
Negative head at top of wave, m.	1.99	1.99	1.95	1.82
Factor of sin $\left(\frac{t}{T} - \beta\right)$ in formula for h at top of wave, m.	4.417	4.358	3.825	3.188
β deg min.	41 24	39 30	22 44	5 46

The level of the water at the top of the wave being the most important quantity, it is seen that this varies very little; it begins to decrease perceptibly only with periods of closure longer than 1½ min. In Fig. 4 the three curves for 0, 10, 100 sec. are plotted together and to the scale of the diagram the differences between them are barely measurable. Dr. Prásil therefore concludes that for practical purposes the much simpler calculation based upon the assumption of instantaneous closure, either complete or partial, is sufficiently accurate, especially as it deviates from exact physical truth in the direction of safety in the provision to be made in designing the water tower.

Dr. Prásil then proceeds to investigate the results of sudden opening almost immediately followed by sudden closure, a condition arising in the supply of electric energy to tramways of limited extent and not very frequent service so that the load curve is very peaked, and also the effects of an overflow or waste weir at the top of the water tower such as we see in the Löntsch Valley. The necessary limits of this article prevent us following him further in these analyses. He also gives a careful examination of the difference resulting from using the formula $f v^2$ instead of $f v$ for frictional resistance to water flow.

His general conclusions are as follows:—

1. If in place of a water tower the relief opening is into a reservoir of water area A, and if A/*a* be greater than about 100 *l* in kilometres then no periodic wave motion will occur on opening and closing the discharge valves, the frictional damping effect preventing this; but in ordinary practice where A/*a* is much less than this such waves will arise.

2. The maximum height of the wave is reduced very little by gradual closing of the valves below what is calculated for sudden closing.

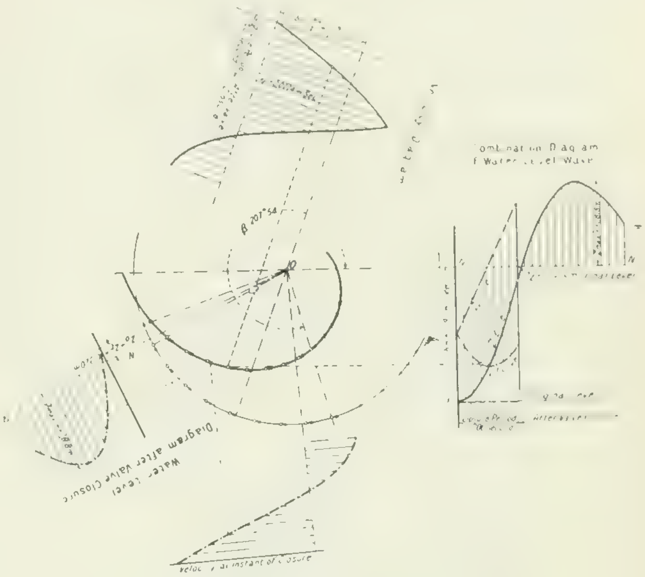


Fig. 4.—Diagram Illustrating Case III.

3. The approximate height of the wave can be calculated by help of a work balance account.

4. The maximum dip of the wave due to opening is nearly the same as the height calculated for closing the valves.

5. The theory of damped vibrations gives approximately correct results when applied to this problem.

6. In a service in which periodic variations of discharge take place the phenomenon of resonance may arise under certain conditions.

7. The maximum height of wave may be limited by the use of an overflow weir arranged at top level of the water tower.

GAS RATES IN MONTREAL.

The town of Montreal West, being the extreme western end of Westmount, which in turn is the west end of Montreal, has adopted a twenty-year contract with the Montreal Light, Heat and Power Co., for the supply of gas for lighting and heating and industrial purposes. The terms are $25 per light per annum for lighting the roads, streets, lanes and other public places, the posts to be supplied by the town and the lamps and apparatus by the company.

The rates for private lighting will be as follows per 1,000 cubic feet:

For the first five years, $1.25.
For the second five years, $1.15.
For the third five years, $1.05.
For the fourth five years, $1.00.

These quotations are net; and the company also reserves the right to charge an extra 10 cents per 1,000 cubic feet to persons who do not promptly pay their accounts. It is also provided that if the town of Montreal West is hereafter annexed to the city of Montreal, the terms given to the customers in the city shall be extended to the citizens of Montreal West, after the second term mentioned above.

It may be of interest to add that recently the company made a rate of 95 cents per 1,000 cubic feet to the citizens of the city of Montreal.

ELECTROLYSIS FROM STRAY ELECTRIC CURRENTS.*

By Albert F. Ganz, M.E.†

Electrolysis is defined as chemical decomposition by means of electric currents. Stray electric currents escaping from grounded electrical distribution systems which reach underground pipes cause destruction from electrolysis where these currents leave the pipes for the surrounding soil, because soil is an electrolytic conductor. Theory and experience show that the weight of metal destroyed by electrolysis is independent of the voltage, except in so far as this determines the amount of current produced, and that this corrosion is directly proportional to the amount of current leaving the pipe and to the time during which it leaves.

In practice the only serious sources of stray currents are single trolley direct-current electric railways. In these railways the running tracks are used as the return conductor, and for this reason they are connected to the negative bus-bar of the power station by return feeder cables. In most systems the tracks are connected to the negative bus-bar directly at the power station, and there are many systems where there are no further return feeders. The running tracks of such single trolley railways are usually in contact with ground, and since there is a drop in voltage in the rails, current leaks from the rails to flow through ground, the amount of stray current depending upon the drop in voltage in the rails and upon the resistance of the path through ground. Since electric current can only flow in a closed circuit, all current which leaks from rails and flows to ground and on underground pipes must again leave these pipes where negative return feeder cables are connected to the rails, in order to flow back to the negative terminal of the generator and so complete the electric circuit. Where these stray currents leave these underground pipes to flow to the surrounding soil electrolytic corrosion is produced, resulting in a destruction of 20 lb. of iron in one year for every ampere of current. It has been disputed whether the amount of destruction produced is always equal to the theoretical amount; a number of laboratory experiments made recently by the author under practical conditions with current densities as low as those found in practice on underground piping seem to indicate that the actual amount of destruction is always at least equal to the theoretical amount, and is often even greater than the theoretical amount.

Since stray currents flowing through ground and through underground piping are caused by potential differences between the pipes and rails set up by the drop in voltage in the rails, the simplest way to determine the probable existence of stray current on underground piping it to measure the potential differences between pipes and rails. Such measurements made throughout a system constitute the usual potential survey. These potential differences are, however, not a measure of the current flow between pipes and rails, as this is determined also by the resistance of the path through the intervening ground, and this resistance cannot be practically measured. Since the actual electrolytic danger of a pipe is determined by the amount of current flowing on the pipe, it is necessary to make current measurements at several points throughout a piping system. The amount and direction of current flow on a pipe can be determined from drop measurements between service connections, but the magnitude of the current flowing cannot be determined from such drop measurements. To determine the actual amount of current flowing a length of pipe is exposed and the drop in potential along a known length of continuous pipe is measured, and this drop is divided by an assumed resistance for the included length of pipe.

Since the positive potential of a pipe referred to rails, plus the negative potential of the pipe referred to rails, plus the drop in the pipe, is equal to the drop in the rails, the potential and current surveys enable one also to form an estimate of the drop in rails, and thus to form an idea as to the condition of the railway return circuit.

After drop and current measurements have been made at a sufficient number of points, they are conveniently plotted on a mains map, and a study of this map will indicate where current is leaving the pipes. Such points will always be found in the regions where the pipes are positive to the rails. Other points remote from the positive region will in most cases also be found where current leaves the pipes to flow to other pipes or to other underground metallic structures, or to flow to ground in cases where the negative bus-bar is grounded through low resistance ground connections. The author has found large stray currents leaving water pipes in districts where these pipes were from ten to twenty-five volts negative in potential to the trolley rails, and more than five miles away from the railway power station. At points where the current survey indicates current leaving excavations should be made and the pipe examined for evidences of electrolytic corrosion.

Besides the danger from electrolytic destruction of the pipes, stray currents where they flow on underground piping systems frequently enter buildings through service connections and produce a serious fire hazard. For example, current may flow into a building through a water service pipe, then flow from the house water piping to the house gas piping, and then out from the building through the gas service pipe. Such contacts between service pipes or between the service pipe and the lead sheathing of a telephone or a power cable frequently occur through metal ceilings, or where the pipes rest against each other. Since dangerous heating may be produced where the current flows through such contacts or where vibration may momentarily separate the contact and produce an arc, nearby inflammable material is in danger of being set on fire. The author has, in fact, found many cases where currents up to 30 amperes were flowing into and out of buildings through service pipes or lead cable sheaths. Evidences of arcing having occurred between such contacts in buildings have also been found. There is no doubt that many fires have started in this way, but it is always difficult to prove the cause of a fire because of the destruction resulting from the fire.

There is only one complete remedy for electrolysis, and that is the use of a completely insulated return circuit. Such railways may be provided with double overhead trolley wires, as used in Washington, D.C., Cincinnati and Havanna; or with an insulated outgoing and return current in underground conduits, as used on the surface lines on Manhattan Island; or with separate insulated third and fourth rails for the outgoing and return current, as is used on the Metropolitan District Railway in London. With these systems the running tracks are not used as a part of the electric circuit, and as both positive and negative sides of the circuit are insulated no stray currents are produced.

Where a road operates on a private right-of-way, the rails can often be practically insulated from ground and the escape of current from the tracks prevented. For surface roads this can sometimes be practically accomplished by placing the rails on wooden ties above ground and using broken stone for ballast and keeping the rails out of contact with ground. In the case of railway lines operating on elevated structures the rails can be fastened to wooden ties and kept out of contact with the structure. In one large elevated railway system this is done, and the running tracks, supplemented by large bare copper cables fastened to the wooden ties, are used for the return circuit. In this way the return circuit is quite thoroughly insulated from the elevated structure and from ground, thus preventing stray currents from this system.

---

* Abstract of paper read before American Waterworks Association at thirty-second annual convention, Louisville, Ky., June [illegible]

† Professor of Electrical Engineering, Stevens Institute of Technology.

A number of remedial measures intended to reduce stray currents from electric railways using the grounded rails for a return conductor have been tried. These methods may be divided into two classes, the first class aiming to remove the current harmlessly from pipes by metallic connections or bonds between the pipes and the railway return circuit, and the second aiming to minimize stray current through ground.

Since stray currents cause damage only where they leave pipes to flow to the surrounding soil, attempts are frequently made to prevent destruction from electrolysis by connecting or bonding the pipes or other structures by means of metallic conductors to the rails or to the negative return circuit, so as to remove the electric current by metallic conduction and thus prevent corrosion from electrolysis. This method can protect lead cable sheaths because they form continuous electrical conductors, but is not generally applicable to underground piping systems, because the latter do not form continuous electrical conductors, but are more or less discontinuous networks. While lead calked joints usually have a relatively low resistance, it frequently happens that they develop such high resistances as to make them practically insulating joints, due undoubtedly to the formation of oxide coatings. Cement joints and cement pipes have such a high resistance compared with iron pipes that they are practically insulating. Bonding of pipes to rails or to the negative return circuit can only afford local protection to the extent that the piping conducted forms a continuous metallic conductor, and this latter is an unknown and uncertain quantity in a piping network.

In the practical working out of a bonding or drainage system two opposing tendencies develop: first, there is a reduction in the difference of potential between pipes and rails in the positive areas, and consequent reduction of damage in those areas; and second, there is an increase of current flow on the pipes throughout the entire system, thus increasing the danger of trouble at high resistance joints or other places where two piping systems, or separate portions of the same system, are electrically discontinuous. As a rule, in the early stages of this system and especially in small networks when there are comparatively few bond connections and the resistances of the paths over the pipes are therefore relatively high, the effect is apt to be beneficial, reducing the danger in positive areas more than it increases the danger elsewhere. As the system grows and the load increases, more and heavier bonds become necessaary. The current on the pipes may finally become so great that the trouble from current shunting around joints or between separate systems will increase more rapidly than the danger in the positive areas is reduced, and any further increase in the bonding becomes an actual source of danger to the system. Since bonding transfers the trouble from the region where it was most evident to a new locality where it may require several years to manifest itself, the false impression is created that the trouble has been removed. It is due largely to this obscure and slow manner in which trouble develops that has caused this method to become quite widely used.

A number of cases have been reported where a main bonded to the negative return circuit at the power station was completely destroyed by electrolysis a block or two away because of a high resistance joint in the main, forcing current to shunt around the joint and leave the main a short distance away from the power station. In one of these cases one entire block of main had to be replaced. In another case the water main on one side of the street was bonded to the negative return circuit at the power station, and a main on the opposite side of the same street, although connected through cross-piping to the bonded main, was completely destroyed because high resistance joints had developed in the connecting pipes.

In addition, bonding pipes as a means of protection always renders the bonded structures a part of the negative return circuit, and therefore a source of danger to other underground structures which are not bonded. It has, in fact, been frequently found that where gas or water service pipes cross bonded cable sheaths, currents are induced to flow from the service pipes to the cable sheaths, and produce gradual destruction of the service pipes. In the case of one city 19 service pipes were destroyed in the course of one year directly where these pipes cross telephone ducts containing cables whose sheaths are bonded to the railway return circuit. One engineer who has studied this problem very carefully and entirely impartially has very aptly likened bonding to the drug habit, producing temporary relief at the expense of permanent and perhaps irreparable injury to the victim, which injury is, however, too rarely attributed to the true cause.

Experience shows that where there is serious trouble from electrolysis caused by large stray currents leaking from street railways, the bulk of this trouble is due to defective rail bonding, to ground connections from the negative bus-bar, and to lack of return feeders to bring current back from the rails to the power station. While stray currents can only be entirely eliminated by insulating the return circuit by the use of a double trolley, either overhead or in conduit, it is nevertheless a fact which is not generally appreciated, that where large stray currents exist, these can always be reduced to a small fraction of their present value by removing all ground connections of the negative bus-bar and installing insulated return feeders proportioned for equal drop from radially-disposed points in the track system located at some distance from the power station. By this method the rails are drained of current and any desired part of the voltage drop can be removed from the rails and transferred to insulated conductors from which currents cannot leak. In Europe such radial insulated return feeders for bringing current back from the rails to the power station are made necessary by regulations limiting the allowable drop in voltage in the rails, and in most cases such installations of insulated return feeders have substantially removed serious trouble from electrolysis.

This system of minimizing stray currents by means of radially-disposed insulated return feeders has also been installed in a number of American cities, and the method is gradually being recognized as by far the best for minimizing stray currents. This system, in fact, removes the root of the trouble by draining the rails of current and removing voltage drop from the rails and thus preventing substantial leakage of current through ground, and is therefore correct in principle. The railroad companies frequently object to this system, claiming that it is prohibitively expensive. This is certainly not the case, as is evidenced by the fact that the method is in general use in Europe and in a number of American cities to-day. The fact is that in many electric railways there is practically no installation of negative feeders and the railway companies are often not willing to install even a moderate amount of return feeder copper.

A mistake is often made in confusing the radial insulated return feeder system with paralleling the rails with copper. Of course, where the negative bus-bar is connected to the rails at the power station, and these rails are paralleled with copper feeders, the drop in the rails is reduced in the proportion that the conductivity of the return circuit is increased, but no part of the drop is actually removed from the grounded rails. The amount of copper paralleling the rails that would be required to reduce stray currents to a negligible amount would in all large systems be absolutely prohibitive. This, however, is not the case with the radial insulated return feeder system. With the latter system any desired reduction in rail drop and consequently in the amount of stray current can be secured, independent of the amount of copper installed, the amount of copper being determined by the allowable drop or power loss in the return circuit. The railway company can divide the annual charge of interest on copper invested and operating expense in any ratio within wide limits without affecting the amount of stray current produced from the system.

The pipe-owning companies suffer constant expense on account of stray railway currents in the form of repairs and depreciation of their underground structures, and in the form of liability for accidents, and this can be reduced with certainty to any desired extent, short of complete elimination, by the assumption on the part of the railway company of expense in the form of interest and power charges for its return circuit. The railway companies should in all fairness assume this expense and responsibility. If the railway companies would apply as much engineering knowledge and money to their negative circuits as they do to their positive circuits there would be but little trouble from electrolysis. The pipe-owning companies should co-operate with the railway companies by affording them access to their pipes for making necessary measurements, etc. After a railway company has installed a reasonable and fair return circuit it sometimes happens that it is desirable to eliminate any remaining current on pipes by the use of properly located insulating joints. Under these circumstances the pipe-owning companies should be willing to co-operate with the railway company in the installation of such joints.

In the decree recently filed in the celebrated Peoria case the railway company is enjoined and restrained from injuring the property of the water company by electric current escaping from the rails or structures of the railway company. No particular method for preventing escape of current is prescribed in the decree, because the court in its decision has already stated that a court does not have the power to prescribe by injunction any specific system, and that this power resides only with legislative bodies. In its decision the court, however, lays great stress upon the insulated radial return feeder system, which is spoken of as a quadrilateral system. The decree also requires the water company to co-operate with the railway company to the extent of giving the railway company access to its piping sys- [illegible] system, and of determining whether injury from electrolysis [illegible] determine whether it is complying with the terms of the [illegible]

It is evident from this decree that the expense of providing a proper return circuit for the railway system so as to minimize escape of current falls entirely upon the railway company, as it should in all fairness. One section of the [illegible]

as to prevent as much as possible the escape of stray electric currents from its system. If, after this has been done, it is found that stray currents still exist on the piping system, then the railway company may apply to the court for a hearing to determine whether the water company should be directed to permit the railway company to try a drainage system as an experiment to remove the remaining current harmlessly.

A drainage system such as contemplated as a possible final measure by the Peoria decree, when properly controlled so that only small currents are drained from the pipes, does not have the objectionable and dangerous features of promiscuous bonding where large currents are made to flow on the pipes, as often found in American cities, and may even be a safe final method where the soil conditions are favorable and where the underground structures are all continuous electrical conductors. It nevertheless seems to the author very unfair that any pipe-owning company should be compelled by a court order to permit an electric railway company to use its pipes as a return conductor for its railway system, even to the slightest extent. If the court does not have the power to compel the railway company to adopt any specific method for eliminating the danger from electrolysis, then it certainly should not impose any specific method upon the pipe-owning companies. The latter may, for example, prefer to remove any small remaining stray currents by means of properly located insulating joints.

It is the author's firm conviction that such remedial measures as pipe drainage or insulating pipe joints should be used, if at all, only as a final measure and never until the return circuit of the railway has been improved so that only small amounts of stray current remain on the underground structures. This view appears to be entirely in accord with the Peoria decision, and is certainly in accord with the best engineering practice.

* * *

BRITISH COLUMBIA'S LUMBER INDUSTRY.

In the lumber industry trade is somewhat brisk, and conditions are healthy. Local demand is better, and orders are increasing in quantity from east of the mountains. For several months past, the output of logs in the coast camps has been almost fifty per cent. higher than for the same periods of last year, in May, for instance, the cut being 65,000,000, as against 45,000,000 a year ago. Yet there is no great surplus on hand. Prices are firm but loggers are looking forward to an advance. The coast mills are all busy, though in the interior activity is hardly average. Manufacturers there decided last winter not to cut extensively this year, preferring to wait until such times that so much lumber was not imported from the United States. Only about two-thirds of the mills are operating, though if the privy council upholds the decision of Mr. Justice Cassels, that lumber sawn twice must pay duty. There will be a distinct diminution in the importations from the western states. On the other hand, many of the mills east of the mountains are preparing to operate double shifts.

Activity is best shown by the new mills. The Empire Lumber Company, which will develop limits at Cowichan Lake, Vancouver Island, has a capital of $7,500,000, New York people being mostly interested, and are getting ready for business. The capital of the Canadian United Lumber Company is $4,000,000, and the operations planned are on a more extensive scale, this company has taken over three mills in the Kamloops district, and will erect two more in the same section, one at Coquitlam and two on Vancouver Island. Mr. Robert Marr has started a new mill near Princeton. The South Vancouver Lumber Company has a new establishment just east of Eburne, on the Fraser.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director

T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."
Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.
Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.
London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, JULY 4, 1912. No. 1

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
A Bridge for Vancouver Island 120
The Canadian Engineer in Montreal 119
The International Roads Congress of 1913 119
Consulting Engineers Wanted 120
The New Commissioner of the Dominion Railway Board 120

Leading Articles:

Description of Reinforced Concrete Arch over Current River, Port Arthur, Ont. 100
Administration of the Highway Improvement Vote in Saskatchewan. 106
Floor Area Unit as a Basis for Estimating Water Consumption 108
Tests for Car Heaters 110
Waves in Long Hydraulic Pipes and Tunnels 112
Electrolysis from Stray Electric Currents 116
A Safety Device for Protecting Lock Gates 121
The Electric Furnace as a Means of Producing Improved Steel 122
Outlook for Railroad Earnings 123
A Well-Planned Concrete Plant 125
Ice Troubles at Buffalo 126
New Garbage Incineration Plant 128

Engineers' Library 130
Personal 133
Coming Meetings 134
Engineering Societies 134
Market Conditions 24-26
Construction News 67
Railway Orders 74

"THE CANADIAN ENGINEER" IN MONTREAL.

In pursuance of the policy of *The Canadian Engineer* to strengthen still further its position in all parts of Canada, a larger and more convenient Montreal office of this journal has been opened at Rooms 617 and 628, Transportation Building, in that city. The importance of Montreal in the engineering and contracting life of Canada cannot be overestimated. Our realization of that fact prompts the present provision of greater service by this journal to Montreal interests. Mr. T. C. Allum, well known throughout the city, will continue as editorial representative, and will, as heretofore, keep our readers in the closest touch with all important developments. A file of *The Canadian Engineer* has been provided for the use of citizens and visitors, who are also invited to make every reasonable use of this branch office.

Special arrangements have also been made for the convenience of those who desire to consult plans and specifications of projected work throughout Canada. The new telephone number is Main 8436.

THE INTERNATIONAL ROADS CONGRESS OF 1913.

We noted in a recent issue that the third International Roads Congress would be held in London, England, in June, 1913. The first was held in Paris, 1908, and the second in Brussels, 1910, and in the future the Congresses will be held triennially. The object of the Congress is to collect, discuss and circulate all the latest scientific knowledge with regard to the construction and maintenance of highways. Mr. W. Rees Jeffreys, the secretary of the Road Board of Great Britain, a Government body which is responsible for the building and maintenance of roads in conjunction with local authority, is now in Canada as the representative of the International Roads Congress to arouse interest in next year's meeting. His aim is to secure as large and as representative an attendance from Canada as possible. Already over thirty governments have intimated to the British Minister of Foreign Affairs their intention of taking part officially in the Congress. In an address to the Ontario Motor League directorate Mr. Jeffreys laid emphasis on the waste of money resulting from slipshod methods of road construction, and we agree with him, for the present deplorable state of many of our roads throughout Canada are due primarily to the lack of judgment in putting down the right class of road for the traffic conditions. A great impetus would be given to interurban motor traffic if roads which could be used by heavy carrying trucks were built. It would in a measure solve the present railway traffic congestion.

There is little question but that a good deal of education must be given and public interest aroused before conditions can be improved here. The sentiment of the Provincial Government of Ontario towards the good roads question is shown by their recent action in refusing to meet the vote of the city of Toronto with a grant of $30,000 towards putting down a class of pavement more fitted for the traffic conditions on the roads leading into Toronto. It is to be regretted that an opportunity like the above should have been turned down by the provincial authorities. It shows very clearly that meetings like the International Roads Congress are most useful in spreading a knowledge of the resulting benefits from proper road facilities. We are pleased to note that the Dominion Government has appointed the Hon. Frank Cochrane as their representative to the Roads Congress for 1913. We sincerely hope that this action will be followed by the several provincial authorities throughout the Dominion, and we believe that results would justify the appointment of delegates from the different county road boards and the cities and towns throughout the country.

CONSULTING ENGINEERS WANTED.

We note in the daily press the following advertisement: "Applications from consulting engineers will be received by the Advisory Industrial Committee of the Toronto Board of Education to instal the power, mechanical equipment, heating, ventilating, illuminating, plumbing, and other appliances in connection with the new Technical School of Toronto. Applications to be addressed to the Secretary-treasurer, Board of Education, City Hall, and to be sent not later than July 2nd, 1912."

The mental capacity of the Toronto Board of Education is exhibited very well by the above. They are accustomed to call for tenders for the material used in the construction of the buildings, so naturally they call for tenders for the engineering knowledge necessary to design and equip the new Technical School. All that is needed to complete the above advertisement is the statement: "The lowest tenderer not necessarily accepted." It would be natural to expect that should one of the Board desire expert medical services he would insert an advertisement, stating the nature of the trouble, and asking for applicants for the position of medical consultant. Or if a lawyer were needed for certain legal advice, naturally the Board, or its individual members, would turn to the publicity of the daily press, and, by soliciting competition between members of the profession, secure the needed advice and the lowest possible market figure for the same.

No doubt applications will be received in answer to the above; and the Board, exercising their accustomed business acumen, will choose the tenderer whose price looks reasonable to them. The city, however, will eventually pay, and pay well, for such methods. The consulting engineers in Canada who take on the class of work outlined in the advertisement are not very large in number, and, by enquiry, in a very short time the Board could have secured reliable information regarding the securing of a competent man. As long, however, as they proceed in the way they have done, the city can expect to pay the difference between expert engineering advice secured in a proper manner and plumber's experience obtained on the "lowest tender" principle, and the difference will be found on examination to be considerable.

THE NEW COMMISSIONER OF THE DOMINION RAILWAY BOARD.

Official announcement has been made that the Government has appointed Henry L. Drayton, K.C., of Toronto, as chief commissioner of the Dominion Railway Board, to fill the vacancy created by the death of the late Judge Mabee. This appointment will receive the unanimous approval of those interested in a capable and efficient Railway Board. It is well known that the efficiency of the Board depends almost altogether on the personality of its chairman. Mr. Drayton, as corporation counsel for Toronto, has succeeded in his [illegible] way in the fight for a square deal for the city with the different corporations, and it is for his ability as a [illegible] [illegible] there that he has been chosen for the chief commissionership. The Dominion Government has made no mistake in choosing Mr. Drayton, for we feel sure his judicial fairness, his executive ability, and his strong personality will make him no mean successor to the late Judge Mabee.

A BRIDGE FOR VANCOUVER ISLAND.

A British Columbia delegation has just waited on the Dominion Government to urge Federal aid for the proposed construction of a bridge to connect Vancouver Island with the mainland at Seymour Narrows on Butte Inlet. The Department of Public Works in the near future will undertake a survey of the situation to determine the feasibility and probable cost of the undertaking. It is understood that a previous survey was made about forty years ago by Sir Sanford Fleming, who at that time estimated the cost of bridging the Narrows at $18,000,000. The delegation informed the Government that they believed with modern methods of construction the bridge could now be built for about $15,000,000. They urged the Government to undertake the work in order that Vancouver Island might have railway connection with Eastern Canada. It was further pointed out that no single transcontinental line could undertake a work of such magnitude alone, and that, therefore, the Federal Government should build one bridge available for all three transcontinental lines, charging a rental to each road on a mileage basis.

There is little question that, should the Government feel justified in committing itself to the project, it would mean a tremendous impetus to the development of Vancouver Island. The immense and now comparatively undeveloped resources there would immediately become capable of development. The engineering features of such a bridge from the point of view of design and construction would be of great interest if the Government decide to finance the work.

EDITORIAL COMMENT.

In last week's issue we published an article, entitled "Longest Reinforced Concrete Arch Bridge in the World." Unfortunately we omitted placing the author's name in the text. Mr. V. Elmont, of Westmount, Que., very kindly compiled the article for us, and we are glad to make this correction here.

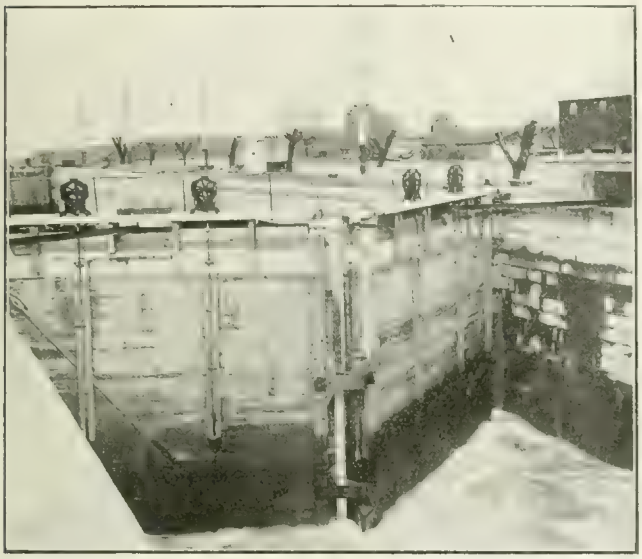
We note considerable criticism in the daily press concerning the expenditure of the highway improvement vote in Saskatchewan. Statements are being made to the effect that the appropriation is being used for political purposes. No doubt much of this talk is of a pre-election nature. At the same time it is to be hoped that the Government will deal fairly with this money, for they have a magnificent opportunity to illustrate the benefit to be derived in the building of bridges and good roads for the opening up of the country.

* * *

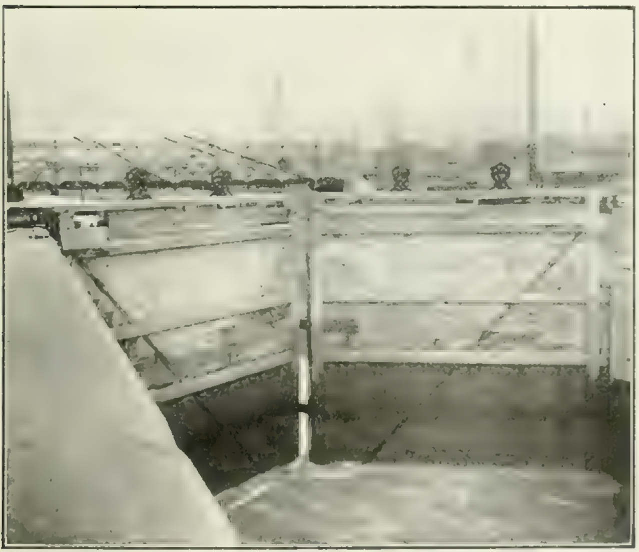
Toronto is at last awaking to the necessity for placing overhead electric wires underground. The Board of Control has arranged a conference with Premier Borden pending an application to the Dominion Railway Board, to compel all Dominion companies having overhead wires in the down-town section placed underground. We doubt very much whether any other city in Canada is in as bad condition from overhead wires as Toronto, and it is high time that definite action was taken for the removal of these wires. Montreal has done a great deal during the past two years to improve conditions there, and the extraordinary growth of Toronto justifies immediate action.

A SAFETY DEVICE FOR PROTECTING LOCK GATES.

The problem of protecting canal lock gates from possible injury from vessels is most important. A device which has been used very successfully on the Welland Canal is the Gowan safety device. It might be explained that miter gates in a lock consist of two leaves or wings, one hinged on either lock wall, which, when closed, rest against a sill on the bottom of the lock and against each other along the miter joint. When the pressure of water is against these leaves their safety depends on the miter joint being held intact. In case of a vessel coming up-stream and striking one of these leaves, as shown in the sketch, it forces this leaf back a short distance; and with the ordinary miter joint, the moment this leaf is forced back the support for the opposite leaf which rested against it is removed and the pressure of water upsets it. The pressure of water now forces the first leaf (and the vessel) down stream, and it also upsets.



Front View of Gates, Showing Cowan Safety Device.

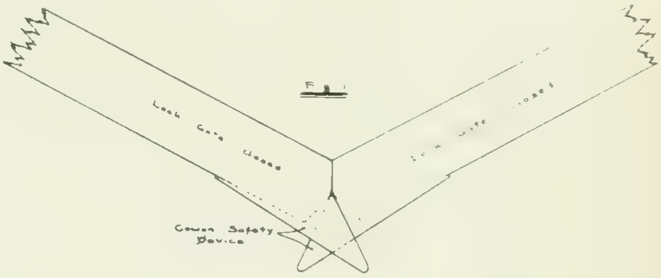


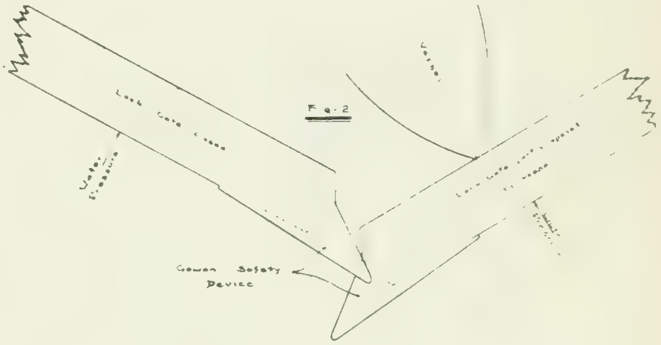
Rear View of Gates, Showing Cowan Safety Device.

The Gowan safety device, as applied to the existing gates on the Welland Canal, consists of four very strong cast steel fingers, two on each leaf, one towards the top of the leaf and the other towards the bottom. These fingers project a couple of feet beyond the miter, and, as will be seen from the sketch and photograph, one leaf can be pushed back very nearly the full length of the finger, but still give support to the opposite leaf.

Vessels rarely hit the lock gates with any great speed, and it is anticipated that this device will prevent a large majority of accidents which would otherwise occur.

The fingers are placed on the leaves, as shown, those on one leaf fitting in between those on the opposite leaf. This will prevent one leaf from jumping off its pivot when the other one is struck, as usually happens, the upward water pressure on the bottom of the gate being sufficient to lift it.





We are indebted to Mr. J. L. Weller, engineer-in-charge of the Welland Canal, for the above information, and for the use of the sketch and photographs. It might be added that it was through Mr. Weller's efforts that the safety device has been installed there..

* * *

ELECTRICITY vs. STEAM FOR WATER PUMPING.

Some interesting figures are shown by a comparison of the cost of pumping water by electricity and steam in the city of Woodstock, Ont. A short time ago the pumping facilities were changed so as to employ the power furnished by the hydro-electric commission.

In January, 1911, there was pumped by steam 46,494,000 gallons of water with the use of 145 tons of coal at a cost of $3.15 per ton. In January, 1912, there was pumped 40,400,000 gallons. The coal used in this month was 18 tons for heating purposes only. In February, 1911, the amount of water pumped was 43,484,000 gallons with 136 tons of coal, as against 38,000,000 gallons in February this year. In March the record shows 48,524,000 gallons last year with 151 tons of coal, and 40,000,000 gallons for March this year. The water is pumped against a head of about 100 pounds pressure.

The actual figures for the electrical operation have not as yet been computed, but it is estimated that the cost will be reduced by about $2,000.00 per year.

Woodstock pays $29.16 per horse-power, including a charge of $3.16 for stepping down expense.

THE ELECTRIC FURNACE AS A MEANS OF PRODUCING IMPROVED STEEL.*

By W. R. Walker.†

In the manufacture of steel by either the Bessemer or open-hearth process, it is very difficult to remove the last traces of oxygen. In the basic Bessemer process the overblown metal, which is an extreme case of oxidation, contains only [illegible] per cent. oxygen. Oxygen in combination with carbon (carbon monoxide), silicon, iron, aluminum and manganese, and also the combinations of silicates with these oxides, are very deleterious in steel.

My investigations lead me to believe that in the manufacture of steel for the so-called heavy products and steel that is produced in large quantities, a combination of either the acid or basic Bessemer converter and the electric furnace will take a very prominent place. With this combination it is possible to produce steel extremely low in oxygen and other impurities at a cost that will not be prohibitive.

At the present time there are over seventy electric furnaces of various types producing electric steel in Europe and America. These range in capacity from 1 to 15 tons. There is now under construction in Germany a furnace of 25 tons capacity. A number of these furnaces are competing successfully with crucibles in the manufacture of very high grade steel.

Generally speaking, electric furnaces may be divided into two groups: (1) Induction furnaces, in which the heat is supplied by a current induced in the bath; (2) arc furnaces, in which the arc is struck either between an electrode and the metal in the bath, or between two or more electrodes so as to heat the metal only by radiation from the arc.

In operating the electric furnace at the present time the most prominent methods or combinations are as follows:—

(1) Oxidation of silicon, carbon and manganese in an acid-lined Bessemer converter and removing the phosphorus in the basic-lined electric furnace with an oxidizing slag and then recarburizing, and with the aid of manganese and carbon and a new reducing slag removing oxygen and sulphur and dead melting as in the crucible process.

(2) Removal of silicon, carbon, manganese and phosphorous in a basic-lined Bessemer converter, and further removing phosphorus (if desired) in the basic-lined electric furnace with an oxidizing slag, and then with the aid of manganese and carbon and a new reducing slag removing oxygen and sulphur and dead melting as in the crucible process.

(3) Removal of silicon, carbon, manganese and phosphorus in the basic open-hearth furnace and then recarburizing, and in the basic-lined electric furnace with the aid of manganese and carbon and a new reducing slag removing oxygen and sulphur and dead melting as in the crucible process.

(4) Melting of cold scrap of inferior quality in a basic-lined electric furnace; removing phosphorus with an oxidizing slag and then recarburizing, and with the aid of manganese and carbon and with a new reducing slag removing oxygen and sulphur and dead melting as in the crucible process.

(5) Melting high-grade materials in the electric furnace and dead melting as in the crucible process.

The phosphorus is removed in the basic electric furnace in the same manner as in the basic open-hearth furnace—that is, by the use of lime and oxide of iron—and the resulting slag containing the phosphorus is removed and a new slag formed consisting of burnt lime and fluor spar; when the slag is melted, coke dust is added, which, coming in contact with the lime in the slag and the electric arc, produces carbide of calcium. The free carbon, and possibly the carbide of calcium in the slag, with the aid of carbon and manganese in the bath, eliminate the oxygen from the steel.

As compared with the Bessemer and basic open-hearth process, the electric has the following advantages: (1) The more complete removal of oxygen; (2) the absence of oxides caused by the additions, such as silicon, manganese, etc.; (3) the production of electric-steel ingots of eight tons in weight and smaller that are practically free from segregation; (4) reduction of sulphur to 0.005 per cent., if desired; (5) reduction of phosphorus to 0.005 per cent., as in the basic open-hearth process, but with the complete removal of oxygen.

As evidence of the reducing properties of the slag in the basic electric furnace, it has been found that if oxide of manganese and oxide of iron are thrown on the molten slag, the oxides are reduced to the metallic state and the reduced metal goes into the bath. Blown metal from the acid Bessemer converter, containing only 0.10 per cent. to 0.20 per cent. manganese, has been completely deoxidized in the electric furnace without addition of manganese or aluminum, the usual amount of silicon being added in the steel ladle. Rails made from this steel are now in service. The composition of one heat of this steel is as follows:—

	Per cent.
Carbon	0.55
Manganese	0.13
Sulphur	0.017
Silicon	0.19
Phosphorus	0.022

These rails are comparatively soft, but are showing superior wearing qualities compared with the Bessemer rails in the same track and under the same service conditions.

Electric-steel ingots crack much less in rolling than either Bessemer or basic open-hearth steel. Cold electric-steel ingots, when heated and rolled into rails, roll extremely well.

At the present time there are approximately 5,000 tons of standard electric-steel rails in service in the United States. These rails have been in the track about two years. During the past winter some of these rails have been subjected to very low temperatures—in some cases as low as —52° F., and are being exposed to all possible conditions of severe service. It is too early to state much about the wearing qualities of these rails, but from present indications it would appear that rails made by the basic electric process can be made somewhat softer than by either the Bessemer or basic open-hearth process and still show highly satisfactory wearing qualities. Up to the present time we have not heard of any basic electric rails in use in this country being broken in service.

For experimental purposes I have had made a small tonnage of electric-steel rails, which have varied in analysis as follows:—

	Per cent.
Carbon	0.50 to 0.75
Manganese	0.15 to 0.80
Silicon	0.10 to 0.40
Phosphorus	0.02 to 0.06

On account of the wide variation in the chemical composition of this steel, it would be difficult, without going into considerable detail, to discuss the physical properties of these rails. It might be stated, however, that electric steel of a given tensile strength has a slightly greater amount of elongation than basic open-hearth steel, and that electric steel is somewhat denser than basic open-hearth or Bessemer steel.

---

*[illegible] American Iron and Steel Institute.

†Assistant to the President, United States Steel Corporation, New York City.

With the electric furnace it is possible to produce steel which, when magnified one thousand diameters, shows no oxides or slag enclosures.

As high-grade electric steel can be produced at a lower cost than crucible steel, there has been a gradual increase in the production of electric steel for certain purposes where crucible steel was formerly employed, and where it has been demonstrated electric steel can be successfully used. This increased production has not been so marked where the object has been the improvement of steel entering into products manufactured in large quantities where the expense involved for experimental work is very great, and where of necessity it takes several years to demonstrate if rails and other products made by the electric process are superior to those made by either the Bessemer or open-hearth process. From present indications it would seem probable that there will be a decided increase in the production of electric steel for these products in the near future.

DISCUSSION.*

Three years ago the 15-ton, basic-lined Heroult furnace erected at the South Chicago works of the Illinois Steel Co. made its first heat. It was then the largest electric furnace in existence, and as yet none of greater capacity has been put into actual operation, although there are a few 20 to 25-ton furnaces under construction in Europe.

Our purpose was to demonstrate whether it was feasible to successfully operate a large electric furnace and make electric steel in large tonnages. At the time the South Chicago furnace was started the electric furnaces used in the manufacture of steel here and abroad were small, running from a ton or less to five tons in capacity. The aim abroad was largely to find a process cheaper than the crucible. Our aim was to command a superior steel, and, if possible, at a cost that would permit of its use in such products as rails.

Our mechanical, metallurgical and other problems proved many, and our experience soon demonstrated that the conditions surrounding the successful operation of a large electric furnace were in many respects entirely different from those involved in the use of smaller units. For example, the demands of a 15-ton electric furnace proved to be far in advance of the art of manufacturing electrodes. Our necessities represented a requirement that the electrode manufacturers of America and Europe had not been called upon to meet, and it took much time and money before there was finally secured the 20-in. round amorphous carbon electrode now being used.

While in the application of the electric furnace to the metallurgy of steel there is usually embodied the preliminary removal of impurities by oxidation, the thermal and chemical conditions that obtain are unusually favorable to the final purification of the metal. Although it has proved perfectly feasible to make steel of superior quality from even low-grade cold material, the usual practice at South Chicago is to refine in the electric furnace full-blown metal from the Bessemer converter.

While the electric furnace at South Chicago has probably operated on a greater variety of products than any other furnace in the world, especial attention has been given to the production of electric steel for rails. The results have been most promising.

The steel, in teeming, lies much more quietly than is ordinarily the case with open-hearth or Bessemer. The ingots when split show a very solid metal, with a remarkable freedom from blowholes. The pipe, unless filled, is as deep as with openhearth or bessemer steel. Segregation is at a minimum, and the steel is exceptionally homogeneous. Chemically speaking, almost any result within reasonable limits can be obtained. Physically, the metal is more dense than either openhearth or bessemer. In its ultimate strength and elongation for the same carbon, there is but little difference between electric and openhearth steel in the higher carbons. In the lower carbons, electric steel has a tendency to a higher tensile strength and a possibly somewhat lower elongation.

Many etched sections of rails indicate that the steel from the electric furnace is peculiarly uniform in structure, and it appears to be exceptionally free from oxide and slag inclosures as partially determined by microscopic examination. In fact, such superiority as electric steel may have, probably largely lies in its relative freedom from oxygen.

How much there may be in the theory advanced by some that the characteristics of electric steel are partially due to the influence of the peculiar thermal conditions upon its molecular structure, I cannot say. Certain indications, however, point to there being more in this hypothesis than is generally recognized.

We have, thus far, received no report of any breakage from the 5,600 tons of standard rails that we have shipped. Some of these rails have been in track for two and a half years or more. Some of the first rails that we produced were intentionally made upon the soft side, running as low as 0.55 per cent. in carbon. Our later electric rails, of which the laboratory results would indicate a relatively better wearing quality, have been made ten or more points higher in carbon.

On account of the comparatively short time that the electric rail has been in service, any statement in respect to its comparative quality is open to question. Of course, the final verdict on the merits of any steel must be in that metallurgical court of last resort—result in service. But whatever may be the verdict, American steel practice and the public must be the gainers from the extensive work that has been done in the endeavor to produce, through the electric furnace, a rail of superior quality.

---

* By T. W. Robinson, Vice-President Illinois Steel Co., South Chicago, Ill.

OUTLOOK FOR RAILROAD EARNINGS.

By H. M. P. Eckardt.

The gross revenues of the Canadian Pacific Railway for March, 1912, were $10,389,000, as compared with $8,648,000 in March, 1911, and $7,667,000 in March, 1910. The increase in 1912 over 1911 therefore amounts to $1,741,000, or over 20 per cent., and the March, 1912, figures represent an increase of 35½ per cent. over March, 1910. Canadian Northern's traffic for March, 1912, was $1,572,700, representing an increase of $302,100, or about 20 per cent., over 1911, and an increase of $638,700, or about 68½ per cent., over 1910. Taking these two Western roads together, their gross earnings in the month just ended amounted to $11,961,000, which figure represents a gain of $2,043,000, or 20 per cent. over 1911, and a gain of 39 per cent. over 1910.

As the Grand Trunk earnings for March exceeded $4,000,000, the gross traffic receipts of the three systems amounted to about $16,000,000. These receipts are all passed through the bank accounts of the companies. So their average daily deposit with the banks in March would approximate $700,000, taking no account of interest on their investments and other income distinct from the freight and passenger receipts. With especial reference to the Western roads it is difficult to see how they can do other than continue to report satisfactory increases during the remainder of the calendar year. In an interview in The Monetary Times on August 6th, the Winnipeg manager of the Canadian Bank of Commerce says, "Everything points to the coming year as being the best we have ever had. * * * Speaking of prosperity, we need only consider the thousands of immigrants who are to enter Canada from both the Old Country and from across the border to realize that it would hardly be possible for anything but a successful year to follow."

There is no doubt that this remark applies with especial force to the business of the railways operating in Western Canada. It might almost be said that the immigration movement alone promises to ensure an eminently successful year for the railways.

Thus, taking the movement from the British Isles, it is well known that the Canadian Pacific and Canadian Northern steamships will derive a large revenue from the ship loads of European immigrants which they discharge at Halifax, St. John, and Montreal. There is not only the passage money across the ocean, but the passage money for the long land journey from the seaports to the Western points. In the case of the movement of American farmers the direct and immediate benefit experienced by our railways is more pronounced. For these settlers bring with them horses, cattle, implements, and effects by the train load. So with a promised movement of 400,000 or 500,000 new settlers into Canada in 1912, it would appear that prosperity for the railways was reasonably assured.

One may get some idea as to how these newcomers benefit the transportation companies by supposing that all of them settled in new towns or cities by themselves. An immigration movement of 400,000 would suffice to create 40 new cities of 10,000 population, or one immense city the size of Montreal. when one considers what an immense amount of freight has to be moved annually in order to supply Montreal's needs it becomes clear that the 1912 newcomers will minister most importantly to the prosperity of the railways.

A good farmer with a sufficient working capital will, with his family, create far more traffic for the railways than will the average family settling in a city. The farmer and his family create more traffic as consumers as well as producers. But, fortunately, one does not have to look solely to the immigration movement for indications of prosperity. Another thing which should help the Dominion is the revival of industry and trade in the United States. Depression has been more or less in evidence across the boundary line for a considerable time; and now there are signs of decided improvement. When the United States are prosperous Canada always derives considerable benefit.

Another auspicious development is the ending of Britain's labor troubles. It will be a little while before the real significance of this event is appreciated. But there is no doubt that the labor leaders saw distinctly that persistence [illegible] to paralyze the trade of the country was fast [illegible]. This with the almost complete exhaustion of many labor unions' funds seems to point [illegible] important labor troubles. At any rate, British finance is now rising hopefully and confidently from the depression in which it has been in-[illegible]. And [illegible] presume that sound Canadian enterprises would receive a better welcome in London.

Our borrowings in London also minister importantly to [illegible] of the Canadian railways. For the [illegible] imports of merchandise of one [illegible] there is the Western [illegible]. Last year 10,000,000 acres were seeded to wheat in the three prairie provinces. Whether this area is increased or not depends largely on the climatic conditions prevailing in the spring months. Fall plowing was interfered with late in 1911 by unfavorable weather; and the farmers are said to have entered the spring season handicapped on that account.

On the other hand there are this year 20,000 more farmers at work in these provinces. Some of them are farming on a big scale. Whatever may be the fortunes of the crop it will probably create much traffic for the railways—before and after it is harvested. Finally, the transportation of construction materials required for new mileage now under way promises to bulk importantly in the accounts of the railways. These and other considerations doubtless have played their part in creating and strengthening the optimism with which the securities of the representative railways are now viewed.

THE PUBLIC HIGHWAYS ACT OF SASKATCHEWAN.

The following is an abstract of the Public Highways Act of Saskatchewan, passed on March 15th, 1912.

There shall be expended annually under the provisions of this Act such sums as may be determined upon from time to time by the Lieutenant-Governor-in-Council, but not exceeding in the aggregate the amount voted by the Legislative Assembly for the purpose.

For the purpose of carrying out the provisions of this Act there shall be a board to be styled "the board of highway commissioners" consisting of three members to be appointed by the Lieutenant-Governor-in-Council, one of whom shall be appointed as chairman; the said commissioners shall receive such remuneration and perform such duties in addition to the duties assigned to them by this Act as may be determined by the Lieutenant-Governor-in-Council.

There shall be associated with the board for advisory purposes a committee consisting of two members to be appointed annually, one by the executive of the provincial organization representing rural municipalities and the other by the executive of the provincial organization representing urban municipalities. The members of this committee shall receive for attendance at meetings at which they are requested to be present by the chairman of the board such per diem allowance and travelling expenses as may be fixed by the Lieutenant-Governor-in-Council.

It shall be the duty of the board and it shall have power:

To lay out, plan and determine upon a system of public highways for the province which system may from time to time be altered or modified as the board may determine;

To determine upon the most feasible and economic methods for constructing, improving and maintaining public highways;

To furnish the officers of municipalities with information respecting the construction, improvement and maintenance of public highways;

To appoint such engineers, inspectors and officers as are necessary for the proper carrying out of the duties of the board and the provisions of this Act. All such appointees shall receive such remuneration as shall be determined by the Lieutenant-Governor-in-Council.

To inquire into and to report from time to time to the minister upon such matters as he may direct;

To report annually to the minister upon all work done and moneys expended under their direction as provided by this Act.

Subject to the approval of the minister the board may expend such sums of money as it may deem advisable upon the construction or improvement of any public highway and may also enter into any contract or agreement with any person, company or municipality for the construction or improvement of any such highway; the minister shall before approving of any such expenditure, contract or agreement, require the board to furnish him with such plans, specifications, estimates and other information as he may deem necessary respecting the proposed work.

For the purpose of the better carrying out of the provisions of this section the Lieutenant-Governor-in-Council may from time to time make such general regulations as may be deemed advisable regarding the expenditures to be made by the board on public highways.

All the provisions of The Public Works Act concerning the entering upon and the expropriation of lands required for public works shall apply to any works carried on or proposed to be carried on by or under the direction of the board and for the purposes of the said entry and expropriation the board shall have all the powers conferred upon the minister by the said Act.

The minister shall submit annually to the Legislative Assembly within the first fifteen days of the session thereof a report containing a statement of the work done and the money expended under the provisions of this Act.

The Lieutenant-Governor-in-Council shall have power to make any provision not inconsistent with this Act which may be required for the better carrying out of its provisions.

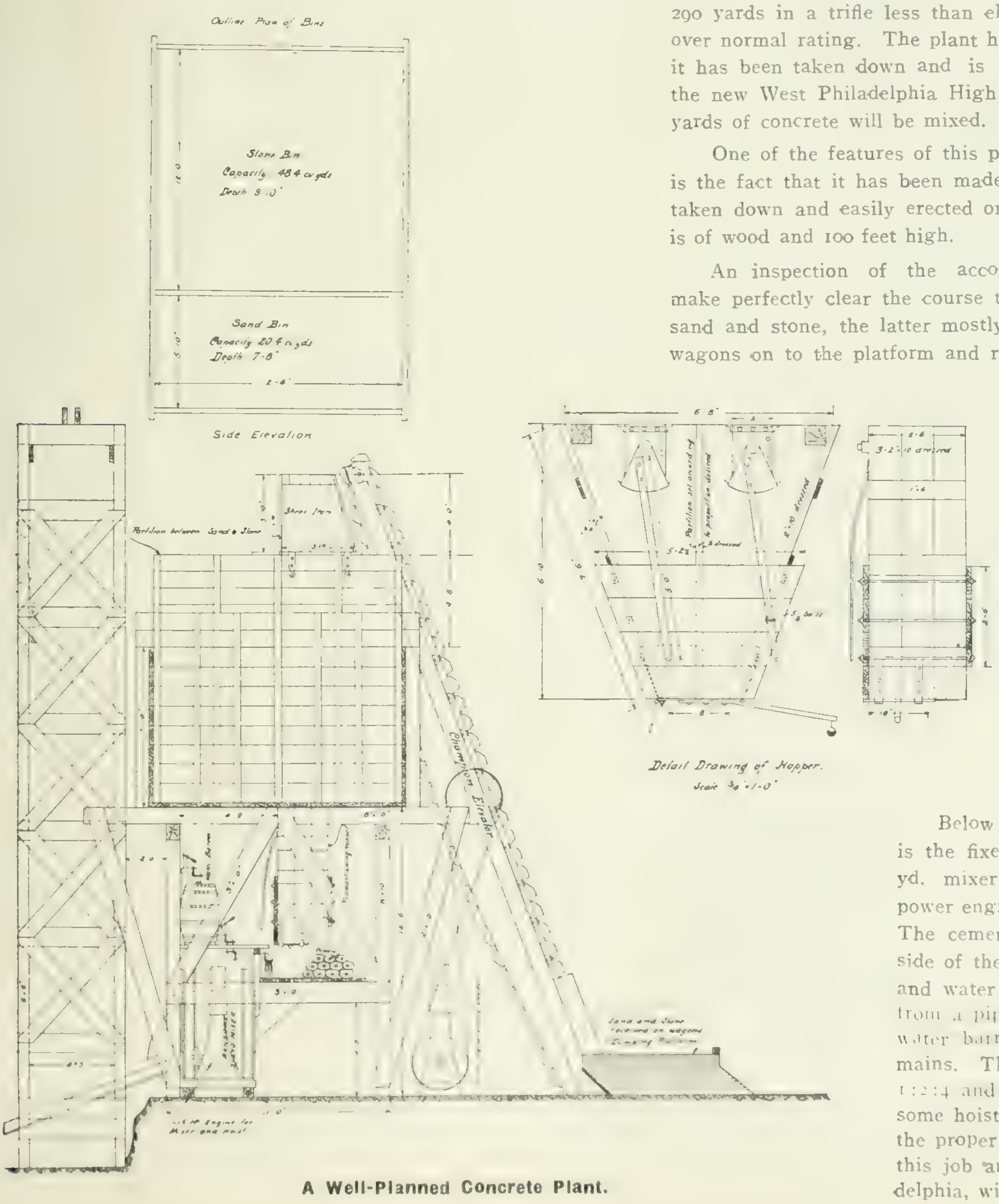
A WELL-PLANNED CONCRETE PLANT.

A plant lay-out which would be very suitable for buildings where about 10,000 cubic yards of concrete are to be placed is that which was employed in building the American Can Company's new reinforced concrete factory, located on Beach and Palmer Streets, Philadelphia. This building is five stories high with basement, and has over-all dimensions of 346 by 100 feet. The ¾-yard Ransome mixer has turned out 9,200 yards of concrete for this work, at times mixing 290 yards in a trifle less than eleven hours or 25 per cent. over normal rating. The plant has been so satisfactory that it has been taken down and is being used in constructing the new West Philadelphia High School, where about 8,000 yards of concrete will be mixed.

One of the features of this plant outside of its economy is the fact that it has been made so simple that it can be taken down and easily erected on another job. The tower is of wood and 100 feet high.

An inspection of the accompanying illustration will make perfectly clear the course the materials follow. The sand and stone, the latter mostly ¾-in., are dumped from wagons on to the platform and raised by a bucket elevator, driven by a 10-horse-power engine, to the sand and stone bins at the top. The stone bin has a capacity of about 48 yards, while the sand bin holds about 20 yards. From this point the aggregate fall by gravity into a proportioning hopper being admitted through gates. The hopper is provided with a partition that can be set according to proportion desired.

Below the proportioning hopper is the fixed batch hopper of the ¾-yd. mixer operated by a 15-horse-power engine that runs the hoist also. The cement is piled in bags alongside of the top of the mixer's hopper and water is turned into the latter from a pipe leading from a marked water barrel connected to the city mains. The concrete is proportioned 1:2:4 and is discharged into a Ransome hoist bucket that is unloaded at the proper point. The contractors on this job are Cramp & Co., of Philadelphia, with F. V. Warren in charge.



A Well-Planned Concrete Plant.

ICE TROUBLES AT BUFFALO.*

By Henry L. Lyon.†

The city of Buffalo takes its water supply from Niagara River and Lake Erie and pumps it direct into the city mains. The source of supply is unlimited, it is only a question of being able to get it to the consumers on time. The reservoir holds 116,000,000 gal., but is not at a sufficient elevation to supply more than half the city and would not supply that part satisfactorily for more than a few hours. The daily average consumption of the city is 135,000,000 gal. and at times it runs up to 200,000,000 gal. The reservoir on the low service and the water tower on the high service act as balance wheels in regulating pressure.

The old intake pier is situated about the middle of Niagara River and 1,000 ft. from the pumping station, which is situated on the bank of the river. The intake is built in the narrowest part of the river about 1 mile from the foot of Lake Erie. The current is from 7 to 15 miles per hour. The pier is connected to the suction canals, or wells, in the station by two tunnels under the river. One is 6 ft. in diameter, the other 6 x 12 ft. in cross section. The ports to admit the water are about 4 ft. above the bottom of the river and on both sides of the pier. The river at this point is 16 ft. deep, the bottom being a smooth limestone rock, with scattered boulders. On the sides of the pier are ice shields of steel (see Engineering Record, April 1, 1899) extending to 2 ft. above the bottom of the river, so that the water must come under the shields from the bottom of the river, not the surface; on the sides of the shields are gates that can be opened and closed so it is possible to take the surface water if ice closes the lower levels.

When ice is running down the river the current turns it over and over and churns it up, forcing large quantities to the lower levels so that the river is a floating mass of ice for its whole depth. When the lake becomes frozen over a certain phase of the ice trouble is over for the winter and does not reappear until the break-up in the spring.

The location of the pier, however, with a swift running river for a mile above so it cannot freeze over, makes an ideal situation for frazil, anchor, ground, and slush ice.

The swift current prevents a surface ice forming. The frozen ice surface in the lake protects the water underneath, as the cold air will penetrate water better than ice. When the water flows from under the lake ice the colder air will cause frazil and anchor ice to form. A heavy snowstorm will not melt readily when it falls into the cold water, but becomes waterlogged and forms slush.

The terms "surface ice," "anchor ice," "ground ice," "frazil ice," "pebble ice," "slush ice," are somewhat indefinite. In a great many cases it is impossible to tell the several kinds of ice apart after they have changed their original position or formation and become broken up and mixed. They then become [illegible] ice.

Surface ice is the form generally found on the surface of lakes and ponds, when their surface is frozen over. It forms first on the surface, as the cold air penetrates the ice and cools the water directly under the surface ice to a lower degree. It makes new ice, attaches to the upper ice and thus increases the thickness of the ice.

Anchor, or ground ice, will only form in a running stream on a clear, cold night, the air temperature being very near or below zero. It never forms under surface ice or in cloudy weather. It forms near the bottom of the river and attaches itself to rocks or other hard substances, preferably a dark substance. It loosens itself from the substance to which it is attached when the sun rises or the weather moderates. It is very buoyant and if stones or other things are imbedded in it will raise them and float them down stream. It has been known to raise and float abandoned anchors so they could be recovered by the owner or pirates. Small boats should look out for such conditions, because at times anchor ice rises in large masses and has been known to overturn such boats.

Frazil ice is only formed in swift running streams, where surface ice cannot form and then only in very cold weather. It forms best on a dark, windy day, or a clear, cold, windy night, when the wind is blowing against the currents. It consists of fine crystals sometimes very hard, and floats readily. When it, as well as anchor ice, is forced under surface ice and attaches to it and to its own particles, it will often fill up the whole bed of the stream and cause floods.

Anchor ice forms on the ports of the intake pier, so as to completely close them. The small particles seem to rise out of the water, like bubbles out of champagne, and attach to the sides of the openings, then to each other in lightning rapidity, until the whole opening is closed and cannot be broken by pike-poles. We then resort to small charges of dynamite.

Runs of ice of all the varieties, sometimes separately, more often all of them mixed into slush, get into the intake, pass down through the shafts and tunnels and then into the suction canals, or wells, in such quantities as to clog the pumps. At times the mixture is so solid that water will not pass through it to the pumps, and the pumps must be stopped entirely. If the ice is formed at a very low temperature, it is very difficult to melt.

At Buffalo there are revolving screens in the canals with which large bodies of the ice may be raised above the water and then melted with hot water and steam. At times there will be a hundred or more men dipping the mixture on to shelves or racks in the wells, above the water, with long-handled scoops, like minnow nets, but made of heavy wire, and then melting it with hot water and steam.

Niagara River for its full length, 35 to 40 miles, is too swift for surface ice to form, so that anchor and frazil ice form readily. It is this ice mostly that runs over Niagara Falls in such quantities that it banks up below the falls and forms each winter the ice bridge which becomes so solid that people walk over the river just a short distance from the falls. It was this same kind of ice that dammed up the mouth of the river and caused the big floods there a few years ago. The same kind of ice has caused the floods at Montreal in the middle of winter when there had been no rains or any warm weather to melt the snow, but the floating anchor and frazil ice had been carried under the surface ice in such quantities as to completely fill the bed of the St. Lawrence River and thus formed a dam over which the whole of the Great Lakes must flow.

The new intake pier at Buffalo is built at the head of the river and foot of Lake Erie in water 24 ft. in depth. The current at this point is only about 2 miles per hour. The lake freezes over up to and around the pier. It is believed that in the present location anchor and frazil ice cannot form; the surface ice will form only 15 in. in thickness and ice troubles are probably a thing of the past.

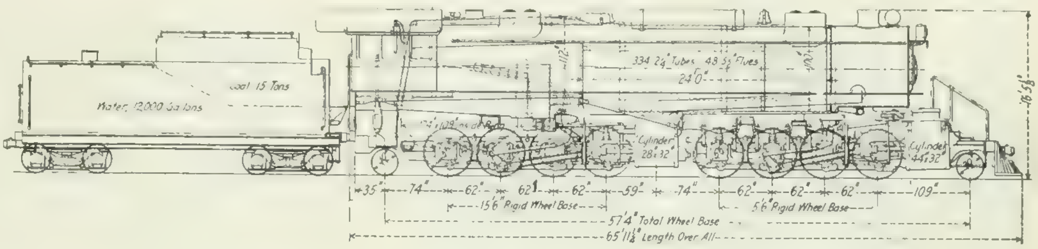
---

*Abstract of paper read before American Waterworks Association at thirty-second annual convention, Louisville, Ky., June 3-8, 1912.

†Deputy Water Commissioner, Buffalo, N.Y.

A NEW LOCOMOTIVE.

The American Locomotive Company is just completing for the Virginian Railway four Mallet compound locomotives that far outclass in weight and power even the largest of the most recently constructed big locomotives. The engine will weigh, in working order, 540,000, with 479,200 lbs. on drivers. The combined weight of the engine and tender will be 752,000 lbs. The total length of the engine over all is 65 feet 11¼ inches, and total length of wheel base, 57 feet 4 inches. These engines will have a tractive power of 115,000 lbs. or 60 per cent. more than the pioneer of this type built in America for the Baltimore and Ohio Railroad. By the American Locomotive Company's system of compounding, the tractive power at slow speeds can be further increased to 138,000 pounds by working the engine simple.



With two of these Mallets as helpers and a Mallet of 92,000 lbs. tractive power as a road engine, it is expected to take a train of 4,230 tons over a 14 mile, 2.07% grade. This grade is the ruling point on the entire line as all the tonnage passes over it. The road engine will then take the train unaided through to the terminal of the division.

Vanadium steel was used in the frames, crossheads, driving tires, all springs, main driving axles, main crank pins, centre of piston heads. Cast iron containing vanadium was used for cylinder castings, valve chamber bushings, piston bull rings.

Apart from the enormous weight and power of the locomotives, the dimensions of some of the principal parts are impressive as showing the extent to which all limits were exceeded in their design and construction. The following dimensions warrant special attention:

Outside diameter of boiler at front end	100″
Outside diameter of largest ring	112″
Tubes, number and diameter	344; 2¼″
Flues, number and diameter	48; 5½″
Heating surface, total	6760 sq. ft.
Superheating surface	1310 sq. ft.
Fire box ring	184½″ x 119″
Length of boiler	50′ 1⅛″
Low pressure cylinders, diameter and stroke	44″ x 32″
High pressure cylinders, diameter and stroke	28″ x 32″
Tender, water capacity	12,000 gal.
Tender, coal capacity	15 tons

◆

PURIFICATION BY COPPER SULPHATE.

In a paper before the Institution of Water Engineers of Great Britain, on the "Use of Copper Sulphate in Purifying Water Supplies," Mr. George Embrey described the measures taken for destroying plant-growth in the Witcombe reservoirs of the Gloucester Waterworks.

He said that his attention was directed to the reports of experiments made by the United States Department of Agriculture with copper sulphate, and in 1904 and 1905 numerous investigations were made to determine the amount which could be used for the destruction of the lower forms of plant life without destroying the fish or rendering the water toxic to human beings. It was found that quantities of 1 to 1,000,000 fulfilled these conditions, but quantities of 1 to 3,000,000 were sufficient to destroy the Algæ which were believed to cause the trouble. In 1908 permission was given by the Sanitary Committee to carry out an experiment at Witcombe reservoirs, which were at the time choked with "Chara Vulgaris." This plant was propagated by means of spores contained in an Archegonium, and fertilized by Antheridia from an Antheridium; the bursting of the Archegonium set free myriads of minute greenish cells, which, with the countless Anthrozoids, gave the water a distinct color and a fishy odor. In consequence of this odor it had been suggested that the particular Chara was a new species named Chara Fœtida, but the author did not find that the plant differed in any material respect from the well-known Chara Vulgaris, except in regard to the odor. This, however, was removed by washing the plants, and an examination of the washing water revealed the presence of numerous Spongilla Fluviatalis, which gave out a distinctly fishy odor. A portion of these was used to inoculate a nutrient agar medium, which, on incubation, yielded Proteus Vulgaris, an organism well known to evolve a fishy odor. The author therefore believed that this was the cause of the odor.

The author's method of applying the copper sulphate differed from that usually adopted, which was to place the crystals in a canvas bag trailed at the stern of a moving boat. The defect of this method was that the copper sulphate solution was very much diluted before it reached the bottom of the reservoir. This, however, was overcome by scattering the fine crystals over the surface of the water, as in sowing seed, the crystals falling rapidly to the bottom before dissolving. The sulphate was used in the form of a fine powder containing 98 per cent. of the salt, the present price of which was 28s. per cwt. The three reservoirs had capacities, when filled, of 60,000,000 gallons (No. 1) and 30,000,000 gallons each (Nos. 2 and 3), and for these 4 cwt. of sulphate was used, giving approximately a proportion of 1 to 3,000,000. Each reservoir was allowed to stand at least three days, and if convenient, a week, at the end of which period not a trace of sulphate of copper could be found in the water. The water should be treated in the early spring (about February), when the bottom was usually covered with diatoms only; in March and April the confervæ made their appearance, and later the Chara began to grow. It had been found that if the treatment was applied in the early stages the diatoms were destroyed, and neither the confervæ nor the Chara appeared.

After four year's experience the author could confidently say that the odor and color so frequently met with in reservoirs containing water collected from the Upper Lias and Inferior Oolite could be perfectly removed by the use of sulphate of copper, and that no danger need be feared if the operation were performed with care and under proper supervision.

◆

ALBANY'S TYPHOID DEATH RATE.

Albany's typhoid death rate in 1911, as reported by the Bureau of Water, was 15.8 per 100,000 population. The city is supplied with Hudson River water purified by sedimentation, double filtration and hypochlorite.

NEW GARBAGE INCINERATION PLANT.

The extensive plant shown in the accompanying illustrations is a garbage and refuse destructor erected in the city of St. Petersburg, Russia, by Messrs. Heenan & Froude, Ltd.,

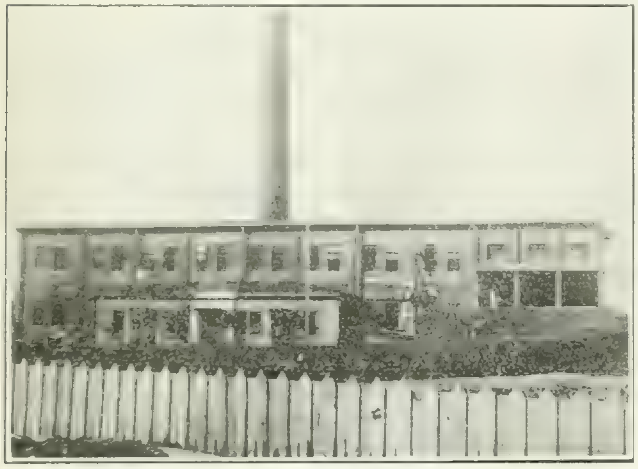


Fig. 1.—General View of Heenan & Froude Garbage Incineration Plant for St. Petersburg, Russia.

of Manchester, the parent company of Heenan & Froude of Canada, Limited, who are erecting somewhat similar plants for the same purpose in Ottawa, Moose Jaw, Calgary and Edmonton. The plant is designed to consume 150 tons per day

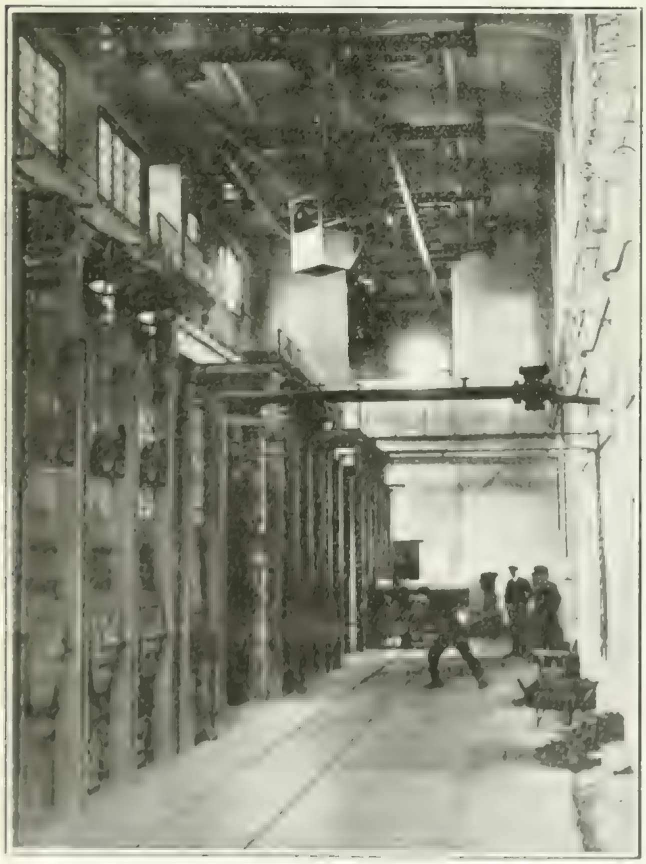


Fig. 2.—View of Clinkering Floor Showing Method of Withdrawing Clinker.

[illegible] of the furnace with a clinker truck opposite one of the grates in the rear of the room. A man is engaged turning a winch on this truck, which withdraws the whole of the clinker from the cell in one operation. As the illustration shows, this is easily performed by one man instead of requiring the laborious efforts of two or three as in the old style of clinkering.

The material to be consumed is charged into the furnace by means of a container opening into the top of the cell. These containers are shown in illustration No. 3. They are filled with material, the upper door is closed, and a door opening direct into the furnace is withdrawn by means of a winch operated from the clinker floor, and the contents are promptly precipitated into the furnace.

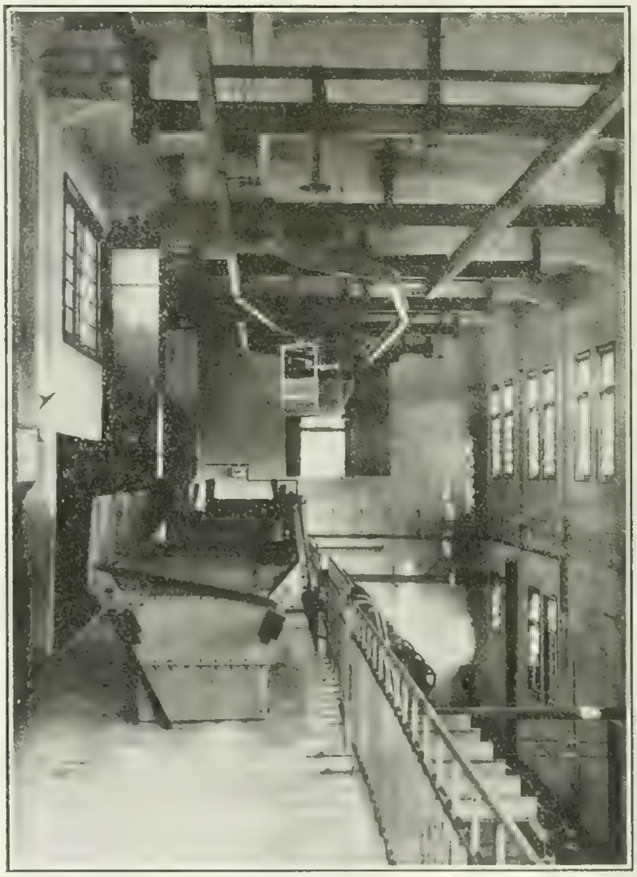
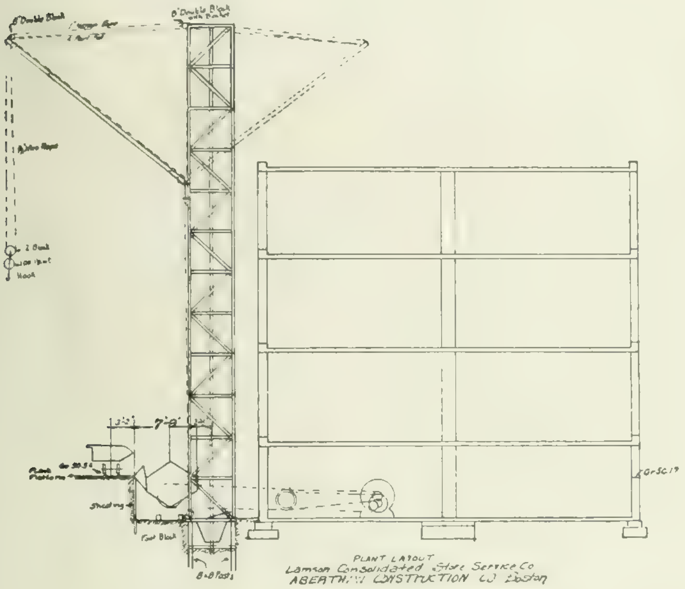


Fig. 3.—Charging Floor Showing Top of Containers from Which Refuse is Charged.

◆

THE CONCRETE PLANT OF A FOUR-STORY MACHINE SHOP JOB.

During the course of last winter the Aberthaw Construction Company, of Boston, erected a four-story reinforced concrete machine shop at Lowell, Mass., for the Lamson Consolidated Store Service Co. This reinforced concrete building is 150 by 50 feet in plan and has brick curtain walls. The general policy of the contractors is to heat both the sand and stone in freezing weather. However, on this only the sand was heated, as the owners who provided the heat has not sufficient steam capacity to heat the stone also. The stone was received in cars, and while the car was on the siding precautions were taken to keep snow out of it by canvas covering. The sand was delivered in wagons and dumped directly onto steam pipes laid on the ground and furnished with a continuous supply of steam during the day time only at about 12 lbs. pressure. To supplement this the contractors used flexible rubber steam hose and iron pipes which were thrust into the sand heaps in specific places where there was reason to doubt the temperature of the sand. The water was heated by having a steam-pipe reaching to the bottom of the water barrel, and salt was added generally in the proportion of about 2 per cent. of weight to the amount of the cement used, the percentage being varied slightly as the temperature changed.



After examining the ground it was decided to place the mixer and hoisting tower at the north side of the building and to omit the building of one bay at the west end of the ground floor, so as to allow industrial cars with the coarse aggregate to be pushed through at the proper grade. Quick unloading chutes, extending from the side of the standard gauge cars were used, the material being dumped into a square-bodied dump car.

After being mixed the concrete was dumped into the Aberthaw hoisting bucket which is standard with this concern in all their construction work. The Aberthaw iron hoisting tower was used with the boom, moving the steel and centering to the upper floors. The distributing of the concrete was done with V-shaped Koppell cars, the length of carriage from the mixer to the point where it was placed on the job in question averaging less than 100 feet. The method of distribution with cars, which take an entire four-bag batch at one time, is very much more conservative in retaining the heat in the mass than when concrete is distributed in barrows. It should be added that salamanders were used after placing the concrete in each floor and the building enclosed in canvas floor by floor. The building was designed by Lockwood, Greene & Co., Boston.

* * *

BRITISH COLUMBIA'S RAILWAYS.

Sir Richard McBride estimates the amount to be spent in railway construction in British Columbia during the next four years at $100,000,000 and expresses the opinion that the expenditure will in all probability be over that amount. Mention of the figures brings one to a realization of what is being done and what is contemplated by the different railway companies that are anxious to do business on the Pacific seaboard. Activity is not confined to any one road, but to all of the four which already have lines in British Columbia, namely, the Canadian Pacific Railway, the Great Northern, The Canadian Northern and the Grand Trunk Pacific, and also the Pacific Great Eastern, which is reckoned practically as the Grand Trunk Pacific. Work was begun this week on the large pier of the Canadian Pacific Railway which will cost three-quarters of a million dollars, and excavation is proceeding on the site of the new depot. The Canadian Pacific Railway will expend more in British Columbia during the next few years than for many years past. The Great Northern will double track its lines between Vancouver and New Westminster.

Mayor Findlay's proposition is that the city prepare to take over the lines of the British Columbia Electric Railway Company within the city, according to the terms of the existing agreement, in 1918. The members of the greater Vancouver transportation committee interviewed the premier this week, and mayor Findlay made his pronouncement upon his return. "Since the company will not compromise in any way in the matter of consolidation of agreements the city said he should decide upon a fixed policy to acquire the lines by arbitration at the termination of the agreement with the city." This suggestion was made in the city council last year, and the proposal that passed then was that the city set aside $500,000 each year so that it would have something to start with in 1918. The uncompromising attitude of the railway company is winning many to the principle of municipal ownership of this great public utility. More would be in favor of the acquisition of the lines but for the reason that they believe, that some other method of transportation will have been evolved by that time, and that the people will not be dependent on a company that has a monopoly of transportation in whole of the lower portion of southwest British Columbia.

Vancouver has not had to trouble about its water supply, since there was plenty for every kind of use. Now that the city has grown, regulations are being enforced which people, accustomed to what prevailed previously, regard somewhat as a hardship. Residents in the outlying districts are sometimes practically devoid of water during the middle of the day, when it is required most. A large fire took place in South Vancouver this week and the supply of water there was insufficient. Such a condition will mean high insurance rates. The necessity of more water is presenting itself, a large watershed area in Seymour Creek Valley, above the city's reservoir might be secured and thus ensure the permanence and continuity of the supply. There is considerable timber on this area, and the owners have approached the British Columbia Electric Railway Company to construct a line to take the timber off. It is conceded that if this is done the water supply will be materially affected. Last fall the water committee took up the matter of purchase of these lands, comprising several thousand acres, and it was almost decided. The aldermen realize that the purchase must be made sooner or later. Half a million dollars or less will secure the whole of the watershed, timber, land and all, while if the city waits a few years longer double this amount will be required for the same purpose. The acquisition of this watershed has been recommended by the city engineer, the consulting waterworks engineers, in fact by all who have to do officially with the waterworks system.

One hears much of American enterprize and American aggressiveness but few companies have progressed so rapidly and expanded so widely as the Norton Griffiths Steel Construction Company, with British capital and Britishers conducting it. This concern has had the contracts for some of the largest and best buildings in the city, including the famous Burns block, and secured this week the contract for the construction of the new ten-story structure to be erected by Henry Birks and Sons at the corner of Granville and Georgia streets. The operation of a large company like this means the investment of considerable Old Country capital here.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

The Design of Mine Structures. By Milo S. Ketchum. Published by the McGraw, Hill Book Co., New York. Cloth: size 6½ x 9 inches; 544 pages; 77 tables; 300 illustrations in the text, and eight folding plates. Price $4.00.

It is a pleasure to record the publication of another book by Prof. Ketchum. His books are always examples of what technical treatises should be, and this volume is no exception to the rule. The design of mine structures is systematically discussed. While the design of headworks for mines is given the principal place, the design of buildings, bins, coal-washers and breakers is discussed very fully. Only the structural engineering side of the operation of mines has been considered and, therefore, the design of hoists and other machinery has been omitted. Statically indeterminate structures are briefly discussed, showing the application of the methods developed to the calculation of stresses in head frames. The methods for the calculation of stresses in simple frame structures and the methods for calculating the pressures on retaining walls and the stresses in bins are briefly discussed. Complete specifications are given for steel, timber and concrete mining structures. A brief resumé of the design of reinforced concrete is given in an appendix. While a good deal of the material appearing in this volume has appeared before in the author's other books, nevertheless the repetition has been justified. This volume is a self-contained, concise and valuable text book for the student, or the structural engineer who wishes to become familiar with the design of mine structures.

Reinforced Concrete Construction. Elementary course. By M. T. Cannell. Published by E. and F. N. Spon. 125 pages. Price $1.25.

This is a small book which has been gotten out primarily for those engaged in reinforced concrete design, who have a limited technical knowledge. A few pages are given to the construction of form work and the mixing and placing of concrete, also the nature of the ingredients. Several pages which are devoted to structural mechanics give bending moments, shears, abutment reactions, simple and continuous beams with various methods of loading. The design of reinforced simple beams, slabs, tee beams and columns are also taken up.

The book is another case of endeavoring to cover too great a subject in a small space, but it will be found useful for draughtsmen and superintendents unfamiliar with theory.

The Principles of Structural Mechanics. By Percy J. Waldram. Published by B. T. Batsford, London. [illegible] pages. Price [illegible].

This book is gotten out primarily to fill a long-felt want, namely, for a treatise on structural mechanics, which is not over-burdened with mathematics, also one that can be understood by engineers or architects with a limited technical [illegible].

The first part of the book deals with the theory of levers, and [illegible] beams, explaining the method of determining forces by graphical methods. A section is devoted to beams and cantilevers, giving various conditions of loading with methods of determining bending moments, reactions and shears. Another portion of the book is devoted to design of walls and foundations. Roofs of several different types are taken up, as are also arches, domes and columns. Material on beams is such as is available in almost any of the hand books, whereas there are very few books, with the exception of advance treatises, in which one finds as much about arches and domes as is contained in this book. For engineers engaged in design of various structures, especially arches, domes and special roofs, in which it is not necessary to go into advance theory, this book will be very useful.

The Heat Treatment of Tool Steel. By Harry Brearly. Published by Longmans, Green Co., London, England. 160 pages; 5½ x 8½; well illustrated. Price $2.50.

Of late there has been a great deal written on the heat treatment of tool steel. The main trouble in dealing with such a subject is to make one's information of practical value, but, unfortunately, as in many other departments, of engineering, those who are well informed practically, are either too busy or have no inclination to put into print what they know.

This book, written by a practical man, contains a great deal of well-written practical information. The theory of hardening and tempering has been well worked into the subject which, to say the least, is a relief to anyone at all accustomed to reading the tiresome learned discussions that appear from time to time. The illustrations also are excellent.

There are thirteen chapters in all, covering structure, fractures, forging and annealing tool steel, hardening and tempering, defective tools, hardening plants, pyrometers, case hardening, and a short discussion of alloy steels.

Anyone interested in the subject of tool steel should have this book.

Measurement of High Temperatures. Burgess & Le Chotelier. John Wiley & Sons, New York. Cloth; 510 pages; 6 x 9¼; illustrated. Price $4.00 net.

In the present day, the practical man has come to realize that the old methods of "judging temperature" are absolutely out of date, more so as the pyrometer has been brought to such a stage of perfection that anyone possessed of ordinary intelligence can operate it. This book has evidently been written largely with the object of helping engineers. The information has been very clearly put together, so much so that the book may be read by student, engineer or scientific investigator, and all three find his needs, the illustrations being very well suited to making the text clear.

The first three chapters deal respectively with standard scales of temperatures, gas pyrometry, and calorimetric pyrometry. Chapter IV. on thermoelectric pyrometers, is very complete. Next comes a description of electrical resistance pyrometers, following a thorough discussion of the laws of radiation. The radiation pyrometers are described, as are pyrometers in the next chapter.

The department of recording pyrometry, in which a great advance has been made of recent years, is very thoroughly gone into. This portion of the book, besides being of value to the student engaged in scientific research, is of interest to the practical man. One of the instances given where the value of having these instruments in works is that of an annealing oven fired by an old and new hand, the record showing how the more experienced hand saves time and money.

A final chapter treats of the standardization of pyrometers, etc. The bibliography of 24 pages is very extensive. The authors are to be congratulated upon the conciseness of their explanations, the long theories being well isoalted in such a manner as to give no trouble to the reader not interested in "such dry information." The book, in fact, "gives results."

The Transit Theodolite, and Other Instruments Mechanically Considered. By H. W. Vallé. Published by the author. Cloth; 4 x 6½ inches; 76 pages; illustrated. Price $1.00.

Mr. Vallé was for twenty-three years instrument maker to different firms in England, and is, therefore, well-qualified to write on the subject of instruments. This little volume has been written for the purpose of assisting surveyors, engineers and others in those difficulties associated with their instruments where help has not hitherto been forthcoming. The adjustments of the different instruments are covered very thoroughly and their general design is thoroughly discussed.

Engineering Directory, 1912. Published by the Crawford Publishing, Chicago, Ill. Cloth; size 4 x 6¾ inches; 1496 pages. Price $5.00.

The book aims to be a complete directory of the plumbing, heating, lighting, power plant and mill supply industries in the United States. It contains a list of wholesale dealers in plumbing, heating and lighting supplies; list of jobbers and dealers in mill, steam, mine and railway supplies, tools and machinery and in addition there are reliable mailing lists of waterworks and gas companies power plants, wholesale dealers in hardware and in electrical supplies and purchasing agents of railroads. The book will be found invaluable to the manufacturer and the engineer.

Modern Illumination Theory and Practice. By H. C. Horstmann and Victor H. Tousley. Published by Frederick J. Drake & Co. Leather; 4½ x 7 inches; 265 pages; illustrated. Price $2.00.

This volume is intended as a hand-book of practical information for the users of electric light, architects, contractors and electricians. Only as much of the theory is given as is needed for a comprehension of the underlying principles. Emphasis is placed upon the practical points which must be considered in the laying out of illumination.

Farm Gas Engines. By H. R. Brate. Published by The Gas Engine Publishing Co., Cincinnati, Ohio. Cloth; 5 x 7 inches; 190 pages; illustrated. Price $1.00.

This is a practical treatise on the action of the parts necessary to the successful running of a gas engine and is intended for the non-technical man. Chapters are given on carburation, compression, ignition, lubrication and cooling, and descriptions are included of the different types of gas engines in common use.

Problems in Engineering. First series. Edited by Sydney G. Turner. Published by St. Bride's Press, Limited, London. Cloth; size 5 x 7½ inches; 186 pages; illustrated. Price $1.25.

This is a compilation of the questions and answers printed from the assistants' and students' section of the the "Surveyor and Municipal and County Engineer," of London. The present volume is published in response to requests from readers of this section. The series of questions and answers will be found of assistance in the solution of many knotty points which arise in the daily work of the municipal engineer, for the series cover practically every phase of the municipal engineers' work.

PUBLICATIONS RECEIVED.

American Waterworks Association. Proceedings for 1911 of the Thirty-first Annual Convention, held at Rochester, N.Y., June 9-10, 1911. Secretary-treasurer, John M. Diven, 47 State Street, Troy N.Y.

Association of Dominion Land Surveyors. The annual report, together with the papers read at the sixth annual meeting, held at Ottawa, on the 5th and 6th of March, 1912. Secretary-treasurer, E. M. Dennis, B.L.S., Ottawa.

Canal Statistics for the Season of Navigation, 1911. Issued by the Department of Railways and Canals. A. W. Campbell, Deputy Minister, Ottawa.

Memoir No. 28, Department of Mines, Geological Surveys Branch, The Geology of Steep Rock Lake, Ontario, by Andrew C. Lawson, and Notes on Fossils from Lime Stone at Steep Rock Lake, Ont., by Charles D. Walcott. R. W Brock, Director.

An Investigation of the Coals of Canada, With Reference to Their Economic Qualities, as Conducted in McGill University, Montreal, under the authority of the Dominion Government. In six volumes, Vol. 2 by J. B. Porter and R. J. Durley, issued by the Department of Mines, Mines Branch. Eugene Haanel, Director.

Commission of Conservation, Canada, 1912. The third annual report of the annual meeting held at Ottawa, January 16, 1912. James White, Secretary.

Illinois Water Supply Association. Proceedings of the fourth meeting held at the University of Illinois, March 5-6, 1912. Published by the society, Urbana-Champaign, Illinois.

Association for Standardizing Paving Specifications. The proceedings of the third meeting held at New Orleans, January 8-13, 1912. John B. Hittell, secretary-treasurer, 5917 Winthrop Avenue, Chicago.

The Test of Clay Refractories with Special Reference to Their Load-Carrying Capacity at Furnace Temperatures. By A. V. Bleininger and G. H. Brown, being No. 7 of the Technologic papers of the Bureau of Standards, Department of Commerce and Labor, U.S. S. W. Stratton, director, Washington.

The White River Development. A description of the construction of the Power Plant and system of Lakes at Puget Sound. Copyright, 1912, by Stone & Webster Engineering Corporation, Boston, Mass.

Electric Power from the Mississippi River. Being Bulletin No. 5, March, 1912, of the Mississippi River Power Co., Keokuk, Iowa.

Vitrified Brick Pavements. The National Paving Brick Manufacturing Association, Engineers' Building, Cleveland, Ohio, forward pamphlet illustrating the use of vitrified brick pavements for city streets and country highways.

CATALOGUES RECEIVED.

Circular 1155, entitled Series Arc Light Systems with Westinghouse-Cooper Hewitt Rectifiers, has just been issued by the Westinghouse Electric and Manufacturing Company. This publication deals very thoroughly with series arc light systems, describing in detail the rectifier apparatus, the arc lamps, and shows a number of views of detailed parts of the apparatus together with installations of same.

Descriptive Leaflet 2499, issued by the Westinghouse Electric and Manufacturing Company, describes their type Q M direct-current commutating pole motor for driving air compressors, pumps, and large blowers. These motors are particularly adapted for this class of service on account of the excellent commutation and the long life of the brushes and commutators. A special feature is the ventilation, as air can reach every part of the machine. The leaflet describes and illustrates the various component parts of the machine.

Descriptive Leaflet 2497, issued by the Westinghouse Electric and Manufacturing Company, covers the Westinghouse underwriter's motors, which have been completed and built in accordance with the specifications and requirements of the Chicago Local Board of Fire Underwriters. This motor has a blower attached to the outer end of the shaft for ventilation and will operate continuously at rated load and voltage with a temperature rise not exceeding 40 degrees centigrade. Its particular application is driving fire pumps and sprinkler systems in buildings.

Milling and Gear Cutters. Weir and Napier, engineers, 58 West Regent Street, Glasgow, forward catalogue illustrating milling and gear cutters, twist drills and splitting saws, in carbon or high speed steel. The firm desire agents in all the leading cities of Canada to represent their various lines.

Specialties for Marine Work. W. H. Allen, Son & Co., Limited, Bedford, England, forward catalogue illustrating different types of centrifugal pumps, electrical generating machinery, oil engines, steam turbines, etc. A. L. Melville, resident engineer, 69 Victoria Street, Toronto.

Industrial Railway System. The C. W. Hunt Company, West New Brighton, N.Y., forward folder illustrating different applications of the Hunt Industrial Railway System.

Concrete Machinery. The London Concrete Machinery Co., of London, Canada, forward catalogue illustrating different types of concrete mixers, concrete block machines and moulds, and the different concrete machinery manufactured by them.

Electrical Fixtures and Shades. A new supply catalogue issued by the Canadian General Electric Co., Limited, Toronto.

Crushing, Quarrying and Road Building Machinery. The Hamilton Machinery Co., Limited, Hamilton, Ont., the Canadian distributors for the American Road Machine Company, forward catalogues illustrating different types of crushing, road-building and quarrying machinery

Steel Valves. The Nelson Valve Company, Chestnut Hill, Philadelphia, Pa., forward catalogue illustrating various types of valves manufactured from bronze, iron and acid open-hearth steel.

Pumping Engines. The Standard Pump and Engine Co., Cleveland, Ohio, forward pamphlet entitled Standard Pumping Engines for Water Supply, consisting of different [illegible] of their apparatus.

Steam Turbines. The Kerr Turbine Company, of Wellsville, N.Y., forward pamphlet called The Economy Steam Turbine, [illegible] advantage of different types of steam turbines manufactured by them.

Railway Signals. The General Railway Signal Company, of Rochester, N.Y., forward [illegible] for their [illegible].

Engines. Ruston, Proctor & Co., Limited, Lincoln, England, forward [illegible] entitled The Products of Ruston, Proctor & Co., Engineers, Lincoln, England, which illustrates the different engines, suction gas plant, gas engines, road rollers, centrifugal pumps, etc., manufactured by them.

Conveying Machinery. The Jeffrey Manufacturing Company, Columbus, Ohio, forward their new general catalogue No. 82, illustrating Jeffrey elevating conveying power transmission machinery and coal mine equipments. The Jeffrey Manufacturing Co., are placing this catalogue in the hands of their customers and intending purchasers.

Electric Locomotives. The Railway and Lighting Department of the Westinghouse Electric Manufacturing Company, East Pittsburg, Pa., forward pamphlet describing the Baldwin Westinghouse Electric locomotive.

* * *

MACKENZIE-MANN GET DOMINION POWER COMPANY.

The Mackenzie-Mann interests are negotiating an important transaction by which they will obtain control of the Dominion Power and Transmission Company, the holding corporation of twelve electrical, generating, transmission, and consuming companies. The official ratification of the deal has yet to be made.

The companies controlled either directly or indirectly by the Dominion Power & Transmission Company are as follows:—The Hamilton Radial Electric Railway Company. The Hamilton Street Railway Company. The Hamilton and Dundas Street Railway Company. The Dundas Electric Company. The Hamilton Electric Light and Power Company. The Lincoln Electric Light and Power Company. The Brantford and Hamilton Electric Company, the Western Counties Electric Company, with its subsidiary corporation. The Brantford Electric and Operating Company. The Hamilton Terminal Company. The Welland Electrical Company. The Hamilton, Grimsby and Beamsville Electric Railway Company.

The authorized capital of the Dominion Power and Transmission Company, with head office at Hamilton, is $50,000,000. Of the preference stock, which is entitled to 7 per cent., $3,673,100 was subscribed and paid-up at the date of the latest annual report of the company, December 31st, 1911. Of the limited preference stock, (which has preference as to dividends over common of 10 per cent. in dividend in all of which 1½ per cent. has been paid), $5,100,000 has been subscribed and paid-up. Of the common stock, $2,622,500 has been subscribed and paid-up. The authorized bond issue is $25,000,000, of which $3,012,000 are outstanding. Bonds of subsidiary companies, amounting to $3,855,000, are outstanding.

The following are figures from the latest annual statement of the company:—

Gross earnings	$ 2,251,247.47
Interest	1,635.04
	$ 2,252,883.01
Operating expenses	$ 1,232,239.49
	$ 1,020,643.07
Bond interest	$ 335,758.42
	$ 684,884.65
The liabilities total	$20,045,040.98

Assets.

Property account	$19,[illegible]
Accounts receivable	[illegible]
Stores on hand	[illegible]
Trustees of bonds	50,018.25
	$20,045,040.98.

Profit and Loss Account.

Balance from 1910	$ 1,010,[illegible]89.63
Surplus earnings, 1911	684,884.65
Adjustments	18,882.93
Transferred to replacements	12,821.85
Transferred to reserve account	550,000.00
Dividend declared	5[illegible].21
Balance	7[illegible]4,[illegible].29
	$1,704,574.28

The incorporation of the Dominion Power and Transmission Company, Limited, was the result of necessary increase in the financial capacity of the Hamilton Cataract Power, Light and Traction Company, Limited, which became inadequate to meet the expansion of that company's business and the probable extension of its field of operation, and this company's charter from the Dominion of Canada was framed with a view to the acquisition by this company of the control, and practically the taking over of the business of the Hamilton Cataract Power, Light and Traction Company, Limited. In view of the fact that four-fifths of the stock of the Hamilton Cataract Power, Light and Traction Company, Limited, has been acquired by this company it may be regarded as a successor to that company and its business, but on a larger scale. The mileage of the company consists of 22 miles of double track in Hamilton and 23 miles of interurban lines, including an extension to Brantford over a private right-of-way.

Large shareholders have been requested to sign the agreement for the sale, and it is understood that all the stockholders are to receive $125 a share for their preference stock, $110 for their second preference, and $100 for their common stock. Stockholders seem to be satisfied with the terms.

The directors and officers of the company are as follows:—J. R. Moodie, president, Hamilton; James Dixon, vice-president, Hamilton; J. W. Sutherland, Hamilton; John Knox, Hamilton; Wm. C. Hawkins, Hamilton; Lloyd Harris, Brantford; Wm. Southam, Hamilton; Sir John M. Gibson, Toronto; secretary and general manager, Wm. C. Hawkins. The present directors will probably remain in charge until the annual meeting next February.

◆

RAILWAY SIGNALLING EXPERIMENTS.

Interesting experiments have recently been made near Birmingham, England, with a remarkable invention designed by the inventor, Mr. H. von Kramer, with the object of preventing train collisions. The inventor's method is to have earth-buried wires laid alongside and parallel with each line of permanent way, which will communicate with the signal boxes all along the line. The guard's coach on the train is fitted with a coil framework whence electricity emanates, connecting with the buried wire. The signal is picked up from either the wire of the train by a "detector," and automatically magnified, so that it is capable of operating a bell, hooter, or even a brake.

In the guard's van are several electric "solenoids," erected on a marble slab, which are entirely automatic. When the detector operates, one of these rings a hooter, while another is used for pulling a lever in the van which puts on the brakes and stops the train. On the other hand, the train can signal from station to station, sending out a current which operates alarm bell and lamps.

If the signalman forgets to pull back a lever after a train has passed from one block section into another, this omission is automatically rectified by the current. If the train over-runs a signal at danger it will be automatically stopped, and will not be able to proceed until a seal has been broken in the signal box, where the incident is recorded. This automatic signal will not be blindly relied upon by the engine-driver and signalman, but rather increase their alertness, as they are certain of having their mistakes recorded without the question of doubt. There is a recording instrument in each box which, when straight, indicates that all is right, but if any trouble occurs it goes up at the exact moment of the incident, and remains in a position of danger.

An outstanding feature of the invention is the extreme delicacy of the detector, which can be tuned to any pitch and only respond to a similarly tuned instrument. For instance, one tuned to 100 frequencies (vibrations) per second would not respond to others of even 95 or 105 frequencies. Moreover, the detector is tunable to such an extent that the signalman can distinguish between goods, slow passenger, and fast trains.

It is impossible for two trains to collide in the same section. If one gets in legitimately it is all right, but if a second runs over the block both trains are automatically stopped.

The experiments are being carried on over a ten-mile stretch of the Stratford and Midland Junction railway between Stratford and Kineton, and so far have proved a striking success.

◆

PERSONALS.

MR. ADAM P. LINTON, of Regina, has been appointed assistant chief engineer for the Province of Saskatchewan.

MR. E. W. MURRAY, of Regina, has been appointed district surveyor and engineer for the Province of Saskatchewan.

MR. L. G. COLEMAN has been appointed superintendent of the Ottawa division of the Grand Trunk Railway, with office at Ottawa, Ont.

MR. H. G. PHILLIPS, of Regina, has resigned his position as district surveyor and engineer of Saskatchewan to engage in private practice.

MR. M. K. ALLAN has been appointed city engineer of Regina, to succeed L. A. Thornton, who was recently appointed city commissioner.

JAMES IRWIN, of Montreal, has been appointed to succeed G. G. Hare, civil engineer of the Kingston & Pembroke Railway Company, who has been transferred to the Dominion Atlantic Railway.

HON. FRANK COCHRANE has been appointed representative of the Federal Government to represent that body at the International Road Congress to be held in London, England next June.

MR. W. REES JEFFREYS, Honorary Secretary of the International Road Congress, is at present in Toronto arranging details of the meeting of that body to be held in London during June, 1913.

MR. R. O. WYNNE-ROBERTS has been asked by the Government of Saskatchewan to report on the lignite deposits of the province with reference to the possibilities for use as fuel, and for the development of cheap power.

MR. H. L. DRAYTON, K.C., has been appointed Chief Commissioner of the Dominion Railway Board to fill the vacancy caused by the death of Judge Mabee. Mr. Drayton's present position is Corporation Counsel for the city of Toronto.

◆

OBITUARY.

We regret to announce the death of Mr. Cecil B. Smith, senior member of the firm of Smith, Kerry & Chase, consulting engineers.

MEETINGS.

The members of the Ontario Motor League held a dinner in honor of Mr. W. Rees Jeffreys, of the Road Board of Great Britain in Toronto on the evening of June 26th last. Mr. Jeffreys explained the workings of the Road Board with which he is connected, and at the conclusion brief addresses were made by Messrs. W. A. McLean, highways engineer of Province of Ontario; Dr. P. E. Doolittle; Willis Chipman, president of the Engineers' Club ,and Dr. John Galbraith, dean of the faculty of engineering, University of Toronto. Among those present were Messrs R. P. Fairbairn, Deputy Minister of Public Works, Ontario; A. S. Forster, Reeve of Oakville; W. G. Trethewey, of the York Highway Board, and A. M. Rankin, M.P.P., Collins Bay.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention at Kelowna, Okanagan Valley, B.C. August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE. Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the [illegible]

VANCOUVER BRANCH Chairman, C. E. Cartwright; Secretary, W. Alan, Kennedy; Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible] Head, Sask. [illegible] Hingley, [illegible]

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. [illegible]

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford [illegible] Secretary-Treasurer, W. D. Lighthall, K.C., [illegible]

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. [illegible] Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible] W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor [illegible] Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

[illegible] MUNICIPALITIES.—President, Mayor Mitchell, [illegible], Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, [illegible] Reeve Cardale, Oak Lake, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont ; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President; Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only unless otherwise noted at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
7-3	—Storm Drain, Orillia, Ont. ....(P. & S.)	6-20
7-1	—Boilers, 300-h.p., Verdun, Que. ....(S.)	6-20
7-10	Supply of electrical machinery and sewage disposal works, Battleford, Sask. ....(P. & S.)	6-27
7-20	—Concrete Arch, Stratford, Ont. ....(P. & S.)	7-4

(Battleford plans and specifications are also on file at The Canadian Engineer Offices, Montreal and Winnipeg.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Arden, Man., bridge	July 3.	June 13.	78
Battleford, Sask., electrical machinery, etc.	July 10.	June 27.	78
Boswell, B.C., pile bent wharf.	July 2.	June 6.	68
Brundage's Point, N.B., wharf	July 4.	June 20.	68
Cache Bay, Ont., wharf	July 10.	June 20.	68
Carleton Place, Ont., sewerage and water supply	July 9	June 20.	67
Elkholm, Man., industrial school buildings	July 9.	June 20.	67
Estevan, Sask., waterworks mains, etc.	July 9.	June 27.	67
Fort William, Ont., sewer	July 5.	June 13.	67
Fort William, Ont., sewer, Marks Street	July 5.	June 20.	67
Georgetown, Ont., bridge work..	July 5.	June 27.	80
High River, Alta., pump house, machinery, etc.	July 16.	June 27.	68
Kindersley, Sask., waterworks and electric light	July 22.	June 27.	80
Moose Jaw, Sask., water gates..	July 10.	June 27.	68
Needles, B.C., wharf	July 4.	June 27.	68
North Toronto, Ont., pavements.	July 30.	June 27.	80
Norwood, Ont., drill hall ..,...	July 3.	June 20.	67
Omemee, Ont., drill hall	July 2.	June 20.	68
Orillia, Ont., storm drain	July 3.	June 20.	78
Orillia, Ont., sanitary sewers ..	July 3.	June 20.	78
Ottawa, Ont., Hudson Bay Rly..	Aug. 1.	June 20.	80
Ottawa, Ont., wooden hopper scows	July 3.	June 20.	68
Ottawa, Ont., alterations to school buildings	July 12.	June 20.	68
Ottawa Ont., designs for monument	**Oct. 1.**	**Apr. 18.**	**60**
Ottawa, Ont., sale of steamer...	July 3.	June 6.	78
Prince Albert, Sask., sewage pumps	July 12.	June 27.	78
Port Hope, Ont., library	July 5.	June 27.	68
Port Arthur, Ont., dredging....	July 2.	June 20.	68
Port of Quebec, Que., proposals for drydock	**July 2.**	**Apr. 18.**	**60**
Point Grey, B.C., plans for university	**July 31.**	**Feb. 7.**	**60**
St. Catharines, Ont., trunk sewer	July 3.	June 13.	80
St. Catharines, Ont., rifle range.	July 10.	June 27	68
St. Charles, Man., trunk sewer..	July 6.	June 27.	68
Toronto, Ont., high level interceptor	July 2.	June 13.	80
Toronto, Ont., reinforced concrete girder bridge	July 2.	June 30.	80
Toronto, Ont., opera chairs....	July 22.	June 20.	68
Toronto, Ont., water main, Front Street	July 2.	June 20	68
Vancouver, B.C., bridge construction	July 8.	May 30.	74
Watrous, Sask., waterworks materials	July 15.	June 27.	68
Watrous, Sask., pump house, machinery and well	July 31.	June 27.	68
Weston, Ont., sewerage and storm water drainage	July 8.	June 27.	80
Windsor, Ont., quarantine buildings	July 8.	June 20.	68
Winnipeg, Man., cast-iron water pipe, etc.	July 15.	June 27.	68

TENDERS.

Brockville, Ont.—Tenders for paving and laying storm drains, etc., on King Street, will be received until July 15th, 1912. Full particulars can be obtained from G. H. Bryson, Town Engineer, Brockville. (See advt. in The Canadian Engineer.)

Buchanan, Sask.—Tenders for the building of a two-story solid brick school house, to be built in accordance with plans and specifications prepared by Messrs. Storey & Van Egmond, Regina, will be received until July 15th, 1912, at the office of Albert Hermanson, secretary-treasurer, Buchanan.

Cumberland, B.C.—Tenders for the construction of cement sidewalks will be received until July 8th, plans and specifications of which may be seen at the office of the City Clerk, Cumberland, B.C. S. McKinnon, City Clerk, City Hall.

Duck Lake, Sask.—Tenders will be received until noon of July 15th, for all work in the erection and completion of a Town Hall in the Town of Duck Lake, Sask. Plans and specifications at the Kings Hotel, Duck Lake. Wm. Fawcett, Mayor; F. Hopwood, Secretary-Treasurer.

Edmonton, Alta.—Tenders for the various trades wanted for the erection of the Strathcona Hospital, Alberta Grounds, Edmonton South, will be received until July 6th, 1912, by Robert Farquharson, Secretary Hospital Board, Bank of Commerce Building, Whyte Avenue. Wilson and Herrald, Architects and Structural Engineers, South Edmonton.

Edmonton, Alta.—Tenders will be received by the City Commissioners up to 31st July, 1912, for steel pipes and specials, and to noon of August 9th, 1912, for gasholder and tank. Specifications, etc., may be obtained at the office of the City Gas Engineer, 143 Elizabeth Street, Edmonton.

Estevan, Sask.—Tenders will be received until July 16th, 1912, for the construction of the following works:—

Contract "M"—Waterworks force main.
" "P"—Waterworks pumphouse.
" "D"—Water pipes.
" "G"—Pumping machinery.
" "I"—Pump well.
" "O"—Outfall sewer.
" "X"—Sewage disposal works.

Plans and specifications may be seen at Estevan, or at the engineers' offices. L. A. Duncan, Esq., secretary-treasurer; Chipman & Power, engineers, Toronto and Winnipeg.

Estevan, Sask.—Tenders will be received by H. N. Scott, secretary-treasurer, High School Board, Estevan, until noon of July 10th, 1912, for the erection of a Collegiate Institute building. Plans and specifications may be seen at the office of Storey & Van Egmond, Architects, Regina, Sask.

Guelph, Ont.—Tenders will be received by T. J. Moore, City Clerk, up to July 13th, for the construction of approximately 10,500 square yards of pavements. Particulars, etc., at the office of M. Ferguson, City Engineer. (See advt. in The Canadian Engineer.)

Kingston, Ont.—Tenders for the construction of 7,200 square yards of asphalt block or vitrified brick pavements and 3,000 lineal feet of concrete curb, will be received at the office of City Engineer, R. J. McClelland, until July 16th, 1912. Plans and specifications at the office of the Engineer. (See advt. in The Canadian Engineer).

Lethbridge, Alta.—Tenders will be received at the office of the Secretary-Treasurer up to noon of July 15th, 1912, for a freight elevator. Specifications can be seen at the office of the General Superintendent, City Hall. A. Reid, General Superintendent, Geo. W. Robinson, Secretary-Treasurer.

Moose Jaw, Sask.—Tenders for the supply and delivery, f.o.b. Moose Jaw, of one 500 k.w. steam driven generating set, will be received up to noon of August 1st, 1912. Specifications, etc., may be obtained upon application to J. D. Peters, Electrical Superintendent, Moose Jaw, or the Commercial Intelligence Branch, Board of Trade, 73 Basinghall Street, London, England. (See advt. in The Canadian Engineer.)

Ottawa, Ont.—The Department of Public Works, Ottawa, is open to receive tenders until July 11th, 1912, for interior fittings, post office, Fairville, N.B. Plans, etc., to be seen on application to Mr. G. E. Bettinson, Clerk of Works, Fairville, N.B.; Mr. D. H. Waterbury, Clerk of Works, St. John, N.B.; and at the Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until July 19th, 1912, for the following works at Point Tupper:—A ten-stall engine house and annex; a brick chimney with concrete foundation; a concrete cinder pit; moving the existing stores and office building, and providing new foundation. Plans and specifications may be seen at the office of the Secretary of the Department of Railways and Canals, Ottawa; at the Station Master's Office, Point Tupper, N.S., and at the Chief Engineer's Office, Moncton, N.B. A. W. Campbell, Chairman, Government Railways Managing Board, Ottawa.

Ottawa, Ont.—Tenders for the construction of an extension to breakwater at Reed's Point, Lorneville, St. John County, N.B., will be received at the office of the Secretary, Department of Public Works, Ottawa, until July 24th, 1912. Plans, etc., at the Department, and at the offices of E. T. P. Shewen, Esq., District Engineer, St. John, N.B.; Geoffrey Stead, Esq., District Engineer, Chatham, N.B., and on application to the Postmaster at Lorneville, N.B.

Ottawa, Ont.—Tenders will be received until July 8th, 1912, for Port Colborne entrance improvements. Plans, etc., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer of the Welland Canal, St. Catharines, Ont. L. K Jones, Secretary, Department of Railways and Canals, Ottawa.

Ottawa, Ont.—Tenders for the construction of a sea wall at Windsor, Hants County, N.S., will be received by the Secretary, Department of Public Works, Ottawa, until July [illegible], 1912. Plans, etc., can be seen at that Department, and at the offices of H. A. Russell, Esq., District Engineer, Halifax, [illegible] District Engineer, Antigonish, N.S., and on application to the Postmaster at Windsor, N.S.

Ottawa, Ont.—Tenders will be received until July 16th, [illegible] at Richmond, N.S. Plans, etc., at the office of the Secretary of the Department of Railways and Canals, Ottawa, the Station Master's Office at Richmond, N.S., and at the Chief Engineer's Office, Moncton, N.B.

Regina, Sask.—[illegible] Acting Deputy [illegible] Regina.

Regina, Sask.—Tenders will be received until July 12th, 1912, for the undermentioned works:—

Group 1:—

(a) Two reinforced concrete bridge abutments for a bridge over [illegible] River, near [illegible], Sask.

(b) Two reinforced concrete bridge abutments for a bridge over [illegible] River north of [illegible].

(c) Two reinforced concrete bridge abutments for a bridge over Whitesand River, near Gorlitz Siding, G.T.R. Railway.

(d) Two reinforced concrete bridge abutments for a bridge over Whitesand River, near Yorkton.

(e) Two reinforced concrete bridge abutments for a bridge over Quill Creek, south of Wadena.

Group 2:—

(a) Two reinforced concrete bridge abutments for a bridge over Wood River at Gravelburg.

(b) Two reinforced concrete bridge abutments for a bridge south of Gravelburg.

(c) Two reinforced concrete bridge abutments for a bridge north of Gravelburg.

Group 3:—

(a) Two reinforced concrete bridge abutments for a bridge over Moose Mountain Creek, north of Oxbow.

(b) A reinforced concrete bridge at Brooking.

Plans, specifications and full information may be obtained on application to A. J. McPherson, Chairman, Highway Commission, Regina, Sask.

Regina, Sask.—Tenders for the construction of earth grade across Lake Chaplin, providing the necessary stone for and rip-rapping embankment, will be received until July 13th, 1912. Full particulars may be had on application to A. J. McPherson, Chairman, Highway Commission Board, Regina.

Regina Sask.—Tenders will be received until noon of July 20th, 1912, for the erection and completion of an addition to the Regina Collegiate Institute, tenders to be addressed to the Secretary-Treasurer, Regina Collegiate Institute Board, Regina. Plans and specifications may be secured at the office of Messrs. Storey and Van Egmond, Architects, Credit Foncier Building, Regina, and at the Builders' Exchange, Winnipeg.

St. Charles, Man.—Tenders to furnish all material and to erect a fire hall and police station on Berry St., in D.G.S., 34-5, St. James, will be received until July 10th. Plans and specifications at the office of Frank Ness, secretary-treasurer, Rural Municipality of Assiniboia, Kirkfield Park P.O., Man., St. Charles.

St. John, N.B.—Tenders are invited by the city of St. John for the following work to be received by the Common Clerk, Room No. 3, City Hall, up to noon of July 8th:—

Bituminous macadam pavement in King Street, and granite block pavement in track allowance.

Sheet asphalt pavement in Charlotte Street, and vitrified brick pavement in track allowance.

Excavation, backfilling and cartage for main sewer renewal in Main Street, Paradise Row and Hazen Alley.

Replanking of sidewalk North Rodney wharf. Plans and specifications to be seen in the office of the City Engineer, Room No. 5, City Hall.

Stratford, Ont.—Tenders for the construction of approximately 6,488 lineal feet of concrete arch, covering Romeo Creek, will be received by A. B. Manson, City Engineer, up to July 20th, 1912. Plans, etc., at the office of The Canadian Engineer, or at the office of the City Engineer, Stratford. (See advt. in The Canadian Engineer).

Toronto, Ont.—Tenders will be received until noon of July 15th, 1912, for the construction of a concrete sidewalk on Ravensden Avenue, Township of York. Plans, etc., at the office of Mr. Frank Barber, Township Engineer, 57 Adelaide Street East, Toronto. (See advt. in The Canadian Engineer.)

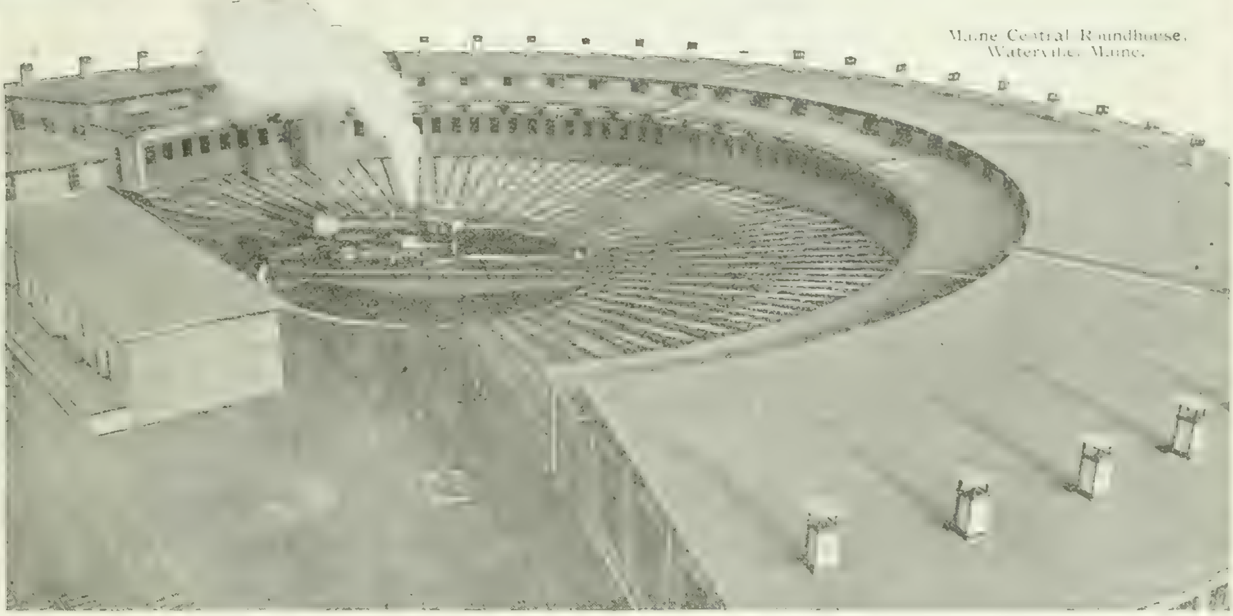
Vernon, B.C.—Tenders will be received by D. G. Tate, City Clerk, Vernon, until July 15th, 1912, for the supply of fuel oil for Diesel Type Oil Engine, for a period of one, three or five years. Messrs. Mather, Yuill and Company, Limited, Consulting Engineers, Vancouver B. C. (See advt. in The Canadian Engineer.)

Victoria, B.C.—Tenders will be received by W. Galt, Purchasing Agent, City Hall, Victoria, until July 8th, for [illegible] feet [illegible] No. [illegible] cable, [illegible] feet No. 16 duplex cable, [illegible] miles No. 12 W P B & S gauge steel wire.

Woodstock, Ont.—Tenders for wiring County Court House, Oxford County, will be received until July 8th, 1912, by N. F. [illegible], County Clerk, Woodstock. Plans and specifications at the Clerk's office.

Winnipeg, Man.—Tenders for the manufacture, delivery and erection in high pressure plant of alternators, switching apparatus and accessories, will be received until July 17th, 1912. Specifications, etc., may be had at the office of the City Light and Power Department, 54 King St. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Barrett Specification Roofs



Maine Central Roundhouse,
Waterville, Maine.

THE RAILROAD TEST.

THE hardest kind of a building to roof successfully and economically is a railroad roundhouse.

Such a building is exposed to heat inside, condensed vapor from above and below, as well as acid fumes of coal smoke and the constant dropping of cinders and sparks on the surface. All this, in addition to the ordinary wear and tear of the weather.

Only one type of roofing can stand up under such conditions successfully and that is a Barrett Specification Roof.

Its low cost makes it attractive to begin with and the fact that there is no maintenance expense such as painting or coating, makes the net cost per year of service far below that shown by any other roof covering.

The reasons which make Barrett Specification Roofs particularly desirable for roundhouses make them even more desirable and economical when used on manufacturing plants, warehouses, apartments in fact, on all flat-roofed commercial structures.

Every architect, engineer and owner should have a copy of The Barrett Specification with tracings for use in future building plans and we are pleased to mail same free on request to our nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Winnipeg, Man.—Tenders for the supply of a quantity of water meters, will be received until noon of July 18th, 1912. Specifications, etc., at the office of the City Engineer. 223 James Avenue. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders or supply of labor and materials required in the erection of a 42-foot steel span, concrete and foundation work for permanent approaches to Louise Bridge, will be received until July 11th, 1912. Plans, etc., at the office of the City Engineer, 223 James Avenue. M. Peterson, Secretary Board of Control Office, Winnipeg.

◆

CONTRACTS AWARDED.

Coleman, Alta.—The School Board have received the following contracts for the construction, painting and plumbing of the new addition to the Coleman School building:—

Construction—E. Disney, $4,950.

Plumbing—The H. G. Goodeve Co., $772.50.

Painting—D. Fraser, $773.50; E. Parrish, $750; R. Dunlop, $602.70; C. F. Higgins, $587.

The contracts were awarded to Messrs. Disney, Goodeve Company and Higgins.

Kamloops, B.C.—The contract for cluster lighting supplies was awarded to Messrs. Hutchinson Bros., Victoria, their tender being $52,000.

Tenders for retaining wall and fill on Nicola Street were opened, the only tender being that of the Graff Construction Company at $1,428. The contract was awarded that firm.

Lethbridge, Alta.—The Elose Paving Company, of Vancouver, was awarded a contract by the city council for paving 20,000 square yards of the streets of the city for the sum of $45,747.50 over the Bitulithic Company, whose tender was [illegible]

Township of London, Ont.—F. W. Farncomb, C.E., acting for the Township of London, has accepted the tender of Bayne and Ross, Embro, for concrete breakwater on the Medway River at $5.48 per cubic yard. Probable cost will be $4,300.

Montreal, Que.—Mr. D. Lorne McGibbon, president of the Consolidated Rubber Company, announces that their company will build a $1,000,000 tire factory, it is thought somewhere in Ontario.

Montreal, Que.—The Board of Control recommends the letting of the contract for the pumping required to divert the Elgin Basin sewer be awarded to the firm of J. T. Farmer at $14,160. The board set aside a tender for constructing a pump building.

Messrs. H. Birks & Sons' Building.—A contract has been let for the construction of an $87,000 ten-story reinforced concrete frame building for Messrs. Henry Birks & Sons. The Norton Griffiths Steel Construction Company has received the contract, the architects being Messrs. Somerville and Putnam.

New Westminster, B.C.—The contract for the construction of the new wharf for Mr. E. J. Fader and his associates has been awarded to Mr. W. A. Gilley, who will commence piling immediately. This wharf will be 600 feet long by 100 feet deep, and it is intended to be the strongest wharf in the city.

Niagara Falls, Ont.—The Cumberland Company of Oakville, have let the contract of building twelve miles of [illegible] Messrs. Lorenze, Murray & Spencer, have the contract.

New Westminster, B.C.—Contracts were let for the paving [illegible]

Regina, Sask.—The Commissioners brought down a [illegible] which was the

lowest figure quoted, and approximately $10,000 less than the highest tenderer's price. They are also recommending the council to purchase plain round rods to the value of $6,596.30 from the Provincial Steel Company, and to buy cement at $2.85 1-2 per barrel from the Canada Cement Company, the lowest tenderer on cement.

Tisdale, Sask.—The contract for the new $10,000 school has been let to the firm of Messrs. Dempsey and Hunter, contractors and builders of this town.

South Vancouver, B.C.—Contracts for the erection of eight-room additions to the Carleton Tecumseh and General Wolfe schools were let by the school board to Messrs. Snider & Brethour and Charles Harrison. Snider & Brethour will build the addition to the Carleton and Tecumseh schools for $32,448 each. Mr. Charles Harrison received the contract for the erection of the General Wolfe addition, his bid being $35,649. Tenders for the building of two two-room schools were opened. The contract for the erection of the school on Sixty-first Avenue was let to Mr. F. P. Rogers for $2,325, and the new Kerr road school will be built by Fletcher and Bonhon at $2,050. Twenty-one tenders were received.

◆

RAILWAYS—STEAM AND ELECTRIC.

Halifax, N.S.—The receipts of the Halifax Electric Tramway Company, Limited, for the week ending June 21st, 1912, were as follows:—

1912.	1911.	Increase.
$5,069.63	$4,759.59	$310.04

Montreal, Que.—It is announced that the North Railway Company of Canada who have the franchise for a projected line from Montreal to Nottawa on the James Bay have financed the project. The survey and location work is now being rushed, and construction will begin in the spring. Mr. F. H. Clergue is interested in the financial arrangements. Mr. E. A. Evans, C.E., of the Quebec Provincial Government has been over the line for the Government.

Saskatoon, Sask.—A by-law was passed to raise $500,000 for the construction of a street railway system in this city. Messrs. Stone and Webster, of Boston, are the constructing engineers and work is already under way.

◆

LIGHT, HEAT AND POWER.

Galt, Ont.—Three by-laws were passed on June 27th, one for $45,000 for the completion of the hydro-electric lighting system and extension of private services, one for the renewal of the Galt, Preston and Hespeler Railway franchise for ten years, and one for $13,500 for permanent civic improvements and road work.

Humboldt, Sask.—The council have decided to submit by-law to the people to raise $30,000 for an electric light system for the town.

Moose Jaw, Sask.—The municipal electrician has submitted a report to the council dealing with the new power house. In this he advocates the change to three phase current, the construction of the building in fire proof materials with steel frame, one additional generator over the number previously employed. The estimated cost of this building is $68,000.

Ottawa, Ont.—A new plant recently installed for the Great North Western Telegraph Company consists of sixteen machines, eight alternating two-phase 60 cycles, 220 volt motors, direct connected to eight generators, with ranges from 25 to 300 volts, the machines being mounted upon a concrete pier, which also supports the slate controlling switch panels, located immediately above. Under the new system, electrical currents of various voltages are placed upon the wires direct from the generators which are capable of being regulated over a wide range. This plant gives the local office of the Great North Western one of the most modern and up to date equipments of any telegraph office in Canada.

Province of Ontario.—The Hydro-Electric Commissioners are planning to send two electric thrashing outfits throughout the province during the coming harvest season and demonstrate to the farmers means whereby this source of power may be used on their farms.

Toronto Townships, Ont.—A meeting to discuss the securing of power from the Hydro-Electric Commissioners was held at Port Credit.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

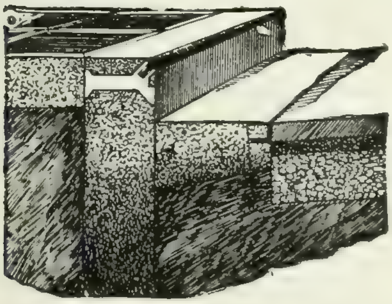
WAINWRIGHT GALVANIZED STEEL CORNER BAR

FOR PROTECTING EDGES OF CONCRETE CURBS, STEPS, COLUMNS, ETC.

WAINWRIGHT PATENTS
March 9, 1897
November 22, 1898
May 5, 1903
March 26, 1907
August 29 1907
August 2, 1910
Canadian Patent 92208

IT HAS A RECORD OF FOURTEEN YEARS' USE WITHOUT A FAILURE.

THIS BAR IS SELF-ANCHORING, THE DOVETAILED WEB HOLDING IT FIRMLY IN PLACE EVERY INCH OF ITS LENGTH, PRESENTING A RESISTING DEPTH OF TWO INCHES OF SOLID STEEL, AT EVERY POSSIBLE POINT OF IMPACT.

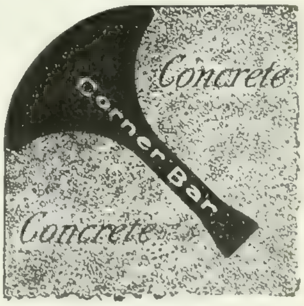


This bar has been in public use for more than fourteen years as the main feature of the

WAINWRIGHT

STEEL-BOUND CONCRETE CURB

ABSOLUTELY NON-BREAKABLE
CHEAPER THAN GRANITE



GALVANIZED STEEL CORNER BAR prevents Chipping or Breaking on Edges
MECHANICALLY PERFECT AND UNEQUALLED FOR CURVED CORNERS.

OVER FOUR MILLION FEET IN USE IN MORE THAN FOUR HUNDRED CITIES IN THE UNITED STATES.

THIS CURB WILL STAND HARDER USE AND LAST TEN TIMES AS LONG AS PLAIN CONCRETE CURBING

CONTRACTORS can make money by laying this curb. CITY ENGINEERS can save money by specifying it.
ARCHITECTS are invited to read pages 238 and 239 "Sweet's Index."

METAL PARTS FOR SALE. **Send for Copyrighted Booklet No. 14.**

STEEL PROTECTED CONCRETE CO., Real Estate Trust Bldg. **Philadelphia, Pa.**

GARBAGE, SEWAGE AND WATER.

Bolton, Ont.—F. H. Farncomb, C.E., London, Ontario, has [illegible] a report to the town of Bolton, for proposed waterworks. The report covers alternative schemes for spring water, deep well and filtration. The latter is recommended. A by-law will be submitted. Estimated cost $25,000. It is expected that the Canadian Pacific Railway will become a large consumer.

Melfort, Sask.—The ratepayers of Melfort have passed three debenture by-laws, totalling $120,000, for waterworks, sewers, sewerage, trunk sewers, and electric plant system. Tenders have been accepted and work will be commenced immediately.

Regina, Sask.—Three tenders have been received for the construction of water main extensions in the city and the commissioners are recommending the council to award the contract to John Brodt at a total cost of $13,761, as follows: 19,000 lineal feet of 6-inch mains at 56 cents per foot; 3,000 lineal feet of 8-inch mains at 60 cents; 350 lineal feet of 18-inch mains at 74 cents per foot.

Regina, Sask.—The contracts for the cast-iron pipe and specials for the construction of water main extensions are to be awarded to the National Iron Works and the Canada Iron Corporation. The former is to deliver 200 tons of pipe and 8 tons of specials at a cost of $8,854 and the latter, 146 tons of pipe and 5 tons of specials at a cost of $6,472.

Regina, Sask.—Orders have been placed by the commissioners for the purchase of an engine costing $3,565 from Crosley and Company of London, England and a pump costing $740 from the Canada Foundry Company. This will be a duplicate unit to the one already installed at the pump well house and will be capable of pumping four million gallons of water a day.

Toronto, Ont.—The municipal council has authorized the establishment of two sewage chlorination plants, at a cost of $12,[illegible].

Welland, Ont.—The Medical Health Officer will advise the municipal council to install a chlorinating plant for use in connection with the supply of water. Dr. Howell is the holder of this office.

Welland, Ont.—Welland will chlorinate its water supply from the Welland Canal, in order to prevent an outbreak of typhoid. It is thought the town will have to establish a sewage disposal plant.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Blairmore, Alta.—The Keystone Portland Cement Company intend constructing a cement plant here to cost $400,000, and to have a capacity of 1,500 barrels per day. The plant will consist of twelve buildings, the largest of which will be a stock house 25 x 60 feet. The power house will be 140 x 60. The syndicate financing the construction of the Blairmore plant has announced that a 2,500 barrel establishment will be erected on the Pacific Coast.

Calgary, Alta.—Steps will be taken shortly towards the erection of a Labor Temple in Calgary.

Calgary, Alta.—The Walker-Fyshe Company have the [illegible]

Carmangay, Alta.—The farmers here propose building a [illegible] elevator.

Estevan, Sask.—[illegible]

Halifax, N.S.—Plans and specifications are being prepared for the erection of a Masonic Temple. Estimated cost, [illegible].

Hamilton, Ont.—[illegible]

Montreal, Que.—[illegible] Arena. If the present plans are carried out, work will be commenced toward the latter part of July, and be completed by November next.

Montreal, P.Q.—Mr. L. Cohen, president of the Baron de Heisch Institute, has had plans prepared for a 10-story building to be erected at the corner of Craig and St. George Street.

Montreal, Que.—The wardens of St. Joseph of Bordeau have obtained a permit to construct a Catholic church on Viel Street valued at $120,000.

Prince Albert, Sask.—Large building operations are being carried on this month, the value of permits from June 6th to June 21st totalling the sum of $200,000.

Toronto, Ont.—The Dominion Bank have decided to put up a new building at the corner of King and Yonge Streets. The plans and specifications are well under way.

Victoria, B.C.—Messrs. Dunford and Son will erect an apartment house on Government and Simcoe Streets, at a cost of $45,000. Designs prepared by Captain H. J. R. Cullin. Material will be brick, concrete and wood.

Welland, Ont.—Building permits, 14 issued for June, value $19,313. No records for June, 1911. Total value of permits 1st six months of 1912 amount to $124,186.

Winnipeg, Man.—Mr. J. A. Glasford, manager of terminals, has intimated that there will be considerable work done around the Union Station with a view of beautifying the premises.

◆

BRIDGES, ROADS AND PAVEMENTS.

East Toronto, Ont.—A deputation waited upon the Works Commissioner requesting that a hill on Du Vernet Avenue be cut down and the earth used to fill a nearby hollow.

Toronto, Ont.—The Commissioners of Works has recommended the construction of a 24-foot medium asphalt pavement on Ossington Avenue from Bloor Street to the Canadian Pacific Railway tracks. Of the total cost of $24,308 the property benefited will bear $18,830 and the city $5,478.

◆

FIRES.

Chicoutimi, P.Q.—A great amount of damage was caused to this town by fire on June 25th last.

West Lahave, N.S.—The woodworking plant and sawmills of Boehmr Brothers, were completely destroyed by fire with a loss of $60,000.

Sarnia, Ont.—The new plant of the Sarnia Gas & Electric Light Company was destroyed by fire on the morning of June 27th last. The loss is estimated at $300,000.

Ottawa, Ont.—The large gasoline truck belonging to the Ottawa Electric Light Company, valued at $900, was almost totally destroyed by fire.

◆

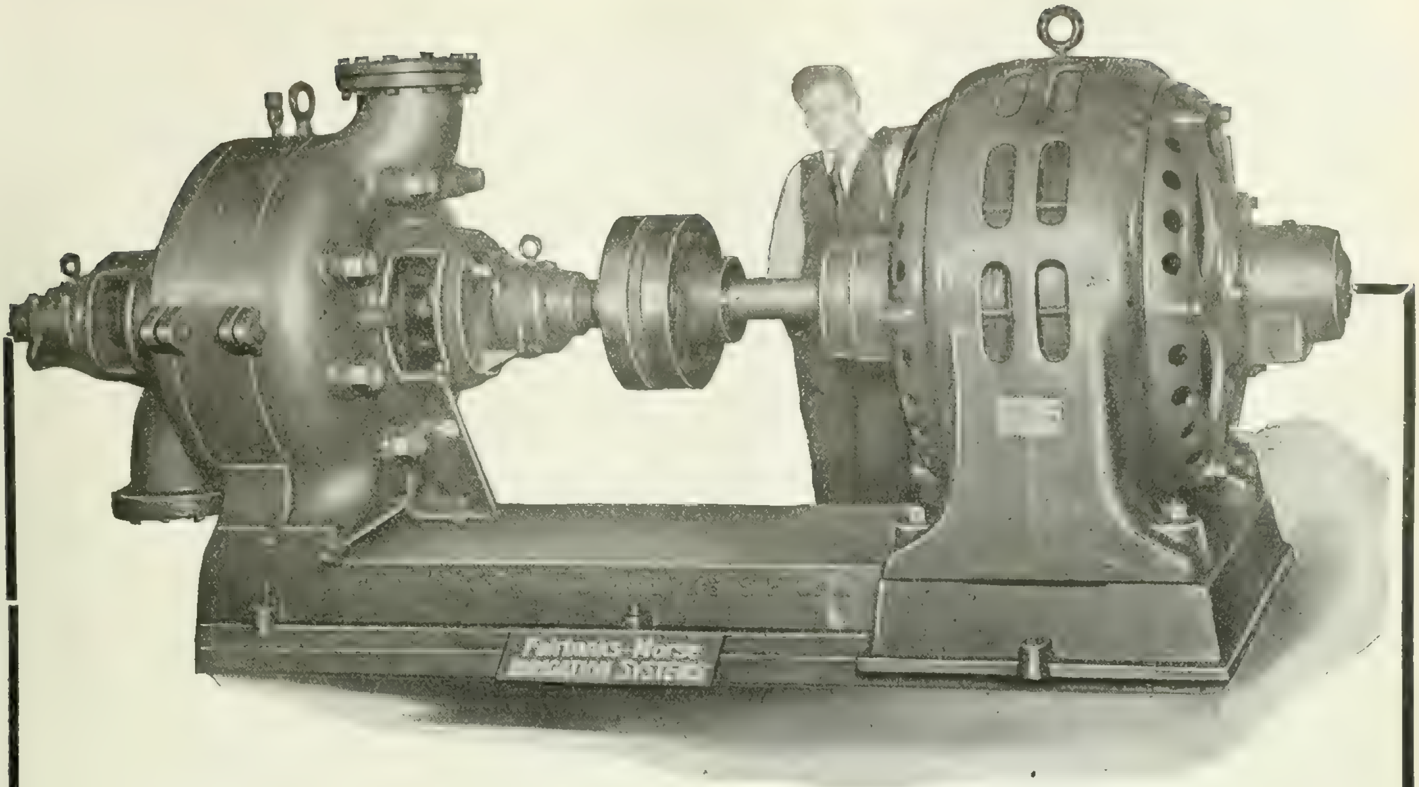
CURRENT NEWS.

St. Catharines, Ont.—The Department of Militia are about to construct a set of rifle ranges near this city.

Tofield, Alta.—The officials of the Grand Trunk Railway report a find of natural gas at this point in large quantities. This place is about forty-one miles from Edmonton and is also the scene of a recent coal discovery.

Toronto, Ont.—Classes in sanitary work for the instruction of the seven physicans appointed by the government as district medical officers of health will open on the first of August. Lectures will be given by Dr. J. W. S. McCullough, chief medical officer of health of the province; Dr. John Amyot, head of the provincial laboratories, and Dr. R. W. Bell, provincial inspector of the Board of Health.

Toronto Island.—A sea wall is to be erected at the Island to preserve the western end of the new athletic field, which has of late been affected by the action of the waves. The work will be done by the Harbor Commission. Engineer F. L. [illegible], has submitted two plans of the proposed wall to Parks Commissioner Chambers for approval.



The Largest Direct Connected Centrifugal Pumping Unit in British Columbia.

The Vancouver Power Company have recently installed at their works at Coquitlam Dam, B.C., the largest direct connected centrifugal pumping unit in British Columbia. This outfit is to operate in parallel with a number of other pumps that are to furnish water under pressure for sluicing into place the material for their new dam.

This pump is a 10-inch, class "F," two-stage centrifugal, with bronze inpellers and renewable bronze diffusion vanes. It has a normal capacity of 1833 imperial gallons per minute when operating at 1160 r.p.m. against a total head of 355 feet or an equivalent pressure of 154 lbs. per square inch. It is mounted on a common sub-base with a 300 h.p. type "B," Fairbanks-Morse squirrel cage, induction motor, 2200 volts, 60-cycle, 3-phase, 1160 r.p.m. at full load, being direct connected thereto by means of a flexible leather link coupling.

The motor possesses a feature in rotor construction that is unique. The end rings are welded on to the rotor bars by a new process, making a perfect joint, free from the troubles common to the purely mechanical or riveted joint, such as oxidation, working loose, and solder-throwing. This improvement marks a long step forward in the elimination of rotor trouble.

Our Vancouver Branch supplied and assembled this complete pumping unit. We are in a position to quote on the necessary equipment for any pumping requirements on receipt of specifications.

The Canadian Fairbanks-Morse Co., Limited

Fairbanks Standard Scales, Fairbanks-Morse Gas Engines
Pumps Safes Vaults

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

COPIES OF ENGINEER WANTED.

Copies of The Canadian Engineer of the issue of June 20th, 1912, are desired. The usual extension of the sender's subscription will apply in this case.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending June 17th, 1912.

An English firm manufacturing a patent improved safety hook for use in mines, desire to hear from mining engineers in Canada who may be interested.

A London firm interested in a new process for utilizing waste vegetable matter, such as twigs and needles of pine trees, bark from pulp factories, sawdust, hedge cuttings, etc., make inquiry respecting sources of supply in Canada.

A London firm make enquiry for the names of Canadian importers of electrical meters, motors, fans, measuring instruments, and metallic filament lamps.

A London firm handling iron, steel, tin-plates, metals and hardware, desire to enter the Canadian market.

An Austrian correspondent makes inquiry for the names of Canadian exporters of linseed.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.

A Scottish company manufacturing paper machine wires are prepared to offer their agency to some resident Canadian agency firm who are already calling on paper mills in connection with other supplies.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

[illegible] June [illegible]—Approving revised location of C.N.O. [illegible] Dist. of Nipissing, mileage [illegible] Badgerow and Gibbons, [illegible]

[illegible] C.P.R. to construct a [illegible] farm crossing [illegible]

[illegible] C.P.R. [illegible] track for inter-[illegible] by Order No. [illegible], January [illegible]

[illegible] time for installation [illegible] Order [illegible], May 3rd, 1912. [illegible]

[illegible] C.P.R. [illegible] at Meath, [illegible]

[illegible] by C.P.R. [illegible] Order No. [illegible], February [illegible]

[illegible] C.P.R. [illegible]

[illegible] Great [illegible]

[illegible]

[illegible] at [illegible]

[illegible] C.P.R. [illegible]

[illegible]

16819 June 19—Approving revised location of C.N.O. Ry. through unsurveyed territory in Dist. of Algoma, mileage 208.3 to 211.47 from Sudbury Junction.

16820—June 20—Authorizing G.T.R. to extend its passing track and to re-align its main line over County Line Road, Twp. of Brant, County of Bruce, Ontario.

16821—April 12—Relieving C.P.R. from erecting and maintaining fences on certain portions of its Fort William, Ignace, and Kenora Subdivisions.

16822—June 24 Authorizing G.T.P. Ry. to open for carriage of traffic between Hinton (mileage [illegible]), and Fitzhugh (mileage [illegible]), in Province of Alberta, speed limit of 20 miles per hour.

16823—June 20—Park Ave. Subway, Montreal, Que. Ordering that city of Montreal be subject to fine of $25 per day for every day after 24th June, 1912, that they are in default of commencing work required by Order [illegible], May 13, 1912, and $25 per day for every day after 15th Dec., 1912, that they are in default of completing work.

16824 June 20—Extending pending sanction of Governor-in-Council of agreements time for operation of Midland Ry. trains over C.N.R., Winnipeg, terminals. Order [illegible], dated May [illegible], 1912.

16825 June [illegible]—Extending until Oct. 1st, 1912, time for completion by C.N.R. of spur into H.B. Reserve, Edmonton.

16826—June 18—Authorizing C.P.R. to construct its Moose Jaw North-Westerly Branch across 34 highways in Saskatchewan.

16827—June 22—Authorizing C.P.R. to use and operate bridge 69.3 on its Boundary S.D.

16828—June 22—Approving revised location James Bay & Eastern Ry. in Twp. of Roberval, Ct. Lake St. John, Quebec.

16829—June [illegible]—Authorizing British Yukon Ry. Co. to open for carriage of traffic its branch line at mile post [illegible], to Pueblo Mine, 13 miles.

16830—June 21—Approving revised location of Edmonton, Dunvegan and B.C. Ry. Co., mile 3 to 14, Alberta.

16831 June 17 Dismissing application of Publishers' Press, Ltd., of Montreal, Que., re Bell Telephone service.

16832 June 20 Amending Order [illegible] of Sept. [illegible], 1911, by substituting plan dated Feb. 17, 1912, re Scarlett Road Subway, C.P.R., to be reimbursed, 20 per cent. from Rly. Grade Crossing Fund.

16833—June 24—Approving location of portion of C.P.R. Moose Jaw Southwesterly Branch at mileage 37.85 to 64.47, Sask., and authorizing crossing of 22 highways on same.

16834—June 21—Authorizing C.P.R. to construct four spurs across Symes and Gunns' Roads, Toronto, Ontario.

16835 June 24 Extending until 31st August, 1912, time for completion of C.P.R. spur into premises of Hanson & Van Winkle Co., Ltd., Toronto, Ont.

16836—June 24—Relieving C.P.R. from erecting and maintaining fences on its Lac Du Bonnet Subdivision.

16837—June 18—Re C.P.R. spur crossing G.T.R. and joining lines used in common by C.P.R. and G.T.R. near Clarence Square to take certain lands of city of Toronto, etc., in connection with enlargement of freight terminals, etc.

16838 June [illegible] Dispensing with services of night watchman at crossing by C.N.O. Ry. of C.P.R. near Ottawa, Ontario.

16839 June 21 Authorizing C.P.R. to construct extension to siding already constructed for Taylor Milling & Elevator Co., at Lethbridge, Alta.

16840 June 21 Authorizing C.P.R. to close up highway near mileage 48, Edmonton Branch.

16841 June 22 Authorizing C.P.R. to construct spur for Lethbridge Brewing and Malting Co., and Messrs. Young Bros., at Macleod, Alberta.

16842 June 25 Approving plan of track elevation of C.P.R. at North Toronto; subway structures plan for Yonge St. and Avenue Rd. to be filed for approval, etc.

16843—June 17—Refusing application of Quebec Rifle Assn. re C.N.R. stopping trains at Point aux Trembles Range, Montreal.

[illegible] June [illegible] Authorizing C.N.Q. Ry. to cross with its St. Eustache-St. Jerome Line, C.P.R., near St. Augustine, Que.

[illegible] Rescinding Order [illegible], Feb. 15, 1909, in so far as it requires maintenance of agent at Montfort, Que.

[illegible] June 25 Approving plan showing track elevation of joint section of C.P.R. and C.N.O. Ry. from Summerhill Avenue to Dovercourt Rd., except approaches to subways at Yonge St. and Avenue Rd. must be level, Christie Street subway to be full width of street.

[illegible] June 19 Amending Order [illegible], May [illegible], 1912, by striking out words "at Bashaw" in third line of operative part.

16848—June 18—Approving location of G.T.P. B.L. Co. station at Dodsland, on its Biggar-Calgary Branch.

[illegible] June [illegible] Authorizing G.T.P. B.L. Co. to construct series of seven industrial spurs in Regina, Saskatchewan.

[illegible] June [illegible] Naming express delivery and collection limits for town of Shawinigan Falls and Fraserville, or Rivière du Loup, Que.

[illegible] June [illegible] Authorizing T.H. & B. Ry. to construct spur for Barton Lumber and Supply Co., Hamilton, Ontario.

[illegible] June [illegible] Refusing application of city of Ottawa for removal of G.T.R. tracks off Preston Street.

[illegible] June [illegible] Directing G.T.R. to within [illegible] days install electric bell at [illegible] per cent. from Grade Fund.

[illegible] June [illegible] Directing M.C.R. to within [illegible] days install electric bells at [illegible] St. and [illegible] St., Springfield, Ontario, [illegible] per cent. from Grade Crossing Fund.

[illegible] June [illegible] Authorizing G.T.R. to construct spur for Export Lumber Co. [illegible] Preston Street, Ottawa, Ont.

[illegible] June [illegible] Naming express delivery and collection limits for City [illegible]

[illegible] June [illegible] Approving G.T.R. [illegible] plan, Richmond, Que.

[illegible] June [illegible] Approving plan of C.P.R. [illegible] from [illegible] Winnipeg, Man. [illegible]

[illegible] June [illegible] Authorizing C.N.R. [illegible] South [illegible] Saskatchewan.

[illegible] June [illegible] Directing C.P.R. [illegible] Ont., to stop [illegible]

[illegible] June [illegible] Authorizing C.P.R. to construct [illegible]

[illegible] June [illegible] Authorizing C.N.O. Ry. [illegible] County of [illegible], Ontario.

[illegible] June [illegible] Authorizing C.P.R. [illegible]

[illegible] June [illegible] Application [illegible]

[illegible] June [illegible] Authorizing C.P.R. [illegible] traffic [illegible] Saskatchewan.

Volume 23 Toronto, July 11, 1912

Contents of this issue on page 151

The Canadian Engineer

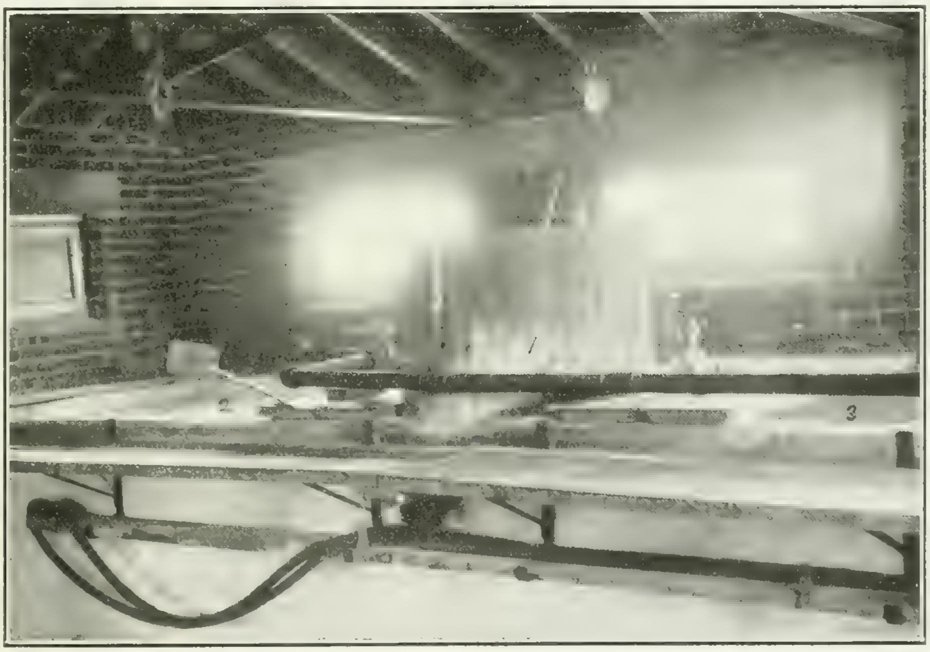
An Engineering Weekly

THE TORONTO WATER CHLORINATION PLANT.

Toronto is supplied by water from three sources, two of which are more or less intermittent. One of these, in East Toronto, where the water supply is obtained from the open lake opposite Balmy Beach, supplies from one-half to one million gallons a day. This water is chlorinated by a small temporary plant of little mechanical interest.

The West Toronto Pumping Station, which formerly supplied the Junction district, is capable of pumping one and a half million gallons of water per day, and draws this supply from the Humber Bay, about 700 feet from shore. As this water is usually contaminated with sewage, it is only operated when absolutely necessary to maintain a sufficient supply of water. This supply is chlorinated by means of injectors attached to the piston rods of the pumps, so that each gallon of water forced into the main is given at the same time a sufficient quantity of chlorine to practically sterilize it.

The main chlorinating plant is situated over tunnel shaft number two on Toronto Island near Hanlan's Point. Formerly the water flowed directly by gravity from Lake Ontario, through a pipe across the Island, and fell into the tunnel at this point. Since the first of January, 1912, however, the water is intercepted by the slow sand filters, through which it passes, and again flows to the tunnel, clarified, and with a large portion of the bacteria removed.



Toronto Water Chlorination Plant. No. 1 shows mixing tank. Nos. 2 and 3, solution tanks.

The plant consists of four tanks, namely, a mixing tank, two solution tanks and a constant head tank, which is divided into two, so that one can overflow into the other, or they can be operated independently.

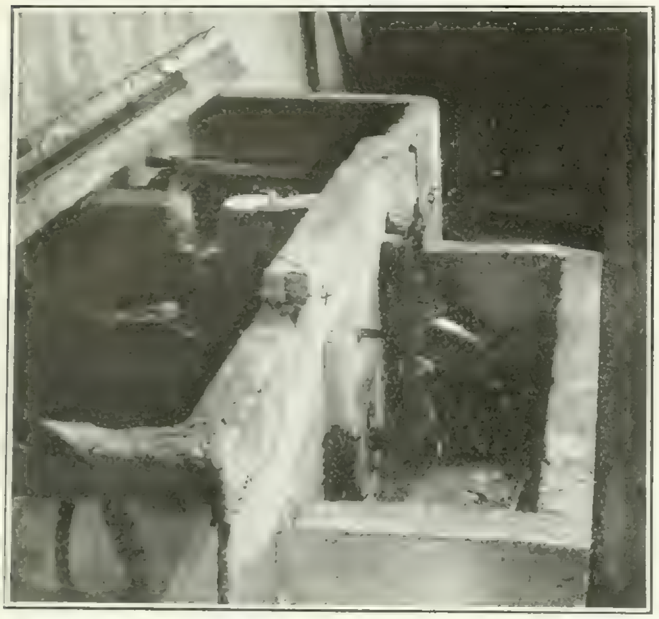
The weighted charge of calcium hypochlorite is placed in the mixing tank, a little water is added, and the mass pounded smooth and then filled to the top with water. The thick milky solution is then run into the solution tank, which is about half-filled with water. The solution tank is then filled, and the mixture stirred at intervals until an hour and a half before it is to be used, so that the sediment can completely settle out. The clear, supernatant fluid, which is alone used, flows into the constant head chamber. At first this was kept at a constant level by a valve operated by a ball float, but not proving satisfactory, a hand valve was substituted. The overflow from the chamber is caught and dipped back into the main tank whenever this becomes necessary.

A calibrated valve allows the solution to flow from this constant head chamber into the pipe leading to the grid in the tunnel shaft. A needle connected to a registering device points out the amount of water flowing along the pipe into the tunnel shaft, the mechanism having been previously calibrated by the amount of water pumped at the main pumping station. The operator opens or closes the gate valve to the proper notch, according to the flow registered by the needle.

The grid consists of a two-inch iron pipe, containing cross arms of ½-inch pipe perforated at intervals. The grid is hung across the stream of water just as it falls into the tunnel shaft, and where it gets a thorough mixing.

The plant is by no means a perfect one, but it has, on the whole, worked satisfactorily since the device for registering the flow of water has been installed. Lake Ontario water is peculiar in this, that the amount of free chlorine required to sterilize the water is very close to the amount which can be detected by taste, i.e., about .3 parts free chlorine per million parts of water. If this amount is reduced, its bactericidal effect is also reduced; if increased, it can be detected by the consumer. The application has, therefore, to be closely watched, and two men are maintained on each twelve-hour shift, night and day, one of whom has always been a chemist, to check up the strength of the hypochlorite, solutions, etc.

The efficiency of the plant may be gauged from the fact that B. coli, though frequently present in the unchlorinated water before the filtration plant was installed, and for some time after, has not been obtained in the laboratory tap since last October, a period of eight months. Fairly high counts have sometimes been obtained in districts supplied by the water after it has been passed through the reservoir or through the high-level pumping station, due to after growths of bacteria, but these are without significance. During May, for instance, the average bacteria count from the laboratory tap on gelatine was only 5 per c.c., which is quite extraordinary. The results seem to prove, moreover, contrary to the experience of Stokes and Hachtel of Baltimore, that the action of chlorine upon B. coli is selective, and that this organism is more readily destroyed than some of the other organisms present.



Toronto Water Chlorination Plant. Nos. 2 and 3, solution tanks. No. 4, constant head tank, and No. 5, calibrated valve.

Toronto Water Chlorination Plant. No. 4 shows constant head tank, and No. 5, the calibrated valve.

[illegible]

[illegible]

45 per 100,000, it was only 20 per 100,000 in 1911, in spite of the fact that for several weeks in 1911, on account of a broken intake pipe, consumers had to drink bay water, heavily contaminated with sewage.

BRITISH COLUMBIA

Application is being made by the International Railway and Development Company for a water right on the Fraser River and for a license to dam that river at a point above Yale at what is known as the canyon. The company is a new one, and the idea is also new. Local men are interested, the names of Mr. H. H. Stevens, M.P., Mr. E. W. Leeson, of Vancouver, and Mr. H. T. Thrift, of Ladner, are mentioned, with Mr. D. M. MacDuff as the company's consulting engineer. It is stated that $5,000,000 is immediately available for development purposes, and that capital up to $20,000,000 will be supplied from Great Britain. The plan outlined is to construct lines of electric railway throughout the lower mainland.

Waterpowers abound at different points on the lower mainland, close to Vancouver the centre of activity and where the biggest market for electrical energy would be found. The promoters of the company must be optimistic, or are building on securing money from Great Britain and going ahead with the project for what there is in it. At present, the field seems covered by the British Columbia Electric Railway Company and the Western Canada Power Company. The British Columbia Electric Company is constantly increasing its supply and building reserve auxiliary plants to obviate any serious loss or inconvenience loss to its patrons through a breakdown of any of its units. Still it is aggressively in the field after business, indicating that it is able to furnish power for more customers. The Western Canada Power Company has its plant thirty-five miles east of Vancouver, considerably less than half the distance to the Yale canyon of the Fraser. This company has spent three million dollars developing the power on the Stave River and is now supplying electrical energy for industrial purposes. It has a very large amount yet to place before it will have exhausted its capacity. To secure use for its power, the company has agitated the construction of an electric tram line between Vancouver and Mission, paralleling the Canadian Pacific Railway. It was in connection with the financing of this that Mr. John Hendry sounded the London market when in the Old Country in the spring.

In addition to these operating plants close to the lower mainland market, or rather in it, there is power on the Lillooet River, this side of Stave River, which has often been suggested but as yet undeveloped. There is a magnificent power on the Squamish River, a little over thirty miles from Vancouver, at the head of Howe Sound. Then there is the big power at Powell River, 80 miles up the coast, where the pulp and paper mills of the Powell River Pulp and Paper Company are located. All these are easier of development than the Fraser canyon proposition, though there is no denying the fact that once a dam was built to withstand the turbulent flow of that mighty river at its flood a great amount of power would be available. To secure adequate returns on their money, the company must expect a large increase of population on the lower mainland. In the meantime, the companies already established will not have been inactive. There is no field north or east of the city proposed, so that what power is placed would have to be utilized in the district lying between Yale and Vancouver. The scheme is no doubt feasible from an engineering point of view, though the construction of a dam to restrain the Fraser will be no easy task. The proposal is certainly speculative.

THE VALUE OF A CONTINUOUS SETTLING BASIN.*

By Alexander Potter.†

The City of Muskogee, Oklahoma, has under construction a number of improvements to its water supply and sewerage systems. The water improvements consist of an intake tower in the Grand River some 2,000 ft. above its junction with the Arkansas River, a 54-in. concrete-lined intake 2,500 ft. long constructed in rock tunnel under the Arkansas basin, the installation of additional pumping units, a water purification plant, the reinforcement of the water distribution system, and a 6,000,000-gal. equalizing reservoir, consisting of a 50-sided polygon whose walls are built entirely above the ground. That portion of the water purification plant now under construction is sedimentation assisted by coagulation with ferrous sulphate and lime. Provision is made so that ultimately mechanical filters can be introduced if they should be found necessary. In this article the settling basin only will be discussed.

The new settling basin is a reinforced concrete structure, 212 ft. square on the inside. When filled to a depth of 18 ft. this basin holds over 6,000,000 gal. A curtain-wall of reinforced concrete divides the basin into two compartments. The first or smaller of these compartments, 212 ft. long and 52½ ft wide, has its bottom perforated and underdrained. A distributing trough, supported upon the counterforts, extends the entire width of the first compartment. The water enters the first compartment from the distributing trough through a series of 8-in. openings spaced two in each panel formed by the counterforts; the counterforts are on 13 ft. 4 in. centres. A 4-in. concrete baffle or stilling-wall in front of the distributing trough extends the extire length of the basin. The water passes through the first compartment over the curtain-wall into the larger compartment. Balanced valves in the bottom of the curtain-wall equalize the pressure on the wall during filling. A collecting channel of the same size as the distributing channel is located at the far end of the basin. The water enters this collecting channel through a series of 2-ft. weirs located one in each panel. The basin is designed to operate continuously.

Advantages of Continuous Settling.—A settling basin operating continuously possesses a number of advantages over a basin which is operated intermittently. There is first a considerable saving in the size of the settling basin. This saving may amount to as much as 50 per cent. over an intermittent installation in which two basins are used, decreasing, of course, somewhat with the number of basins. When a settling basin is operated continuously, the capacity of the basin, except for the sludge displacement, is always available, which is not the case with the intermittent type. There is no reason why in a properly designed basin the settling efficiency should be impaired by the disturbance at the inlets and outlets.

Removal of Sludge.—At the Muskogee settling basin the sludge from the first or smaller compartment is removed without interfering with the efficient continuous operation of the plant by a system of underdrains in the small compartments. These underdrains consist of 3-in vitrified pipe drains, each perforated with a hole 9/16 in. in diameter. The underdrains are laid with Pioneer asphalt joints, and are arranged in five zones. The collecting channel for each zone is 8 in. deep and 14 in. wide. Each channel is covered with a 24-in. square reinforced concrete slab, perforated with a 9/16-in. hole in the centre.

The sludge valves are 12-in. hydraulically-operated valves of the Rensselaer make. Each valve controls a zone approximately 212 ft. long and 10½ ft. wide. In each zone are 405 perforations, each 9/16 in. in diameter, spaced 2 ft. on centres in rows 27½ in. apart. As the amount of sludge deposit depends principally upon the distance from the distributing trough, the arrangement of the zones is such that the sludge will be fairly uniformly deposited over the area of any one zone.

Operation.—The intervals between openings of the valves and the length of time they remain open at the outlet end of the sludge drains will vary with the condition of the raw water. The precipitated solids should not be allowed to accumulate long enough to pack over the openings. The sludge valve should be closed at once when the discharge, which is visible at all times, begins to show up clear. After the sludge is drawn off there is formed a cone-shaped depression in the deposit at each perforation. Between the perforations some of the sludge is left standing in the form of wedges and pyramids. Assuming a side slope of 45 deg. for the sludge, which is considerably steeper than most sludges stand in water, the amount of sludge that is out of reach of the underdrains in this particular case would cover the bottom, if considered uniformly distributed, to a depth of 6 in. This means a decrease in the capacity of the first compartment of approximately 2.8 per cent.

Great care should be exercised in the design of a system of underdrains such as has been outlined to insure its successful operation. The underdrains and perforations must be designed so as to give the same amount of suction for all of the perforations or holes in any one zone. Otherwise, clean water will be drawn in at those points where the suction is greatest, while sludge is still covering a large part of the opening. Such a condition not only leads to a great waste of water, but results sooner or later in the partial clogging of the perforations, and ultimately in the permanent breakdown of the underdrain system. To be efficient, the water must enter the perforations at as high a velocity as it is practicable to obtain. This means that, especially in a shallow tank, the frictional losses in the underdrains and effluent pipes and the velocity head at the discharge end must be kept down as much as possible. In the average plant the area of each valve should approximate the total area of the perforations tributary to the valves, preferably less, although this proportioning is claimed to be protected by patents. Quick-opening valves should also be used for economy. Ample provision should be made to prevent excessive pressures developing in the effluent pipe from water hammer. Valves 8 in. or smaller can be readily operated by hand; larger valves should be either hydraulically or electrically operated.

This system of sludge removal was installed by the author at McKeesport, Pa., and Georgetown, Ky.

The larger compartment of the settling basin comprises three-quarters of the total capacity of the basin. It has a sloping bottom draining to a sump. A 12-in. cast-iron sludge pipe is carried from this sump to a 24-in. vitrified pipe drain located outside of the basin. It is expected that fully 85 per cent. of the suspended solids will settle out in the first compartment. For this reason it was considered unnecessary to underdrain the larger compartment. Whenever the sludge reaches a depth of several feet or more in the larger compartment the operation of the basin will have to be suspended and the basin cleaned. The turbidity of the river water, however, is normally low, and it is not expected that this will happen more than once in several years.

The cost of constructing the underdrain system for the removal of sludge is not great when compared with the economy resulting in the cost of operation. By removing the sludge daily the capacity of the basin is not impaired as is the case when the deposits are allowed to accumulate. The emptying and cleaning of a basin is a costly operation, especially in winter time, and is to a very great extent avoided even if only a portion of the basin is properly underdrained.

---

* Abstract of paper read before American Waterworks Association at thirty-second annual convention, Louisville, Ky., June 3-8, 1912.

† Consulting Engineer, New York City.

Water Required in Cleaning.—The amount of water that passes off with the sludge in the system just described for Muskogee, it is estimated, will not exceed one-sixth of 1 per cent. of the water treated.

Discussion of Reinforced Concrete.—The basin is being constructed of reinforced concrete. It is possible to construct a monolith of considerable proportions of plain concrete. However, it is but a question of time when the unequal settlement of the foundation, always possible except when the foundation is solid rock, and the shrinkage and temperature stresses set up in the mass, destroy the continuity of the structure. On the other hand, it is possible to construct and maintain as such, a reinforced concrete monolith of very large proportions.

There appears to be some doubt that thin sections of reinforced concrete are suitable for water-tight structures. There need be no fear whatever that there will be any trouble if the work is carried out as it should be. The water-tightness of concrete depends principally upon the amount of cement present, provided the sand and stone or gravel are properly proportioned. Six bags of cement per cubic yard of concrete is ordinarily sufficient to produce a water-tight mixture. This amount, however, should be increased when the hydro-static head is considerable.

The author is opposed to the use of waterproofing ingredients or waterproofing applications. Both increase the cost of the concrete work considerably. It is far better to put the value of the waterproofing materials into the concrete itself by adding more cement. The use of a waterproofing ingredient or application tends to poor construction work, the contractor counting upon the waterproofing to help out careless construction.

The author, from his study and experience in the construction of tanks and reservoirs, has reached the conclusion that leakage may be due to any one of the following causes:

(1) Faulty construction, (a) Lean and porous concrete work. (b) Inexperience and carelessness in carrying out the construction.

(2) Faulty design. (a) Weak details at the connections. (b) Excessive secondary stresses at connections. (c) The use of too high unit stresses in steel and concrete.

Faulty construction can be rectified to some extent, but often only at a considerable cost, by waterproofing the structure from the inside. Leaks developing through faulty design are, on the other hand, always difficult to master, and in many cases very little can be done to remedy the unsatisfactory condition of the completed structure. To guard against the production of lean concrete work, the author's specifications provide that all cement used in the work should [illegible]

As 10 ft. of the basin is constructed below the original [illegible] widening out to 18 ins. at the bottom. The floor [illegible] will however, be an expansion joint between the present [illegible]

[illegible]

both plain and reinforced, especially with reference to the conditions under which such construction has given more or less trouble.

Details of Design of Basin.—The success of a reinforced concrete structure of any magnitude depends primarily upon the thoroughness with which the various structural details, especially the connections, are worked out. The connections should receive the same careful attention that is given them in structural work. The author, therefore, thinks it advisable to dwell as some length upon the design of the structure.

The Muskogee basin is being constructed of gravel concrete. The gravel is washed river gravel obtained from the bed of the Arkansas River. Its size is limited to 1 in. in the side walls and counterforts, and to 2 ins. in the bottom. The sand is a very coarse river sand, obtained from the same river. It is clean, coarse and sharp, and makes a splendid concrete sand. The concrete is being mixed approximately in the proportion of one part of Portland cement, two parts of sand, four parts of gravel. The mixture is changed slightly from time to time to meet slight changes in the quality of the aggregate.

In the design of the structure, the unit stresses were assumed as follows:

fc = The maximum allowable working compression in the concrete in flexure, 650 lbs. per sq. in.

fs = The maximum allowable tension is the steel, 14,000 lbs. per sq. in.

v = The maximum intensity of transverse shear in concrete (assuming a uniform distribution of the shear) 50 lbs. per sq. in.

u = The maximum working adhesion or bond stress between the concrete and deformed bars, 80 lbs. per sq. in.

e = The ratio of the modulus of elasticity of steel to concrete, 12.

These values are conservative. They limit the percentage of the steel to be used in the structure to 0.83 per cent. of the area of the concrete above the steel.

The following equations, with numerical constants, have been developed in accordance with the now universally recognized theory:

$$q = \sqrt{\frac{M}{8.54}} \qquad \text{(Equation 1)}$$

$$As = \frac{M}{1020 \times q} \qquad \text{(Equation 2)}$$

Where q is the distance from the compression side of the beam to the steel, known commonly as the effective depth of the beam; M is the bending moment in foot-pounds per inch width of beam, and As is the area of the steel required.

Equation 1 gives the effective depth of the beam when the bending moment is known and the reinforcement is fixed at 0.83 per cent. of the area of the concrete above the steel.

Equation 2 gives the amount of the steel reinforcement when the bending moment is known and the depth of the beam (q) is fixed. It can only be used when the percentage of steel reinforcement is 0.83 per cent. or less.

Design of Side Walls.—The reinforcement in the side walls and their construction make them partially continuous. The common theory of flexure as we know it is applicable to this case, but not with the numerical constants familiar to us. The allowance that is usually made in reinforced concrete construction for the increase in strength due to the partial continuity is a reduction of from 25 to 50 per cent. of the bending moment computed on the basis of a simple beam. The exact amount of the increase in strength due to partial continuity can be computed in any one case when all the factors are known. The process, however, is a very tedious one, and entirely unnecessary. A fair assumption as to the allowance can nearly always be made. In this case, on account of the small amount of reinforcement in tension over the counterforts, this reduction has been taken as 25 per cent.

For the design of a tank, equations 1 and 2 can be put in a more convenient form, as follows:

Replacing M by its value $\frac{(w \times X \times L)^2}{10 \times b}$, where w is the weight of the water, 62½ lbs. per cu. ft., X the depth of the water, L the clear span between counterforts, b the width considered, namely 12 ins., we get,

$$q = 0.247L \times \text{square root of } X \qquad \text{(Equation 3)}$$

$$As = \frac{(.00051XL)^2}{q} \qquad \text{(Equation 4)}$$

Equation 3 gives the minimum effective depth of the beam or slab at any depth (X ft.) below the surface of the water. Equation 4 gives the amount of the steel reinforcement required per inch width of beam when the effective depth (q) is fixed. It cannot be used, however, when the percentage of steel reinforcement exceeds 0.83 per cent.

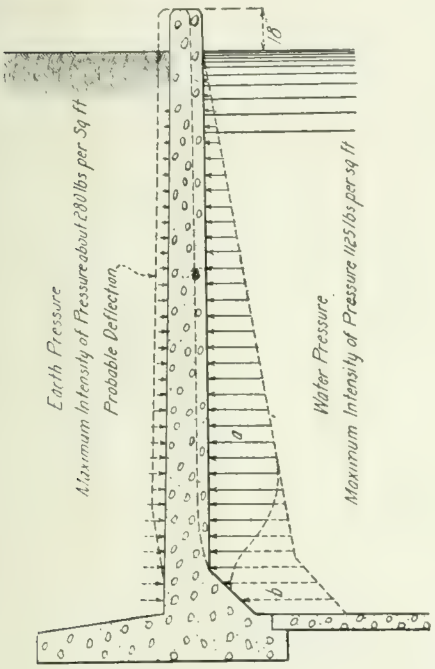

18
Earth Pressure
Maximum Intensity of Pressure about 280 lbs per Sq ft
Probable Deflection
Water Pressure
Maximum Intensity of Pressure 1125 lbs per sq ft
a
b

Fig. 1.—Diagram of Forces Acting on the Walls.

Figure 1 shows the forces that are acting on the walls. The water pressure increases from zero at the water surface to a maximum of 1,125 lbs. per square foot at the bottom. Only a portion of this pressure, namely, that portion marked a, is carried by beam action to the counterforts. That portion marked b and shown by the dashed arrows, is carried by cantilever action directly to the footing. The diagram shows that the walls receive their maximum stress as a beam at a point approximately 15 feet below the water level. The minimum thickness of concrete wall that it is possible to use under the conditions assumed is computed as follows from equation 3: Substituting in this equation, we have

$$q = 0.247 \times 12.08 \times \text{square root of } 15 = 11.55 \text{ ins.}$$

Allowing 2½ ins. of concrete to cover the steel, we obtained a minimum thickness of 14 ins. The plans show the thickness of the wall at this depth to be 17 ins. On account of the low cost of the concrete materials and the comparatively high cost of the steel reinforcement, it was deemed more economical to use a heavier section than the minimum that could be used. In places where concrete materials are costly, it would be possible to construct the side walls 8 ins. thick on the top and 15 ins. thick at the bottom.

The amount of steel reinforcement, As, that would be required 15 ft. below the water level can be readily obtained by means of equation 4: $As = \frac{.00051XL^2}{q}$.

Substituting for X, 15 ft; for L, 12.08 ft., and for q, 14.64 ins., we obtain, As = .0763

The spacing of ¾-in. round rods will be .4418 (the area of a ¾-in. round rod divided by .0763 (the amount of steel required per lineal inch), giving 5.79 ins. as the spacing. The drawing shows the spacing to be 5.5 ins. at this point.

In Fig. 1 is shown graphically by dotted arrows the earth pressure acting against the wall from the outside. It is proposed to back up the walls of the basin on three sides, as shown on the plan. As there is a possibility that this backing may be removed at any time, no allowance whatever has been made for the additional stability given to the tank by this backing.

Attention is called to the connection of the walls of the tank to the bottom. The pressure from within forces the side walls outward, the deflection reaching the maximum half-way between the counterforts. The connection of the walls to the footing must be either a sliding joint to permit of this movement, which is impracticable, or sufficient reinforcement must be provided to prevent the possibility of rupture at this point. Fig. 1 shows diagrammatically, but in a somewhat exaggerated form, the deflection of the side walls at the centre of the span when the reservoir is full of water. The rigid connection spoken of is a concrete fillet 18 ins. on the side, reinforced with ½-in. round bars spaced 12 ins. on centres. This rigid connection transfers by cantilever action some of the hydrostatic pressure against the lower portion of the wall directly to the footing. The amount of this pressure transfer is shown diagrammatically by the dashed arrows in Fig. 1, marked b.

Figure 2 shows all of the forces except the earth pressure, acting on a section of the tank 13 ft. 4 ins. long, including one counterfort and half of the clear span of the walls on either side of it. The total weight of the concrete for this section is 106,150 lbs., with its centre of gravity located 9 ft. from the heel (o) of the footing. The total horizontal water pressure against this part of the tank is 135,000 lbs. and the weight of the water resting on the footing is 150,000 lbs. Let us assume for the present that the sliding of the wall is prevented by the tension in the bottom. This tension amounts to 10,100 lbs. per lineal foot of footing and is shown acting 1.25 ft. above the bottom of the footings. All these forces are shown in their true positions in this figure.

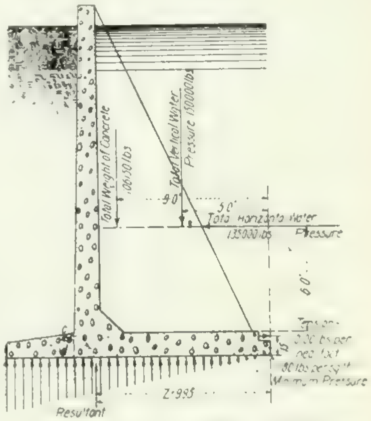

Total Weight of Concrete 106150 lbs
Total Vertical Water Pressure 150000 lbs
9.0'
5.0'
Total Horizontal Water Pressure 135000 lbs
6.0'
Tension
lbs per
foot
lbs per sq ft
Maximum Pressure
Z·995
Resultant

Fig. 2.—All Forces Acting Except Earth Pressure.

Since the forces shown acting on this portion of the structure are in equilibrium, we have

$$z - \frac{\Sigma Mo}{\Sigma W} \text{ or}$$

$$\begin{aligned} 106{,}150 \times 9 &= +955{,}350 \\ 150{,}000 \times 5 &= +750{,}000 \\ 135{,}000 \times 7.5 &= 1{,}012{,}500 \\ -135{,}000 \times 1.25 &= -168{,}750 \\ \hline \Sigma M &= 2{,}549{,}100 \\ z &= 9.95 \\ \Sigma V &= 256{,}150 \end{aligned}$$

This shows that the resultant pressure on the footing, namely, 256,150 lbs., pierces the base 9.95 ft. from the heel, which is practically two-thirds of 15⅓ ft., the width of the base. Consequently, the distribution of the foundation pressure on the footing is in the form of a triangle, about as shown in the figure. It reaches a maximum pressure of 2,300 lbs. at the toe and nearly zero at the heel. Sufficient steel is provided for in the bottom to take care of a tension of 10,100 lbs. per lineal foot of footing where it joins the 6-in. concrete bottom. This reinforcement consists of ⅜-in. round rods spaced 6 ins. centres. The plan erroneously shows these bars to be placed 12-in. centres. This amount of steel is sufficient to resist this tension at a unit stress well within the elastic limit of these steel bars. The author does not wish to convey the idea that this tension is developed to the extent shown in Fig. 2. A very large proportion of it will be developed by friction between the footing and the supporting earth, and some by the earth backing, which, however, will not be always present.

Design of Counterforts.—Figure 3 shows the forces acting on the counterforts proper. The reaction of the walls, tension in this case, amounts to 93,500 lbs., and its distribution is about as shown in the figure. It reaches its maximum 15 ft. below the water level. This tension is taken care of by thirty-two ½-in. round bars at an average unit stress of 14,900 lbs. This is not a very high value. In the discussion we have ignored the additional stability received from the earth pressure, and also the tensile strength of the concrete in the counterforts, which may be considerable.

The greatest of care must be taken to anchor the walls to the counterforts. In this case, this has been done by threading the ends of the ½-in. tension bars and fastening them with double nuts to two 2½-in. by ⅜-in. plates, 18 ft. long, embedded in the walls, as shown in the reinforcing plan. The object of the double nut is to prevent the possibility of play at the joint.

A study of this figure shows that the counterfort is not a cantilever at all. In a cantilever, the internal resisting forces acting on the plane yz, must balance algebraically, that is, the total tension must be equal to the total compression. This is not the case in the counterfort, as can be readily seen. The forces that act on the counterfort are as follows:

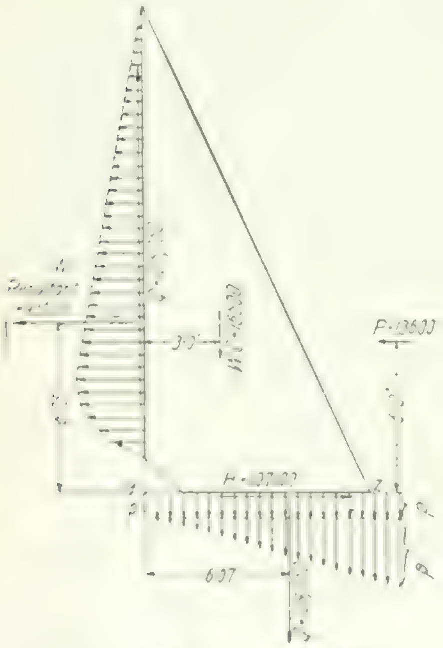


Fig 3.- Stresses Acting on the Counterfort Proper.

W, the tension exerted by the walls on the counterfort, 93,500 lbs.

P, the horizontal pressure of the water acting against the counterfort proper, 13,600 lbs.

W¹, the weight of the counterfort proper, 16,500 lbs.

Q, the total tension between the footing and the counterfort along the plane yz, 109,250 lbs., shown acting 6.07 ft. from the point y.

Q¹, the shear between the counterfort and the wall of the basin, 109,250 lbs. plus 16,500 lbs.

R, the horizontal shear acting along the plane yz, 109,250 lbs.

The determination of the resultant tension Q and its distribution with reference to the plane yz, is a very interesting one, and is for this reason given in detail. Taking moments about the point y, we obtain the following equation:

[illegible]

In this equation, there are two unknown quantities, p and p¹. A safe assumption to make, since there is no tension at the heel (c) is that p + p¹ cannot exceed the sum of the weight of the water above the footing and the weight of the concrete itself. This amounts to 1,350 lbs. per square foot of footing, thus giving the additional equation

$$p + p^1 = 1350 \times 13.33$$

From these two equations we obtain

$$p = 3,850 \text{ lbs. and}$$
$$p^1 = 14,150 \text{ lbs.}$$

The total resultant tension Q, and its location, can now be readily found, and is given in the figure as 109,250 acting 6.07 ft. from y.

This tension of 109,250 lbs. is taken care of by sixteen ⅞-in. round bars at an average unit stress of 11,350 lbs. The maximum stress in these bars probably reaches 14,000 lbs. per square inch. The bars are anchored in the concrete footing by two 2½-in. by ⅜-in. plates 8 ft. 6 ins. long, to which they are fastened by double nuts.

The distribution of the pressure along the plane yz is a more or less indeterminate one. It depends principally upon the shape and the reinforcement of the footing course. Only in a very special case will its distribution be such as to make the counterfort a cantilever. The method so often followed of designing a counterfort as a cantilever and placing all the steel reinforcement in the back of the counterfort, is an erroneous one. It places in the footing course a concentrated and rather high tension, and at a point where it cannot be properly taken care of, thus producing enormous secondary stresses in the footing, which would be a serious defect in the structure.

Design of Corners.—The reinforcement of the corners of the settling basin is of some interest. This reinforcement consists of a triangular concrete fillet 24 ins. on each side, reinforced with ⅜-in. round bars, each 6 ft. 3 ins. long, and spaced the same as the ¾-in. horizontal reinforcement in the walls of the basin. The adhesion between the steel and the concrete is counted upon to securely tie in the corner. No rigid connection whatever is used for the reinforcement.

Design of Footings.—The footing overhangs the wall for a distance of 4 ft. It is 18 ins. thick at this point where it joins the wall and narrows down to 12 ins. at the outer end. The following computations give some idea as to the methods used in designing this footing.

The upward pressure on the overhanging portion ranges from 2,300 lbs. per square foot to 1,750 lbs. per square foot. The thickness of the footing at c-d, Fig. 2, should be sufficient to keep the shearing stress down to a safe working value. The total upward pressure per lineal foot of footing course, amounts to 8,100 lbs. This gives an average value for the shear of 37.5 lbs. per square inch—a very safe value. Equation 2 can be used to compute the amount of steel required, as follows:

$$As = \frac{M}{1020 \times q}$$

where M represents the bending moment in foot-pounds per lineal inch of footing at the plane c-d, which amounts to 1,410 foot-pounds.

q is 18 ins. minus 3 ins.

Substituting in this equation, we obtain for As, 0.0922 sq. ins. This amount of steel requires a spacing of 4.80 ins. for ¾-in. round bars. A spacing of 6 ins. is shown on the plans. This spacing used is considered ample, as the computations just outlined do not take into consideration the weight of the overhanging footing nor the weight of the earth backing.

The above general outline of the methods used in designing the settling basin conveys some idea of the thoroughness and carefulness with which a structure of this type must be designed.

Horizontal construction joints are used freely. The unfinished surface is always left in as rough a condition as possible, but never roughened up after the concrete has partially set. The author has found that this roughening often loosens the stone in the concrete, but not sufficiently so that they can be removed, a condition which is apt to impair the water-tightness of the structure. To start a day's work, the surface is thoroughly cleaned with wire brushes and water, and a cement liquid mortar mixed in the same proportions as the mortar in the concrete, is poured over the old work to a depth of ½ in. This method always gives a good water-tight horizontal construction joint.

Vertical joints are permitted only in certain places, as these joints are very difficult to make water-tight. All vertical joints in the walls are made directly over the counterforts.

The specifications call for two coats of neat cement wash to be applied with a white-wash brush on the inside of the basin. Both of these coats are to be applied to the concrete when damp but not wet, and the second coat must be applied before the first one has had time to get very hard. Any leakage that may develop in the basin previous to its final acceptance must be repaired by the contractor, at his own expense, no additional compensation whatever being permitted for this work under the specifications. The contractor, realizing the importance of doing conscientious work all the time to prevent subsequent trouble from leakage, is producing a first-class structure. The work is beind done so thoroughly that very little leakage, if any, is expected when the basin is filled for the first time this summer.

The contract for the construction of the basin was let to W. W. Fuller, of Muskogee, Oklahoma. The following is an approximate estimate of the quantities of material required, together with the contract unit prices:

18,000	cu. yds. of earth excavation at $0.40	$ 7,200.00
1,930	cu. yds. 1:2:4 concrete at $6.25	12,062.50
820	cu. yds. 1:3:6 concrete at $5.40	4,428.00
4,000	bbls. of cement at $1.40	5,600.00
220,000	lbs. of steel at $0.035	7,700.00
3,520	ft. 3-in. vitrified sewer pipe at $0.20	704.00
800	ft. 6-in. vitrified sewer pipe at $0.20	160.00
220	ft. 24-in. vitrified sewer pipe at $3.50	770.00
1	manhole complete	50.00
160	ft. 12-in. cast iron pipe at $2.25	360.00
40	ft. 18-in. cast iron pipe at $4.00	160.00
380	ft. 36-in. cast iron pipe at $8.00	3,040.00
28,000	lbs. cast iron specials at $0.05	1,400.00
5	12-in. gate valves at $10.00	150.00
6	18-in. press. equalizing valves at $12.00	72.00
1	24-in. tidal valve at $18.00	18.00
485	ft. 1½-in. pipe railing at $0.60	291.00
	Superstructure for valve chamber	500.00
1,000	lbs. wrought iron and steel at $0.05	50,00
300	ft. ¾-in. galv. w. i. pipe at $0.30	90.00
	Total	$44,805.50

The imports of iron and steel from the United States for the fiscal year ended March 31st, 1912, totalled $36,382,725, as against $29,307,039 for the previous year. This total does not include machinery, agricultural implements, nor many other articles properly classified as iron and steel. The gain in imports from the United States the last fiscal year in the above items of iron and steel was $7,075,686, or more than 27 per cent.

SOME NOTES ON BAND CONVEYORS.

By F. Tissington.

This is the first of a series of articles by Mr. Tissington on Band Conveyors.—Editor.

At the present time band conveyors are used for conveying all kinds of material, and they can be found scattered all round the world generally fulfilling their duty comparatively with little cost for maintenance providing the original designing of their various parts has been carefully considered to suit their requirements.

The following is a list of a few of the uses to which they have been put and this is only given to show their adaptability.

In collieries, docks, store yards, storage bins, etc., for transportation of coal from one point to another, also for the purpose of cleaning and sorting same into various grades.

In gasworks for charging retorts, conveying coke and other substances.

Also for the conveyance of all kinds of earth, clay, rock, ore, sand, gravel, cement, plaster, paper and pulp.

They are also used for transporting sugar, wet charcoal, grain of all descriptions, postal packets and letters, and even invade our workshops to handle small repetition parts collecting same from the machines and delivering them to the store or any other point desired.

There are, of course, dozens of other purposes for which they are or can be utilized, and if any manufacturer has a conveying problem of any kind that involves any quantity of hand labor he would do well to consider the idea of installing either a band conveyor or a mechanical conveyor of some other type, because of all costs in the process of manufacture, generally speaking, that of hand labor is the highest, and a machine, unlike the ordinary human being, does not require to stop for a time every now and again to rest a while. A little oil and a small amount of adjustment occasionally being sufficient.

Its adaptability is again emphasized by the fact that it will not only run horizontally in one direction but may be made to reverse the direction with very little additional gear. Also it may be inclined to almost any angle, depending, of course upon the nature of the material and the construction of its top surface.

For instance, the writer has known of one conveyor working at about forty degrees with the horizontal conveying flat packages, the only addition to the ordinary type being a number of wooden slats bolted on to the working surface of the belt to prevent the packages sliding down the incline. Going further still, we find the band conveyor turned into an elevator with buckets attached to the band and working vertically.

The construction of these belts is very simple, consisting only of two terminals, generally one being the driving end and the other the tension end, the supporting rollers for the carrying and return sides, the belt itself, and the framing to carry the gearing and rollers.

Sometimes, however, the gearing may be placed with advantage in the middle of the belt owing perhaps to this position being near the source of power for driving same, but this is by no means usual. If this is done, it is generally necessary to arrange the driving drum on the bottom or return strand.

Further, it is practicable to arrange the driving gear at either the loading or delivery end, but where possible it is an advantage to place it at the delivery end especially in long conveyors.

The tension gear may be either of an adjustable screw design or an ordinary weighted tension, and this, like the driving gear, may be placed almost anywhere taking into account, of course, local conditions and the general disposition of the plant. It is preferable in the case of long conveyors to use a weighted tension as there is a certain amount of lengthening and shortening of the fabric of the belt due to atmospheric conditions, and this alteration in the case of a long belt would necessitate constantly adjusting the tension gear if it was of the screw type, whereas with the simple weighted tension this arrangement automatically makes its own adjustment. The weighted tension gear has also another advantage and that is, it is impossible for the attendant to overstress the fabric which could be done with the other type.

The supporting rollers, idlers, as they are usually called, are made in various designs according to the fancy of the manufacturer or purchaser, but, generally speaking, they consist of a roller, or series of rollers, mounted on a spindle carried in bearings having grease lubrication. If a troughed top strand is required, each set of rollers is then generally made up of a series of small ones, some being set at the necessary angle to form the top strand into the trough shape. This type is much to be preferred to the conical roller all in one piece as the full width of the band is travelling at the same speed all across its surface. But on the roller either the outer edge of the cone is travelling faster or the smaller diameter is not running as fast as the band, and this sets up quite a considerable amount of friction liable to wear the band out very rapidly. The return strand is always carried on flat rollers similar in construction to the top rollers.

Some firms make a practice of putting in guide rollers. These are set at right angles to the edge of the belt and are intended to keep the band running true on the rollers. These are generally omitted on belts of short length and a common practice is to place a pair (one on each side of the belt) about every sixty feet. It is claimed that these are necessary owing to the belt having a tendency to run up the inclined rollers forming the trough in a similar manner that an ordinary driving belt keeps in the centre of a crowned face pulley.

Another method adopted to keep the belt in line is to set the top idle rollers at a very slight angle with a line drawn at right angles to the length of the band, that is, one would be set slightly out of line one way and the next the opposite way.

The conveying bands are manufactured in a number of [illegible] woven cotton, canvas or duck, either plain or impregnated with some kind of waterproofing material such as Salata, tar, or rubber coating. For most purposes, however, a rubber impregnated belt with an additional rubber covering will give the best results, as this [illegible] a belt impervious to water. If the belt is being continually exposed to the action of rain it will soon rot away. Further, the rubber covering is a factor in preventing an undue lengthening and shortening [illegible] atmosphere. [illegible] the life of the rubber covering [illegible] the life of the belt as a whole, even [illegible] quarter of the [illegible]

[illegible]

[illegible] ordinary cotton belt used as a picking conveyor for coal at a colliery only lasted about seven or eight months, and the expense of renewing it so often made the maintenance cost very high, but rubber faced belts used for similar purposes will last you two, three and perhaps four years if they are properly handled.

There seems to be quite a difference of opinion as to the desirability of making the belt of even plies right across its width, or of reducing the plies in the centre of the belt and thickening the rubber facing.

The general practice in this country seems, however, to lean towards the even ply belt, whereas in England the reverse is the case.

The writer's opinion inclines towards the uneven ply belt with an additional thickening of rubber in the centre where all the abrasive action takes place, because as soon as this protective covering is destroyed the final destruction of the belt is soon brought about. It is a good plan to overhaul the belt periodically and repair any bad cuts with a good stiff rubber solution; also where any sand or grit slobs have been made under the surface they should be taken out and the cut repaired in a similar manner.

If this is done it will be found that the life of the belt will be much longer and will repay the expense incurred. The rubber coating varies from about one-sixteenth to a quarter of an inch, and the ples of the canvas or duck vary from about three to seven or eight according to the kind of material to be conveyed, the width and the length of the belt.

If material of a sticky or wet nature is being conveyed it is a wise plan to arrange a brush under the delivery shoot to clean the face of the belt, otherwise rapid wear is liable to take place owing to the gritty matter being carried round on the underside and thereby come into contact with the snub or gripping rollers and the bottom guide rollers. Further, this grit is likely to get into the bearings of the rollers and cause trouble with these also.

Another good point in an installation of this kind is to avoid all sharp reverse bends of the belt as far as possible, although sometimes this is not altogether practicable. The framing for these conveyors is generally of a very simple character simply consisting of cross supports for the rollers carried on longitudinal stringers of iron or steel. The latter are usually made to suit the general layout of the rest of the structure.

When starting to design a plant it is necessary to know the kind, quantity, general size of the material required to be handled, the magnitude of the largest pieces; whether the material is of a sticky or wet nature. The general layout of the surrounding structures. The points at which the material will be loaded on the band and also where it is required to be delivered, and the relative elevations of these two points, if they are not at the same height. Also whether it is proposed to drive by electric motor, steam engine, or from an existing shaft, and if the latter is the case, the size, speed and direction of rotation should be given and the position of same should be shown on a small sketch in relation to the rest of the other particulars required as to the location of the belt and the surrounding plant. With this information it will be possible for the designing engineer to submit a scheme suitable for the purpose required.

Having now got a general idea of the uses of belt conveyor installation with some of its general features, it is proposed to discuss a few of the smaller parts and then give some data on the capacities, horse-power required to drive same, etc.

THIRTY YEARS' PROGRESS IN THE ELECTRIC FURNACE.*

By F. A. J. Fitzgerald.

There has been so much written about the electric furnace since it entered into regular commercial use about 20 years ago that the presentation of a paper on the subject treating it in a general way is not apt to be interesting. But a promise to attempt the preparation of such a paper having been given, it was thought that there might be some interest attaching to a review of the development of some furnaces during the past 30 years. Moreover, it is often useful to look back over ground that has been covered in order to obtain suggestions as to the best direction to be taken in attempting further advances.

It is now 30 years since Sir William Siemens melted about 20 pounds of steel, as well as platinum in notable quantities in an electric furnace with which he had been experimenting since 1878, and since then the electric furnace has so far developed that there are great numbers, both in Europe and this country regularly engaged in the commercial manufacture of steel. While it is true that others had made some use of electrothermic methods at a much earlier day, for example Despretz, whose source of current was 600 Bunsen cells, yet Siemens' furnace must be considered the first really practical one, coming as it did after the invention of a cheap source of energy—the electric generator.

Siemens' work is of particular interest because he saw the possibility of using the electric furnace for steel manufacture, and, so far as the principles are concerned, they are the same as those in actual commercial use to-day. One of his furnaces was made of a graphite or other refractory crucible enclosed in a jacket of heat insulating material. Inserted in the bottom of the crucible was an electrode of iron, platinum or carbon, while passing through the cover of the crucible was another electrode. The latter was connected to automatic regulating device consisting of a solenoid, this serving to vary the length of the arc and thus keep the rate of generation of energy constant. In working the furnace the steel or other metal was introduced into the crucible and made contact with the lower electrode, while an arc was drawn between the upper electrode and the charge. In such a furnace Siemens melted steel in quantities of more than 20 pounds.

In another form of electric furnace devised by Siemens, the electrodes entered the crucible in a horizontal direction near the top and opposite one another so that an arc was formed between them and heated the charge below by radiation.

Siemens' work must be considered as the forerunner of at least two well-known kinds of electric steel furnaces which are in existence to-day in actual comercial use for the manufacture of steel, although he never was able to do commercial work with his apparatus because electrical engineering was not sufficiently advanced.

The growth of the Siemens' electric furnace for steel making was at first slow for numerous practical difficulties in its working had to be overcome, but so many of these have at last been met successfully by men like Heroult Girod, Stassano and others who have modified the apparatus in various ways, that now we have furnaces like those of the Steel Corporation in Chicago and Worcester working on charges of 15 tons of steel.

Siemens in his furnace used direct current and laid particular stress on the point that the charge should be connected to the positive side of the circuit, since it is well known that in the electric arc it is at the positive electrode the main generation of heat occurs. In the modern furnaces, however, alternating currents are used for obvious reasons, and the surface of the molten bath is covered with a layer of slag which becomes intensely heated, not only by the arc but by the current which it carries. In this way ideal conditions are obtained for refining the metal as the steel and the molten slag between which chemical reaction is desired are intensely heated at their surfaces of contact. Moreover, the slag effectually prevents the introduction of carbon from the electrodes into the metal. The problem of regulating the electrodes automatically has also been successfully worked out by means of the well known Thury regulator, though it would seem that this could be simplified.

There were, of course, a large number of metallurgical problems to be worked out in connection with the steel furnace, but these have apparently been met successfully, and we finally have the electric furnace working alone commercially, or what is perhaps more generally important, acting as an auxiliary to fuel heated furnaces. The most serious problems connected with furnaces of this type at the present time are those relating to electrodes and roofs. Some years ago when the electric furnace was working on a much smaller scale than is demanded to-day, the strongest argument advanced against it was that the cost of heating by means of an electric current must of necessity be so excesive that the idea was impracticable. That, however, is criticism seldom heard to-day for it has been found that in actual practice the furnace can be so used that the question of cost of electrical energy is by no means of the first importance. On the other hand, little used to be said about electrode cost, but now that is a most vital question and is apt to enter into the total cost of working as a much larger item than power.

The manufacture of large carbon electrodes, say 20-in. (50.8 cm.) square and from 7 to 10-ft. (2.3 to 3.04 m.) long, is by no means easy, and even when they are successfully made in the electrode factory they may go to pieces in the furnace. Even if they do not break there is the problem of "butts." Suppose a large electric steel furnace with the roof three ft (0.91 m.) away from the bath, then it is safe to say that when the electrode holder is lowered down and comes in contact with the roof of the furnace, that there will be a carbon "butt" about four ft. long (1.22 m.) which must go in the scrap pile. Apparently this serious difficulty is going to be overcome by electrodes which can be fastened end to end so that they may be continuously fed into the furnace, and thus there will be no waste from "butts." Within the last few months there has been a good deal of work done in this direction and the results are very promising. The electrodes are made with a circular cross-section instead of square and have threaded sockets in the ends so that by means of threaded plugs the electrodes may be fastened together and thus fed continuously into the furnace without any waste.

This, as has been said, is promising, but has the limit of the electric steel furnace been reached as regards size? Except as regards electrodes there is no reason to believe that it has, but the 15-ton furnaces working now, need electrodes about 20 in (50.8 cm.) in diameter, and if the size is doubled and the general design is kept the same.

---

*A paper presented at the 29th Annual Convention of the American Institute of Electrical Engineers, Boston, Mass., June 25, 1912.

electrodes 27 or 28 in (68.5 or 71.1 cm.) in diameter will be required. Perhaps these can be made and can be used continuously as described above, but the writer believes that development in this direction is a mistake, and that far better results can be obtained by multiplying the number of electrodes and keeping the size within reasonable limits. This is not merely a question of avoiding the difficulties of large electrode manufacture, but involves more efficient and satisfactory working of the furnace. It will readily be seen that distribution of temperature in the furnace is bound to be better as we multiply the relatively small areas where the heat is generated, and this is an important consideration. The objection that is raised to this proposal is the difficulty of regulating the rate of generation of energy at the various electrodes. It does not seem that this difficulty is a real one.

The roof problem is altogether a different one. It must be remembered that the heating effect in the steel furnace is generated in an arc and in a resistor formed by the slag, and that consequently the surface of the slag is intensely hot, particularly where the arc strikes it. These conditions are very severe and combined with the corrosive action of the lime which is vaporized from the slag, make the roof renewals a heavy item in the cost of electric steel.

This problem has recently been the subject of careful study in two research laboratories, with one of which the writer is connected. As a result of a great deal of experimental work a brick made of silicon carbide has been manufactured which it is believed will have a much longer life in the steel furnace than the silica brick now used. The brick is made by taking powdered or granular silicon carbide, mixing it with a suitable temporary binder, such as a solution of dextrine, molding and then heating in an electric furnace to the temperature at which silicon carbide is formed. Bricks made in this way have been used in the roof of an experimental steel furnace in one of these laboratories and then put to the severest test possible. The bottom of the furnace was purposely raised well above the normal level so as to bring the surface of the slag as close to the roof as possible, the actual distance in some experiments being only 10 in. (25.4 cm.) Then the furnace was worked at double the normal rate of generation of energy so that the heating of the roof was very intense, so much so that an ordinary silica roof would melt down rapidly and be completely destroyed in a single heat. Even under these very severe conditions the silicon carbide roof stood up perfectly. Experiments have also been made in other steel furnaces and these results confirmed. The most serious objection to a roof of this kind is its relatively great cost, but if it lasts a sufficiently long time it is nevertheless economical.

Twenty-five years ago Ferranti in England and Colby in this country worked on the very interesting furnaces known as the induction type. In this the secondary of a transformer consists of the metal to be melted. As in the case of the Heroult furnace the original inventors were too far ahead of the times and it was not till 10 or more years later that any commercial application of the furnace was made. Since then the induction furnace has developed considerably and is now used with success in the manufacture of steel. An objection to the induction type is that the low power factor gives rise to certain problems, connected [illegible] which are serious where it is desired to build furnaces of large capacity. The worst of these is the very low power factor of the furnace. To overcome this objection [illegible] plant [illegible] to have a generator furnishing currents of excessively low frequency. Thus, at the Völklingen steel works a generator giving a current of 15 cycles is used, and for larger furnaces it has been proposed to use a five-cycle current. In an experimental induction furnace plant built by the writer's laboratories for an electric furnace company at Niagara Falls, the low power factor was corrected by using a synchronous motor as a condenser.

Nearly thirty years ago the Cowles brothers were working with the electric furnace in attempts to heat the charge of zinc retorts by electrical means. The principle involved in this case was mixing with the ore to be reduced a certain amount of carbon which not only acted as a reducing agent, but made the charge as a whole a conductor of the current. This furnace may be considered the forerunner of an immense number of electric furnaces in operation to-day, furnaces for making calcium carbide, the ferro alloys, iron ore smelting, graphitizing, etc. The Cowles furnace was a small one, but since its day the development of the electric furnace helped by the corresponding development of electrical apparatus has led to the construction of units of continually increasing size. To follow up the development of these furnaces would certainly trangress the limits of this paper, and instead, the development of a somewhat different type will be considered because the writer has been more intimately associated with it, and because it contains points which are, perhaps, of more particular interest to the electrical engineer.

In Acheson's first experiments which led him to the discovery of silicon carbide (carborundum) he used a furnace of the Cowles type. It consisted of a small brick box with carbon terminals at each end so arranged that they could be moved in and out in a horizontal direction. This box was then filled with the mixture of sand and coke (clay and coke in the earlier experiments) and the terminals brought together, or very close to each other, and then gadually withdawn as the furnace heated. It was soon observed that a more satisfactory way of constructing the furnace was to have stationary terminals connected to each other by means of a resistor composed of granular carbon and then surround this with the charge. With such an arrangement it was necessary to have some means by which the voltage could be regulated so as to keep the rate of generation of energy in the resistor constant throughout the run. This was found by Acheson to be a much more satisfactory way of working the silicon carbide furnace, and by experiment he found the best dimensions for his resistor. In the original small plant, where the furnaces had a capacity of about 100 kilowatts, the generator supplied current to a great bank of small transformers so that variations in the voltage could be obtained by suitable connections of the secondaries. When, however, a plant was established at Niagara Falls using furnaces of 750 kilowatts, the problem of varying the voltage at the furnace terminals became important. This was solved by the construction of a large induction regulator to be used in the secondary circuit of the transformer which stepped down the primary current of 2200 volts to 160 volts. The induction regulator then made it possible to vary the e.m.f. by 60 volts on either side of this, so that at the furnace terminals the total range was from 100 to 220 volts. For furnaces of this resistant type the induction regulator is an ideal apparatus, and it is to be regretted that it is not more generally used. The objection raised to it is usually its relatively high cost, but the convenience and simplicity of the apparatus far more than compensate for the extra cost. In working with a furnace having a carbon resistor the resistance when starting is high and, consequently, to save time it is necessary to start the furnace with a high voltage. When the resistor becomes hot its resistance progressively decreases and the voltage must then be decreased to keep the rate of generation of energy constant. If this is done in a series of steps the results are not satisfactory, for when the maximum kilowatts are reached and the voltage is lowered one step the kilowatts are decreased proportionally, and in large furnaces it is a long time before the resistance drops to the point where the desired rate of generation of energy is again reached. This is a most inefficient method of working and the consequent loss will more than pay the interest on the cost of suitable apparatus for regulating the voltage.

Even at the time when these much larger furnaces were built the theoretical conditions involved in their construction were not understood, nor indeed for long afterwards. Thus, when the Niagara furnaces were first built the dimensions of the resistors were found to be altogether wrong, and about that time, when the writer took charge of the furnace department, experiments were tried with flat resistors, though an appreciation of the theoretical conditions of the problem shows at once that, other things equal, the resistor of circular cross-section must be best.

In any furnace in which the charge surrounds a resistor heated by means of an electric current it is obvious that the important consideration is the rate of generation of energy per unit surface of the resistor. The surrounding charge, or whatever it is desired to treat, can at a definite temperature absorb heat at a definite rate. Therefore, if it is desired to preserve the charge at a definite temperature it is necessary to generate the heat only so fast as the charge will absorb it. In other words, it is necessary that the watts should be a certain definite amount per unit surface of the resistor. The knowledge of the absolute value of the temperatures in such furnaces as those used in making silicon carbide is very scant, although some excellent work is now being done on this subject; but from the data obtained experimentally and the theoretical considerations of the working of such furnaces, it is possible to calculate relative temperatures with considerable accuracy.

This was well illustrated in the experimental work done by the writer in the difficult problem of making what Acheson called "siloxicon." This substance is formed by the reduction or partial reduction of silica and is combined in some way with carbon. The great difficulty in making the material is due to the fact that at a temperature very slightly above that at which the reduction of silica by carbon begins the process goes too far and the well known crystalline silicon carbide is formed. In order to calculate the dimensions of a resistor suitable for making the material the only data available were those which could be obtained from a study of conditions in the silicon carbide furnace. Without going into details it is sufficient to say that working in this way a furnace was soon designed which made large quantities of "siloxicon" without the formation of any serious quantity of crystalline silicon carbide.

The object in devoting so much consideration to this subject is because it illustrates in a marked manner the comparative ease with which electric furnaces can be adjusted to delicate temperature conditions. This is, of course, well known as regards small laboratory furnaces, but what we are considering now is a furnace about 30-ft. (9 m.) long, 12-ft. (3.6 m.) wide and 6-ft. (1.8 m.) high, having a capacity for a charge of about 60 tons.

The greatest progress in the electric furnace since Siemens' time has been in the arc furnaces of the kinds he used; in the induction furnaces of Ferranti and Colby; and in the resistance furnace of the Cowles type; but so far as the furnace depending on the use of a heating resistor, other than the charge, is concerned there has not been any great advance as regards apparatus of large capacity. The explanation of this is found in the structural difficulties involved. It is believed, however, that those can be overcome, and, moreover, that it is well worth while spending considerable effort in this direction. In the laboratories with which the writer is connected much time has been devoted to a study of this type of furnace, and more or less successful furnaces worked out. This kind of furnace for example lends itself very readily to a form of apparatus which is bound to be developed sooner or later where the heating is accomplished by means of fuel as well as the electric current. This has been done with success in furnaces on a large scale where the preliminary heating is carried on by means of fuel until a temperature is reached where it becomes economical to use the electric current to get the higher temperatures desired. Moreover, in such furnaces we may usefully employ nearly all of the electric current by jacketing with burning gases which eliminates nearly all radiation from the interior of the furnace by supplying the inevitable heat losses from fuel rather than electricity.

The question of the loss of heat through the walls of electric furnaces is a matter that is now attracting a great deal of attention for its importance is very great. The writer has recently had occasion to give this matter careful consideration owing to the inefficient working of an electric furnace designed for some special smelting work. The testing of this furnace showed that the heat losses amounted to 50 per cent. but merely covering 25 per cent. of the outer surface of the furnace with a moderately good heat insulator reduced this loss nearly 20 per cent.

Before closing the remarks on this type of furnace it may be of interest to note some experiments recently carried out with an electric kiln at the writer's laboratories. The kiln is the invention of Mr. John L. Harper and is of the continuous channel type. Two long channels run parallel to each other and through each of these passes a train of trucks in opposite directions. The centre part of the kiln is heated electrically. With this arrangement, the trucks with their contents passing from the high temperature part of the kiln, give up their heat to the trucks going to the high temperature part. Theoretically with an arrangement of this sort all that is required of the electric energy is to supply the heat losses from the kiln. Various experimental furnaces of this kind have been built, the chief object in view being a study of the structural features of the kiln, such as the best form of resistor, refractory linings, etc., also tests of the control of temperature maximum temperature available, control of atmosphere, heat insulation, etc. The kiln was used for various purposes, but the prinicpal experiments were made on porcelain with the production of "biscuit" and glazed ware. The control of temperature was found to be very good and the kiln was extremely simple to work, requiring very little attention.

It is not pretended that in this paper the subject of the development of the electric furnace has been more than superficially treated, the attempt being simply to take a few examples which would illustrate how the electric furnace has developed and indicate some of the problems involved in its construction and working to-day. This, naturally, confined the subject to a certain extent to matters within the writer's own experience; but it is hoped that this may prove somewhat more interesting than a mere catalogue of modern furnaces compiled from the literature on the subject.

CULTURE IN THE EDUCATION OF ENGINEERS.*

By William L. Saunders.

At one of the meetings of the American Institue of Mining Engineers, held in the hall of the Sheffield Scientific School at New Haven, a discussion arose as to whether or not sufficient importance was given to cultural studies in our scientific schools. A diagram was exhibited showing graphically the relative proportion that culture bore to other studies in the various colleges. In some there was a wide distribution of cultural work, in others the proportion was small, and in a few cases it was shown that these studies were entirely omitted in the curriculum. During recess a group of students were discussing the subject; one of them, a senior, said, "I don't see why they should learn a person culture in a scientific school." This remark, made in my presence, so impressed me as a concrete example of neglect in true educational lines that it has been chosen as a text for what is to follow.

Education in its broadest sense is mental and moral training. High schools and colleges differ from common schools in that they aim at higher planes of mental and moral life. The small boy is taught by stuffing, as one puts sawdust in a doll; this is because his mind has not grown to the stage when it can think for itself. Impressions are received and transfixed by memory; the process is one of mental photography; the moral code is learned by rote as though it were the multiplication table. Not so with the older, the college student; his highest aim in education is to learn to think for himself. "If you are a student force yourself to think independently; if a teacher compel your youth to express their own minds," writes Dr. Osborn of Columbia; and again, "The lesson of Huxley's life and the result of my own experience is that productive thinking is the chief means as well as the chief end of education.

Now what is productive thinking? Let me answer this question by giving you Huxley's definition of culture: "The pursuit of any art or science with the view of its improvement." The storage process is of paramount importance only when applied to elemetary education. It is but the auxiliary of the scholar who has passed from the junior to the senior stage of student life, and who aims to do things in the world. The pursuit of facts is a mathematical study. We learn of things that exist as a result of divine and human creation. The earth is round and it is composed of land and water. Water is hydrogen and oxygen combined. The square of the hypotenuse of a right angle triangle is equal to the sum of the square of the other two sides. How important are these facts? It is important that we should know them but even a large volume of facts when stored in the human mind is powerless to add one cubit to progress. It is like putting a pair of legs on the Encyclopedia Britannica and expecting it to do something. Knowledge is power, but reason is power in action.

Mr. James Gayley of the United States Steel Corporation, recalling recently that his professor at Lafayette College who taught him how to think made so deep an impression [illegible] his life. Mr. Gayley is distinguished for what he has done as a metallurgical engineer. His life has been one of productive thinking; he has pursued science with the view of its improvement. That teacher, Mr. Gayley said, once gave him a [illegible] and instead of instructing him how to do it [illegible] told him to try three or four ways of doing it and report which was best. This led directly to thought and resason and built up a master mind among engineers. We may still heed the voice of old Carlyle crying from the heathery hills of Dunscore; "Produce! Produce! Were it but the pitifullest infinitesimal fraction of a product, produce in God's name! 'Tis the utmost thou hast in thee; out with it then."

Where among all the professions do we get the results that come through productive thinking as from engineering? The engineer is the architect of the world's progress. Transportation in railways and ships, in motor cars and aeroplanes, is the productive thinking of mechanical engineers woven into our industrial life. The men who did these things were students of science, not that they might be mere storehouses of knowledge, but that they might produce. Civil, electrical, chemical and mining engineers are fields which afford infinite opportunities for research and progress. If you men of the future do not rise to your chance in these lines it is not because the fields are not still open for cutivation and growth, but rather through your own inefficiency or perhaps your top-heaviness.

"In vain our toil,
We ought to blame the culture, not the soil."

Even Huxley feared that men might be over-fed scientifically when he said: "An exclusively scientific training will bring about a mental twist as surely as an exclusively literary training. The value of the cargo does not compensate for a ship's being out of trim; and I should be very sorry to think that a scientific college would turn out none but lop-sided men."

All this bears upon culture in its broadest sense. Productive thinking is the most important form of culture. It makes for power, refinement, progress, knowledge, taste, civilization. The subject, you see, is a very broad one; the obligation upon you as students of science is equally broad. Take care that you be not "lop-sided men." A graduate of the Colorado School of Mines, like all graduates of the higher institutions of learning, misses his opportunities and discredits his college if he does not carry throughout all his walks of life the imprint of the educated man. Noblesse oblige is a degree and an obligation which is uniformly conferred upon all college men. To carry this obligation properly one should study culutre in all its phases and in its broadest sense. Study it as an undergraduate and study it still harder and more fully through all your post-graduate life. To this end let us accept and profit by that definition of culture given us by Matthew Arnold: "Acquainting ourselves with the best that has been known and said in the world." A professor at Wellesley College defined culture to the students as that which is left after all else learned at college is forgotten.

Virtue and moral training belong to cultural work in the education of engineers. It is a mistake to suppose that schools and colleges are places for mental training only. Physical exercise through athletics is just as much a part of one's college life nowadays as the study of mathematics; the one helps the other. Emerson said, "Archery, cricket, gun and fishing rod, horse and boat, are all educators, liberalizers." To the engineer physical training is of value in order to fit him for outdoor work. Moral training is of even greater importance. Locke has placed virtue first in defining the objects of education. Wisdom he puts next, and then good breeding; last of all learning. It is more the province of the teacher than of the student to safeguard and train the character by precept and example, for, after all, "the foundation of culture, as of character, is at last the moral sentiment. This is the foundation of power."

It is a common saying that manners make the man. Good manners afford us easy weapons with which to win friends and to conquer enemies. Manners adorn the gentleman and smooth the way of the educated man through the world. Manners are never born in men; but they are bred by association and study. Like oil on the journals of an engine, they avoid friction and aid efficiency. There are many reasons why we should be polite, but the best reason is because it pays; it costs nothing. It is said of William Earl of Nassau that he won a subject from the King of Spain every time he put off his hat. So engaging were the manners of Charles Fox that Napoleon said of him on the occasion of his visit to Paris in 1805: "Mr. Fox will always hold the first place in an assembly of the Tuileries." "My gentleman," said Emerson, "will outpray saints in chapel, out-general veterans in the field and outshine all courtesy in the hall. He is good company for pirates and good with academicians; so that it is useless to fortify yourself against him; he has the private entrance to all minds, and I could as easily exclude myself as him."

---

*Address delivered at the 38th Annual Commencement, Colorado School of Mines, Golden, Colo., May 14, 1912.

Good speech is a rule of manners. It always avoids exaggeration. Moderation in language and tone is the trademark of good breeding, and good breeding is after all mainly a mater of self culture. Madame de Staël valued conversation above everything, and so engaging was she in that art that a prominent lady of France said of her: "If I were Queen I should command her to talk to me every day." The man of education mixes with the right kind of people and reads good books. Books lead us into pleasant paths of culture and happiness. Read that you may avoid worry; read that too much hard thinking may not dull the edge of intelligence and sap the roots of memory; read that you may know what has been done in the world; read that you may acquire that power which comes from knowledge; read that you may learn to value the example of great men's lives; that through them you may know that the grave is not the goal of life. Montaigne had a passion for books and never travelled without them; he said that reading roused his reason and employed his judgment rather than his memory.

But of greater importance than good speech and reading, of higher value to the engineer than manners, is ability to write good English. Engineers are not given to public speaking; they pride themselves in being workers; they compare themselves with General Grant who did things. It is very true that the engineering profession is one of practical work; but no one can hope to achieve prominence in this profession who cannot write good understandable English. An engineer may not talk, but he must make reports, he must write letters; he should draw specifications and plans. To do these things properly he must command and know how to use the tools of language. Lord Bacon tells us that "reading makes a full man, conversation a ready man and writing an exact man." Engineering is an exact science; accuracy is the one column on which the whole structure is reared. To write clearly and accurately can hardly be called an accomplishment; it is really a necessity. No college course is complete, whether it be a classical, scientific, medical or law course, without a thorough training in English. No graduate is worthy to be called an educated man who does not speak and write good English. It lifts a man above the common; it makes him bigger than his business or profession; it trims the ship of knowledge and puts oil on rough places; it makes the man.

Margaret Fuller said that the object of life is to grow, and James Freeman Clarke has written a lecture upon this subject, "Man's Duty to Grow." A post-graduate course in self-culture will tend to upward growth. Such a course is open to every one. The greatest opportunities for that education which unfolds the whole nature of man are those which are opened when we close the college door behind us. Graduation only marks the beginning of education to one whose face looks forward and upward. Let us build high; "they build too low who build beneath the stars." Build so that life and strength and growth may vitalize the whole structure; build on lines that are straight; build so that every root and branch of the tree of knowledge lends support and does not add a twist to the whole; build that men may see in you not alone skill and wisdom, but honor, culture, manhood, example; study to improve self—

"For virtue only makes our bliss below,
For all our knowledge is ourselves to know."

DRILLING 1 1/16-INCH HOLES IN ONE-INCH PLATES IN FOUR SECONDS AT THE PANAMA CANAL.

For the final riveting of the enormous lock gates at the Panama Canal the McClintic-Marshall Construction Company, of Pittsburg, has installed sixteen special electrically operated machines for drilling and reaming rivet holes. Each of these machines weighs about six tons, and is capable of doing the work of five ordinary type reamers.

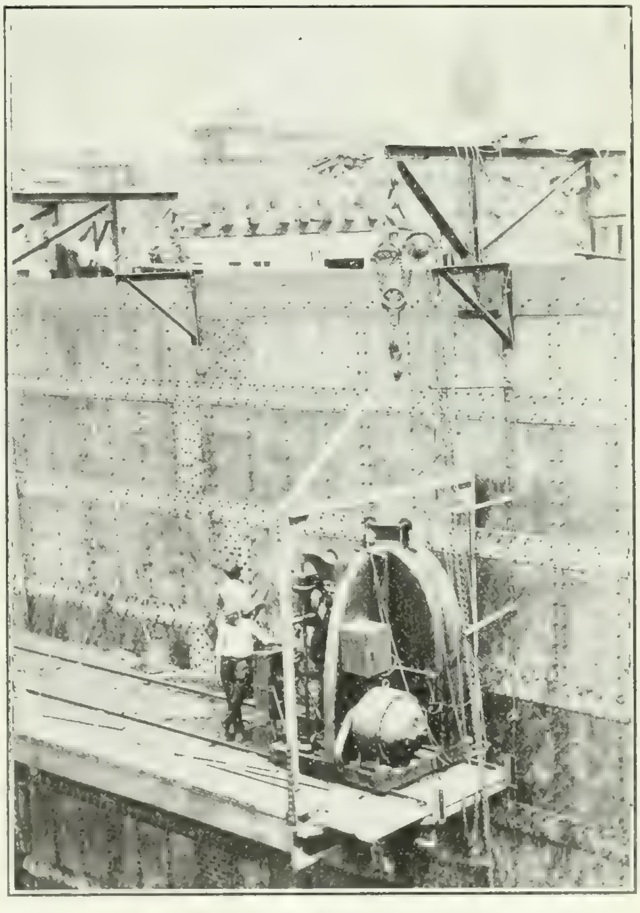


Fig. 1.

The machines are designed to run on a standard gauge track and are mounted on broad adjustable scaffolds, which are suspended from brackets by chains from the top of the gate, as shown in Fig. 1.

The inclined hand wheel shown in Fig. 2 operates through a train of gears and moves the machine along the track. The tool can readily be moved as roller bearings are used.

It will be noticed from Fig. 2 that the entire controlling mechanism is placed within easy reach of the operator. The horizontal hand wheel actuates suitable reduction gearing and a screw which raises or lowers the spindles, while the quick return motion through the spindles is actuated by means of the spider hand wheel, or by any of four levers. These levers automatically engage the quick return mechanism and enable the spindles to be run in and out.

Each machine is provided with four changes of power feed, which are instantly available through the quick-change gear mechanism. The length of the power feed is 16 inches, and the machine is so arranged that either one or both of the spindles can be fed independently.

The clutch lever for placing either spindle in operation is located on the head of the machine, while the feed changing lever is just above the clutch lever. This hand wheel is used for raising and lowering the head, which in turn is accurately counterbalanced, so that this raising and lowering is done with the least possible effort.

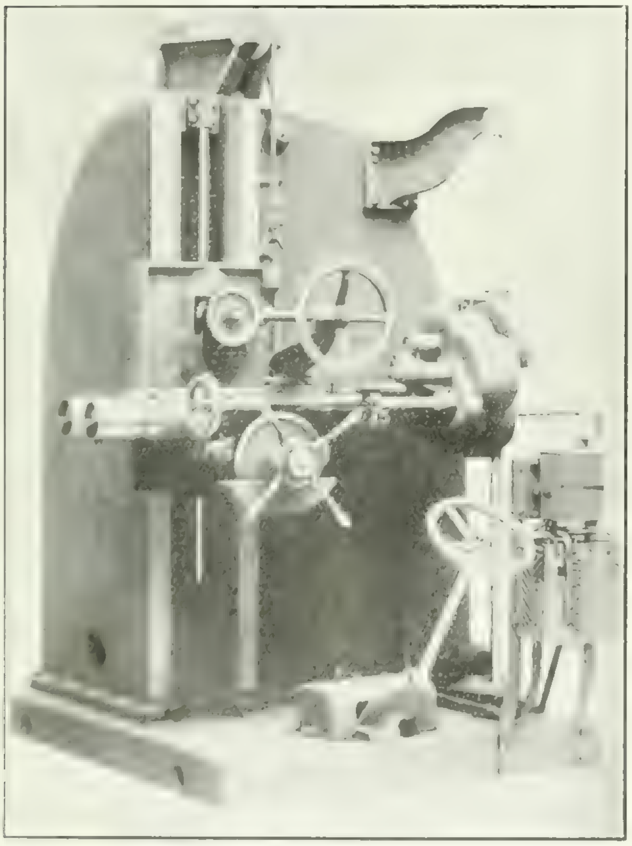


FIG. 2.

[illegible]

[illegible]

COSTS OF STEAM POWER PLANTS.

At the January meeting of the Engineers' Society of Western Pennsylvania some general unit construction costs of turbo-electric power plants were presented by R. W. Stovel and O. S. Lyford, Jr. These costs were based upon the maximum continuous capacity of the plant instead of on the "normal" rating. In this way the costs became comparable with those of gas-engine and hyrdo-electric installations. For coal-burning plants ranging from 2000-kw. to 20,000-kw. capacity the costs were stated to vary between the following limits:

TABLE I.—COST OF STEAM TURBO-ELECTRIC GENERATING STATIONS FROM SAY 2000-KW TO 20,000-KW CAPACITY, BASED ON MAXIMUM CONTINUOUS CAPACITY OF GENERATORS.

	Dollars per kw High.	Dollars per kw Low.
Preparing Site.—Dismantling and removing structures from site, making construction roads, tracks, etc.	$0.25	$0.00
Yard Work.—Intake and discharge flumes for condensing water, railway siding, grading, fencing sidewalks, etc.	2.50	1.00
Foundations.—Including foundations for building, stacks and machinery, together with excavation, piling, waterproofing, etc.	6.00	1.00
Building.—Including frame, walls, floors, roofs, windows and doors, coal bunker, etc., but exclusive of foundations, heating, plumbing and lighting	12.00	4.00
Boiler-room Equipment.—Including boilers, stokers, flues, stacks, feed-pumps, feed-water heater, economizers, mechanical draft and all piping and pipe covering for entire station except condenser water piping	24.00	12.00
Turbine Room Equipment.—Including steam turbines and generators, condensers with condenser auxiliaries and condensing water piping, oiling system, etc.	22.00	12.00
Electrical Switching Equipment.—Including exciters of all kinds, masonry switch structure with all switchboards, switches, instruments, etc., and all wiring except for building lighting	5.00	2.00
Service Equipment.—Such as cranes, lighting, heating, plumbing, fire protection, compressed air, furniture, permanent tools, coal and ash handling machinery, etc., etc.	5.00	2.50
Starting Up.—Labor, fuel and supplies for getting plant ready to carry useful load	1.00	0.50
General Charges.—Such as engineering, purchasing, supervision, clerical work, construction, plant and supplies, watchmen, cleaning up, etc.	6.00	3.00
Total cost of plant to owner, except land and interest during construction	$83.75	$38.00

Some of the group costs in this table do not have any very specific relation to the kilowatt capacity installed in the plant and the probable range in such costs is given. This refers to such groups as "Preparing Site," "Yard Work," "Electrical Switching Equipment" and "Service Equipment." For instance, the electrical switching equipment costs depend much more on the extent and the scope of the electrical distributing system than upon the actual capacity of the plant. Again, the largest item of the "Service Equipment" costs—namely, that of coal handling—depends upon the existing physical conditions much more than upon the capacity.

The foundation costs will run from $1.25 to $4 per square foot of building plan area, depending on the character of the soil, the lower cost covering simple concrete footings on thoroughly good bearing soil, while the necessity for piling, waterproofing, excessive rock excavation, etc., will run this cost toward the higher limit. Then the plant area will vary from 0.8 sq. ft. to 1.5 sq. ft. for each kilowatt of capacity installed, depending upon the size of the units and upon their arrangement, the combined effect of these two cost ranges giving the range in price per kilowatt shown on the table.

The building costs will vary from 8 cents to 12 cents per cubic foot of over-all building volume, according to the size of the building, the character of construction and the local price of building material and labor. Depending again upon the size of the units and upon the efficiency used in arranging them, there will be required from 50 cu. ft. to 100 cu. ft. of volume per kilowatt of capacity. The combined effect is to make the building costs range from $4 to $12 per kilowatt as shown.

In boiler room equipment the cost of material and labor will generally be between $[illegible] and $40 per nominal boiler horse-power, and generally there will be installed between 0.4 and 0.6 boiler horse-power per kilowatt of capacity, resulting in the cost range shown in the table.

It is seen that the cost of such stations under normal conditions may range in price from $40 to $85 per kilowatt of maximum continuous generator capacity. The minimum is possible only with an extremely fortunate combination of circumstances, such as natural advantages of location combined with most favorable sizes and arrangement of apparatus.

Table II. shows a probable high and low range of costs for detailed boiler room equipment. It will be noticed that the totals here shown cover a wider range than used in preparing Table I., where the price per horse-power was taken as from $30 to $40; this is because, while the wider range is possible, the costs in generating stations generally lies within the narrower range. The unit costs in this table are related to rated boiler horse-power instead of the kilowatt as used in Table I., as these costs vary almost directly with the rating of the boilers, regardless of how much boiler capacity may be installed.

Table II.—Boiler Room Equipment Costs per Rated Boiler Horse-power Using Coal for Fuel.

	Dollars per hp High.	Dollars per hp Low.
Boilers exclusive of masonry setting	$11.00	$8.00
Superheaters	3 00	0
Stokers	5.50	3.00
Masonry settings for boilers	3.50	2.00
Flues	1.50	0.75
Stacks	4.00	2.00
Economizers	4.00	0
Mechanical draft	3.00	0
Feed pumps	1.50	0.50
Feed heaters	1.00	0.40
All piping and pipe covering	10.00	6.00
Coal chutes and ash hoppers	1.25	0
Various, such as indicating and recording devices, damper regulator, ladders and runways, painting, etc., etc.	1.00	0.50
Total	$50.25	$23.15

Note—The above costs are for labor and material only. They do not include any "general charges" such as engineering or supervision. The piping item includes all piping in the entire plant except condenser water piping.

Table III. indicates generally the range of ordinary operating results. Coal of 14,000 b.t.u. per pound is assumed in both cases for convenience.

Table III.—Summary of Operating Results.

	Range of Common Practice.	
British thermal units per pound of fuel	14,000	
Average yearly over-all boiler and furnace efficiency	50	70
Effective British thermal units per pound of fuel	7,000	9,800
Boiler pressure, pounds per square inch, gage	125	190
Superheat, degrees Fahr	0	125
Average feed-water temperature, degrees Fahr	120	200
British thermal units per pound of steam (approximate)	1,100	1,100
Pounds of water evaporated per pound of fuel, actual	6.36	8.91
Pounds of fuel per standard boiler hp (33,305 b.t.u.'s)	4.76	3.40
Average over-all station water rate kw	30	20
Pounds of coal per kw generated	4.72	2.25
British thermal units in coal per kw generated	66,000	31,500
Thermal efficiency of station	5.2%	10.8%

◆

INCREASED USE OF WATER-POWER.

Of the 30,000,000 horse-power used in industrial and public-utility enterprises in the United States, reports the Commissioner of Corporations, 6,000,000 horse-power is now developed by water. At a conservative estimate, this saves 33,000,000 tons of coal per year. Several million more horse-power could profitably be developed from the same inexhaustible source.

Of the 6,000,000 horse-power now developed, 3,270,755 is generated for sale (that is, not for private use, as in manufacturing) by companies or groups of interests having 50,000 horse-power or more actually developed or under construction. The report concludes that it is not feasible to regulate the price of water power by itself but rather to control the sites, or their uses.

TO WHAT DEGREE MUST SEWAGE BE PURIFIED?*

By Chester G. Wigley, of the Division of Sewerage and Water Supplies, State Board of Health, New Jersey.

The economic disposal of sewage resolves itself into a problem of deciding what degree of purification is to be obtained and this degree of purity should depend primarily upon the size and character of the body of water into which the effluent is to be discharged. It too frequently happens that the effluents from disposal plants are not of acceptable quality and this condition can often be traced directly to inefficient supervision over the operation of the works. If a political officeseeker, without knowledge of the requirements of sanitary engineering, be placed in charge of the plant, there is small chance of securing satisfactory results.

Sometimes it has happened that engineers after designing and constructing a sewage disposal plant depart without leaving any directions for its proper maintenance. This has sometimes resulted in a rapid deterioration of the plant and a consequent loss to the municipality. It is for this reason that one of the chief functions of a board of health or sewerage commission is to see that the disposal plants are operated in a satisfactory manner. This is one of the most difficult phases of the sewage disposal question to-day, especially in connection with small installations.

In the design of any disposal plant there are two questions of economy. The first deals with the relative economy of the various types of any of the units comprising the plant, for example, the relative advantages of various types of settling tanks, and the second to a consideration of the general public welfare and the interrelations of groups of municipalities situated upon the same body of water. It is these latter relations which are directly affected by the limitations of the degree of purification of sewage and the most economic method of disposal is the one in which the best relations may be maintained at the smallest cost. It would appear that we are fast approaching, if we have not already reached the point, at which the large quantity of sewage from populous districts is compelling a bacterial standard of efficiency rather than one of sight and odor.

We may first consider the disposal of sewage with reference to the waters, according to their geographical classifications, such as the ocean, bays, rivers, brooks and lakes. Any system of disposal must be viewed from the several sanitary standpoints of liability of infection, creation of nuisances, and the effect upon the environment.

It is generally conceded that the purification of sewage discharged into the ocean shall be of a rudimentary nature. This is so because the ocean is so large that it requires a large amount of sewage to cause even a local nuisance. Another reason tending to make elaborate disposal plants unnecessary is that the salt water appears to have the power of more readily oxidizing organic matter than does fresh water. Where surf bathing is a pecuniary asset it is necessary to remove from the sewage floating grease, garbage and fecal matter by screening or sedimentation and discharge the effluent at a distance from shore sufficent to prevent its immediate return. Where bathing does not enter into the problem, sewage may be satisfactorily taken care of by discharging into the ocean at some distance from shore and below the surface of the water.

In the case of a bay or sound the degree of purification demanded is higher than in the case of an ocean outfall.

---

* Abstract of paper read before American Waterworks Association at thirty-second annual convention, Louisville, Ky., June 3-8, 1912.

Here the protection of the shellfish from contamination sometimes must be provided for. The currents in the bay will ordinarily be less strong and because of its land-locked nature the sewage is discharged into a more or less restricted volume of water in which it is carried back and forth by oscillating tides. In most cases, where shellfish are not present, rough screening and sedimentation, or possibly very fine screening will be satisfactory if the effluent is discharged at some distance from the shore and the outlet at all times submerged.

In the case of rivers disposal by dilution sometimes may be adopted advantageously, but an important point to keep in mind is that the outfall should be designed to diffuse the sewage in deep running water and not to discharge it at a single point near the shore line.

Some people claim that it would be cheaper to allow a water purification plant, which should be installed in most cases where the supply is taken from a river subject to pollution, to take care of the additional burdens caused by the sewage. It is difficult to see why the burden should be shifted from the sewage disposal works to the water filters. The only place in which such a procedure would be permissible is where the quantity of sewage to be purified would cost considerably more than to purify a comparatively smaller amount of water. While this would be strictly an economic arrangement there are several things that would argue against such a practice.

The chief of these objections is this: Water purification plants are not perfect. They will at certain times fail to produce a satisfactory effluent, especially with filters of th[illegible] mechanical type. Those who advocate the purification of water instead of the purification of sewage are not allowing a large enough factor of safety. The failure of the Schmutzdecke, the entrance of wash-water into the clear water, failure in the supply of alum, soda or hypochlorite are all apt to occur and then the barriers are down. Would it not be better to relieve the burden of the water purification plant as much as possible and wherever possible destroy the pathogenic bacteria in sewage? Would it do any harm to have a factor of safety of two and purify both the sewage and water? Then in the event of the failure of one plant the consequent results would not be as bad as though all the burden were placed on one installation.

With respect to rivers, then, we may conclude that where [illegible] greatly reduce the number of pathogenic bacteria would be [illegible] simply the settling and sterilization of the sewage or its purification by settling tanks, sprinkling filters and disinfection. The latter method would only be neces[illegible] portion to the flow of the river.

◆

TERMINUS FOR HUDSON'S BAY ROAD.

[illegible]

SALE OF QUEBEC WATER-POWERS.

The announcement was made some time ago that henceforth no more water-powers would be sold in the province of Quebec. On the other hand, it will be the policy of the government to lease the water-powers for a term of years at a fixed annual rental. Accordingly, for some time past the Provincial Government has been advertising the lease, by auction, of some fifteen water-powers, for a term of seventy-five years. A number of these were disposed of at the Parliament Buildings at Quebec on June 26th. Just before the bidding, three of the powers were withdrawn, leaving twelve to be competed for. Of these, apparently only four were wanted, that, at any rate, being the number taken. These were as follows:—

At $51 per annum, power on the Assemetquagon River, near Metapedia River, Bonaventure Co., leased by James Hall, New Carlisle, in trust.

At $53 per annum, Riviere des Aux Nortes, in Hackett township, Champlain county, by Charles LeBrun, of Shawinigan.

At $3,800 per annum, Chute de la Martine, Metabetchuan River, Lake St. John county, by Herbert Moisan, of Quebec.

At $1,001 per annum, Riviere aux Outardes, Saguenay county, by St. Lawrence Industrial Company.

It is not stated what amount of power can be developed on the different falls, so that the work of making comparisons between the different leases is impossible. However, the very fact that the government will get over $5,000 per annum out of the four leases which formerly would quite possibly be given away free, is most encouraging from the standpoint of public interest, and the knowledge that all the powers of Quebec will in future be treated in this manner is very gratifying.

◆

THE C.N.R. TRANSCONTINENTAL LINE.

The Canadian Northern Railway's transcontinental line will positively be ready in 1914.

The C.N.R. tunnel under Mount Royal will be ready in two years' time, about.

Montreal, Toronto, Ottawa and other important points will be linked up by the C.N.R. line this year.

The C.N.R. has just obtained the money to complete its transcontinental line.

These are some of the statements made by Sir William Mackenzie while in Montreal en route to England. It was the common thought among financial circles that Sir William was going to England for the purpose of obtaining additional capital for carrying out the projects of the Canadian Northern Railway, and it is still thought that this actually is the case, although the president of the company states the company has just obtained the money to complete the line. It is assumed that he does not refer to the cost of constructing the tunnel under Mount Royal and various other schemes more or less essential to the completion of the C.N.R. Transcontinental line.

It was the general idea in Montreal that the C.N.R. hoped to be able to build the tunnel out of the profits reaped in the rise of land values at the northern portal of the tunnel, a large area of which the company purchased as farm land before announcing its project, and the bulk of which has probably since been sold as building lots at prices ranging to upward of $1 per square foot. In any case, Sir William intimates that he may have something of importance to announce upon his return.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **60** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, JULY 11, 1912. No. 2

CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Late Cecil B. Smith ... 151
The International Geological Congress ... 151
The Internal Combustion Engine and the Gas Producer ... 152

Leading Articles:

Toronto Water Chlorination Plant ... 135
British Columbia ... 136
The Value of a Continuous Settling Basin ... 137
Some Notes on Band Conveyors ... 141
Thirty Years' Progress in The Electric Furnace ... 143
Culture in the Education of Engineers ... 146
Drilling 1 1/16-inch Holes in One-inch Plates in Four Seconds at the Panama Canal ... 147
Cost of Steam Power Plants ... 148
To What Degree Must Sewage be Purified? ... 149
Letters to the Editor ... 153
Pig-Iron and Steel ... 154
The Construction of Distribution Systems for Outlying Systems and Small Plants ... 155
Precise Levelling in Canada ... 159
International Geological Congress ... 163
The New Chief Commissioner of the Dominion Railway Board ... [illegible]
Western Canada Irrigation 6th Annual Convention. 164
Personals ... 152
Coming Meetings ... [illegible]
Engineering Societies ... [illegible]
Market Conditions ... [illegible]
Construction News ... [illegible]
Railway Orders ... [illegible]

THE LATE CECIL B. SMITH.

By the death of Cecil B. Smith the country has lost one of its most successful and brilliant engineers. Mr. Smith was one of the first of a new type of consulting engineer to enter the professional field in Canada. Many of the older men of the profession were men educated under the pupilage system who obtained their knowledge of engineering through practical experience. This class are steadily becoming in the minority, the newer class being men trained in the technical colleges before taking up practical engineering. Mr. Smith was one of the first of the college-trained men to enter the consulting field in Canada. He was educated at McGill University, and, after having obtained considerable experience, was appointed assistant Professor of Civil Engineering there. As a man Mr. Smith was well liked by everyone. The younger men of the profession, who at different times have been employed under his direction, have always parted from him with the greatest liking for his personality and with the highest respect for his ability. As an engineer he ranked with the leaders of the profession on the continent. The work which will probably be remembered most to his credit was that which he did as chairman of the Temiskaming and Northern Ontario Railway Commission and as Chief Engineer of the Ontario Hydro-Electric Commission in its early days.

THE INTERNATIONAL GEOLOGICAL CONGRESS.

The programme of the twelfth International Geological Congress, which is to be held in Canada in 1913, will be found in this issue of *The Canadian Engineer*. This Congress is of great interest to Canadians in general. The value of the annual mineral output of Canada has steadily increased year by year for the last thirty years, and is now over one hundred million dollars. Considering, however, the known resources and the enormous territory whose resources are unknown, this output is small, and Canada needs more men and more money for prospecting, development and operation. This she can best secure by attracting, not the general public, but those people whose business it is to engage in such industries and who understand their management. Geologists and mining engineers are obviously those best able to influence opinion in their own countries on the subject in which they are recognized authorities; hence the opportunity afforded by the meeting in Canada of so many eminent specialists should not be neglected. Every effort should be made to show to the world that, while our known mineral resources are large, we have an immense undeveloped territory awaiting the advent of the trained prospector. Meetings of various geological and other scientific societies have been held in Canada in the past, but this is the first occasion on which the International Geological Congress has met here, and the opportunity will not occur again for many years, since the meetings are held triennially in the different countries of the world.

Canadian geologists are fully alive to the high honor paid them and their country by the selection of Canada for the meeting, and they are being generously assisted in preparing for it by the Dominion and Provincial Governments and by the railway and mining corporations, as well as by individual business and professional men, all of whom are contributing liberally both money and time.

THE INTERNAL COMBUSTION ENGINE AND THE GAS PRODUCER.

There has been considerable discussion recently concerning the longevity of the coal fields of the country. With the increasing depletion of the coal deposits there has been a momentum given to hydro-electric installations, and an increasing demand for information concerning the possibilities of power from the internal combustion engine and the gas producer. Only last week we noted in *The Canadian Engineer* that the Province of Saskatchewan had appointed a consulting engineer to make an exhaustive report on the lignite deposits of that Province and their power-producing possibilities. The United States Bureau of Mines has been conducting investigations into the possibility of generating producer gas for power purposes in a commercial way from the various mineral fuels of the country. These investigations have been associated with steaming, briquetting, coking, and other tests, all of which supplemented an examination into the nature, extent, and distribution of the fuels used. The tests have been made with carefully selected representative samples and carload lots of coal, lignite, etc., procured especially for the purpose by experienced collectors.

The investigations have shown the adaptability of the gas producer for the utilization of low-grade coal, lignite, peat, etc, As mined, these fuels cannot be used in boiler furnaces and will not bear long transportation, but the gas producer makes them of potential value. Where deposits of low-grade coal, lignite, and peat are found, the present cost of power, as developed in steam plants with coal that has been shipped a considerable distance, can be materially reduced by placing producer plants at the mines or bogs so as to utilize these low-grade fuels without cost of shipment by generating electric current, which can be easily transmitted to desired points within a wide radius.

The tests in the gas producer have shown that many fuels of so low grade as to be practically valueless for steaming purposes, such as slack coal, bone coal, and lignite, may be economically converted into producer gas, and may thus generate sufficient power to render them of high commercial value.

It is estimated that on an average each coal tested in the producer-gas plant developed two and one-half times the power that it would develop in the ordinary steam-boiler plant. Investigations into the waste of coal in mining have shown that it probably aggregates 250,000,000 to 300,000,000 tons yearly, of which at least one-half might be saved. It has been demonstrated that the low-grade coals, high in sulphur and ash, now left underground, can be used economically in the gas producer for the ultimate production of power, heat, and light, and should, therefore, be mined at the same time as the high-grade coal. The investigations also show that the general use of gas producers for the development of power means the elimination practically of the smoke nuisance. This result is especially important in cities that are compelled to use bituminous coals. The great saving in fuel obtained through the gas producer has led to the installation within the last decade of several hundred of these power plants throughout the country. These producer plants are practically smokeless during operation. The establishment of producer-gas plants at the mines and the distribution of electric energy, or gas over large areas will also tend to eliminate smoke. When a large percentage of the small, isolated power and heating plants and all steam locomotives have been removed from the larger cities, the atmosphere of these cities will be much clearer and heavy financial losses directly traceable to smoke will be eliminated.

EDITORIAL COMMENT.

We are publishing in this issue the first of a series of articles on band conveyors. The importance of the use of conveying machinery in connection with engineering work has increased to such an extent that we feel the publication of such a series should be of considerable interest to our readers.

* * * *

The new Commissioner of Works at Toronto appears to have grasped conditions in connection with the Waterworks Department. He has just recommended that a new position be created, that of mechanical and electrical engineer of the Waterworks Branch of the Works Department. There is little question that if the right man is obtained for the position, great economies will be effected in the Department. The operation of the waterworks is one which demands a knowledge which only a mechanical man of considerable experience can furnish, and we feel sure that a much higher standard of efficiency will obtain under the new condition.

GENERAL NOTES.

Precipitation was deficient throughout Canada except very locally in the Central Valleys of British Columbia, and in southern parts of Vancouver Osland and the lower mainland, where the normal amount was slightly exceeded; also very locally in Alberta, especially in the neighborhood of Calgary, where the fall was considerably more than usual. The deficiency was particularly pronounced in Manitoba, where the fall was only a very small percentage of the normal.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for June, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	4.3	+1.03
Edmonton, Alta	3.0	—0.41
Swift Current, Sask.	2.8	—0.25
Winnipeg, Man.	0.9	—2.54
Port Stanley, Ont.	1.3	—1.41
Toronto, Ont.	1.75	—1.04
Parry Sound, Ont.	1.7	—1.26
Ottawa, Ont.	0.8	—2.95
Kingston, Ont	1.1	—2.1
Montreal, Que	1.6	—2.42
Quebec, Que.	3.1	—1.2
Chatham, N B	2.3	—0.73
Halifax, N.S.	2.6	—1.3
Victoria, B.C.	1.0	+0.04
Kamloops, B.C.	1.5	+0.22

PERSONALS.

DR. W. E. GEORGE, of Haileybury, has been appointed medical health officer for the eastern section of Northern Ontario.

MR. B. RIPLEY, A.M. Can. Soc. C.E., A.M. Am. Soc. C.E., who for the past two years has been in charge of bridge construction and renewals on the Dominion Atlantic Railway, has been appointed engineer of grade separation for the Canadian Pacific Railway at Toronto.

LETTERS TO THE EDITOR.

CONCRETING IN COLD WEATHER.

Sir,—While looking over the titles to articles in the last half year of *The Canadian Engineer* I noticed one entitled "First Reinforced Concrete in Cold Weather." As the laying of concrete in cold weather is probably an interesting subject to many engineers and contractors in Canada, I might say that the Ambursen Hydraulic Construction Company were engaged all last winter in the construction of a dam across a river called the "Magpie," in Michipicoten district, Ontario, and that concrete was laid, and perfectly taken care of there in weather of the severest description, temperatures of 30 deg. to 50 deg. below zero being common during the nights.

An Ambursen type dam is a reinforced concrete hollow dam, consisting of a number of buttresses, in this particular case 14 in. to 18 in. thick, 60 ft. long at the bottom and 36 feet high, and spaced 12 ft. centres, upon the sloping front of which buttresses a deck slab 30 in. to 21 in. thick is poured. This deck slab, resting on the buttresses, of course holds back the waters, the space between buttresses and under the deck being hollow.

Rock for the concrete was crushed in a crusher and ran from the crusher mouth into a large timber bin, on the floor of which was laid a grillage of steam pipes, pipes being about three feet centres up and down the sloped floor of the bin. The pipes were drilled with ¼-in. holes at close intervals, and the steam escaping from these holes heated up the rock in the storage bin. Sand was similarly treated or heated in an adjoining bin.

The material was run from these bins in a car to the mixer house, some distance away. In the mixer house, directly above the mixer, a water tank, holding about 10 or 12 barrels of water, was built. A steam pipe from the mixer boiler heated this water to a high temperature. Of course the water pipes from the pump at the river to the tank were protected from the frost, being laid in a box of manure with a steam line running beside the water line in the manure box.

The sand, cement and water were all, therefore, heated before entering the mixer; the concrete coming out of the mixer being generally steaming hot.

Concrete was only poured when the sun was up during the day as a precaution against being frozen before it was taken care of in the forms.

The forms were ordinary forms, built of 1-in. lumber in panels 12 ft. high and 6 ft. wide. The forms for two buttresses, 12-ft. centres, were set up and braced together. A car running along the top of these buttresses dumped the concrete into the forms. When the two buttresses were poured, which generally meant a five-hour run, a large tarpaulin was hauled across the top and let drop over the sides and ends, completely covering in the buttresses newly poured. In the space between the two buttresses several large Peterborough "lumberman" stoves fed with cord wood were kept going all night and heated the space enclosed by the canvas with such success that on several occasions, after nights during which the temperature was as low as 40 deg. below zero, forms were taken off 24 hours after the 18-inch concrete walls were poured. Of course the use of stoves necessitated cutting stove pipe holes in the canvas roof. This might probably be done away with and the canvas roof probably better preserved by the use of salamanders, using coke instead of the clumsier heavy stoves and stovepipes.

"READER."

RE PONTE DEL RISORGIMENTO.

Sir,—I have read with great interest the historical sketch on the evolution of the building of reinforced concrete arch bridges given in your issue of June 27th by Mr. H. G. Tyrrell and his remarks on the new Tiber River bridge, about which I have given a description in the same number.

There is, however, one point to which I would like to take exception. Mr. Tyrrell writes namely: "In the new Tiber River bridge with curved arch slab without hinges, rigidly connected to seven vertical ribs, it would seem that the stress condition was indefinite and the amount of thrust taken by the vertical ribs indeterminate.

I do not think that many engineers, with experience in reinforced concrete arch bridges and the use of the elastic theory would agree with that. As far as I know there has not yet been a single one of the numerous bridges figured out in that way that has shown any considerable disagreement between the calculated stresses and deflections and those actually measured on the bridge by test loads.

The circumstance that the cross section of the Tiber bridge is an inverted T does not introduce in itself any special difficulties to figuring out the forces in the slab and in the ribs. The bridge being fixed at its ends, there are three quantities which must be determined by the equations of elasticity. Maxwell's rule has very materially simplified those equations and by the choice of a special point at which we let these three quantities act we get the following practical equations:

$$X_a = \frac{\delta ma}{\delta aa}$$

$$X_b = \frac{\delta mb}{\delta bb}$$

$$X_c = \frac{\delta mc}{\delta cc}$$

X_a, X_b, X_c. mean the unknown qualities, δma, δmb and δmc are the deflections at the various points m of the main system for forces 1 acting in the direction of X_a, X_b and X_c respectively.

Whatever deflections are to be found by calculations or graphically (Villiots method) the proper moment of inertia for each section has to be used and thus the acting bending moments, normal and transversal forces can easily be found and thereafter the stresses in the steel and concrete in the sections.

V. J. ELMONT, C.E.

* * * *

Sir,—Replying to the comments of Mr. V. J. Elmont, on my report concerning the Ponte del Risorgimento over the Tiber River at Rome, it is very doubtful if any practical benefit is derived from the use of the elastic theory for computing stresses in masonry arches. The Romans used no such theory, and yet their bridges as far as endurance is concerned are far superior to many that are being built in recent years, proportioned perhaps by the elastic theory or some other equally gratifying to mathematicians, though of no greater use.

Sonstructive forms in which stress conditions are uncertain have been well exploited during the past 60 years since Mr. Whipple first published his methods of computing bridge stresses in 1847, and as far as economy of material is concerned, such forms are often quite economical, but experience has shown that conditions of uncertain stress are undesirable and such forms are now avoided by conservative designers. Many types, such as trusses with multiple web systems, or combinations of truss and arch, unquestionably have some points of merit, but because of their indefinite action they have gradually been discarded and other uncertain forms will doubtless follow in the same course. "Simplicity" is a fundamental principle of bridge design which should not be violated.

The latest Tiber River bridge is unquestionably a fine structure, reflecting great credit on its engineers and originators, but the unfortunate practice of competitive designing too often reduces the dimensions and strength almost to the danger point. Limitations in money appropriation and time, are also responsible in many cases for slender proportions, and the absence of features which might otherwise be most appropriate.

H. G. TYRRELL.

◆

PIG IRON AND STEEL

An increase of 5.58 per cent. is shown in the production of pig iron in Canada in 1910 over the production of 1909, as compared with an increase of 20 per cent. in 1909 over that of 1908, according to the report of the Department of Mines, Ottawa.

At the close of the year Canada had seventeen completed furnaces and two under construction, grouped in ten separate plants and operated by eight separate companies or corporations.

The total production in 1910 was 800,797 short tons (714,998 long tons), valued at approximately $11,245,622; as compared with 757,162 short tons (676,038 long tons), valued at $9,581,864, in 1909, and 630,835 short tons (563,246 long tons), valued at $8,111,194, in 1908. The Londonderry furnace was not in operation during either of the past two years. These figures do not include the output from electric furnaces making ferro-products which are situated at Welland and Sault Ste. Marie, Ont., and Buckingham, Que. Ferro-silicon was made at Welland during 1910, but the Sault Ste. Marie and Buckingham plants were not in operation during the year.

Of the total output of pig iron in 1910, 17,164 tons, valued at $333,956, or $19.78 per short ton, were made with charcoal as fuel, and 783,633 tons, valued at $10,911,674, or $13.92 per ton, with coke. The amount of charcoal iron made in 1909 was 17,003 tons, and in 1908, 6,709 tons; while the quantity made with coke in 1909 was 740,159 tons and in 1908, 624,126 tons.

The classification of the production in 1910 according to the purpose for which it was intended was as follows: Bessemer 219,492 tons, basic 425,400 tons, foundry (including miscellaneous) [illegible] tons.

The classification of the production in 1909 was: Bessemer [illegible] tons, basic [illegible] tons, foundry (including miscellaneous) 116,307 tons.

The American Iron and Steel Association reported the production of Bessemer pig iron in 1908 as 126,348 short tons, as against [illegible] tons in [illegible], and the production of basic pig iron in 1908 as 375,659 short tons, as against 382,208 tons in [illegible].

In Nova Scotia a large proportion of the pig iron is directly converted to steel, and as a very small portion of the metal [illegible] pig iron it is [illegible] difficult to place a satisfactory [illegible] upon the output. For statistical purposes a value of [illegible] placed upon the production in 1910. The Quebec production is entirely charcoal iron, which has for [illegible].

[illegible] prices of pig iron in Canada during 1910, a firm of iron merchants in Montreal gives the following information: [illegible] etc.; nevertheless it may be said that good average brands of Scotch iron sold in Montreal during the first three months of 1910 at about $20 per gross ton. Later in the year, particularly after the opening of navigation, prices eased up somewhat and an average price would be $19.50 per gross ton. On the other hand good foundry iron of English manufacture could have been purchased during the early part of 1910 at $18 per gross ton, then shading down to $17.25 per gross ton during the summer months. There was little competition from Canadian made iron in the Montreal district during 1910, the Sydney furnaces not marketing anything there during that period.

In Toronto the situation was somewhat different. It costs approximately $2 per ton more to lay down Scotch and English iron at that point than it does in Montreal, and during the early part of the year such advance in price was obtained. Later in the year, however, the Amreican situation seriously affected prices in Ontario, and United States pig iron competed very keenly in the Toronto-Hamilton district, practically cutting out Scotch and English iron and compellng the local furnaces to reduce their prices to an equivalent of $18.50 and down to $18, f.o.b. cars Toronto, for good average grades of foundry iron.

In Pittsburgh, Bessemer iron was quoted at $19 per gross ton in January, 1910, falling to $17.50 in March, $17 in May, $15.75 in June, and $15 from the latter part of August to the close of the year. Basic iron ruled from $1.75 to $2 per ton less.

Previous to 1896 pig iron was made entirely from Canadian ore. Since that date, however, increasing quantities of imported ore have been used as well as imported fuels and fluxes, and in 1910 about 89 per cent. of the ore charged, 49 per cent. of the coke, and 18 per cent. of the limestone, were imported. This condition is due largely to questions of cost and transportation affecting each furnace. The Newfoundland iron ores can be cheaply and conveniently laid down in Sydney, N.S.; in fact the iron industry here has been built up on the basis of these ores and of the local coal supplies. In Ontario, also, large quantities of imported ores are used. In 1910 the imported ores used in Ontario amounted to 681,918 tons and the Canadian ores 143,283 tons, the imported ores being derived from Michigan and Minnesota deposits; thus during 1910 about 83 per cent. of the ore used in the province was imported, as compared with 71 per cent. in 1909, and about 67 per cent. in 1908. The fuel used in Ontario was also almost altogether imported as well as a portion of the limestone flux.

According to returns made to the Department of Trade and Commerce in connection with claims for bounty, 84,759 tons only of the total pig iron production in Canada in 1910 were credited to Canadian ore and 659,891 tons to imported ore and bounty paid upon it as such. In 1909 bounty was paid upon 126,298 tons of pig iron from Canadian ore, and 607,718 tons from imported ore. No bounty is paid on the iron credited to the mill cinder, scale, etc., charged, so that the above figures do not represent the total output of the furnaces.

There has been comparatively little pig iron exported from Canada. During 1910, the exports were 9,763 tons, valued at $296,310, or an average value per ton of $30.35. The exports during 1909 were 5,063 tons, valued at $186,778, an average of $36.89; while during 1908 the exports were 290 tons, valued at $10,614, an average of $42.45 per ton. These exports probably include ferro-silicon as well as ordinary pig iron.

Considerable quantities of pig iron are annually imported into Canada. During 1910, the imports of ordinary pig iron were 227,753 tons, valued at $3,122,695, an average of $13.71 per ton, and of charcoal pig iron 16,106 tons, valued at $242,[illegible], an average of [illegible] per ton, or a total importation of 243,859 tons, valued at $3,364,847. During 1909 the imports were: ordinary pig iron, 147,925 tons, valued at $1,798,172, and charcoal pig iron, 413 tons valued at $5,727; and 1908, the imports were: ordinary pig iron 57,343 tons, valued at $771,715, and charcoal iron 1,022 tons, valued at $18,818. The rate of general tariff on pig iron is [illegible] per ton.

THE CONSTRUCTION OF DISTRIBUTION SYSTEMS FOR OUTLYING SYSTEMS AND SMALLER PLANTS.*

By S. Bingham Hood.

Toronto Electric Light Company.

In establishing an electricity supply service in small villages, or the more or less scattered population surrounding our larger cities, the problem becomes much more complex, both commercially and electrically, than that of the supply within the city itself. Most of the earlier small systems were constructed in a crude makeshift manner and gave at best anything but what we class to-day as reliable service. The men who financed these small plants seldom had any electrical knowledge and frequently operated the systems as a side line to their regular business—the power plant being located in some local mill or factory with the idea, generally, of using the prime mover for factory operation during the day and making it work overtime to earn its salt by driving a small generator at night. The operator of the plant, a local jack of all trades, attended to inside wiring, did the construction work on the lines; installed, read and repaired the meters (unless it was a flat rate proposition), and in his spare time operated the plant. The natural result was generally that, where the system was growing he had no time to attend to operating duties and the service became unreliable in proportion to its prosperity—at least until such time as the unreliability overshadowed the prosperity and the whole undertaking went on the rocks. This was the favorite time for the big fish to swallow the little one and has resulted quite generally in the present-day suburban systems being owned and operated by the large system of the nearest city, the local plant under these conditions being abandoned and supply obtained from the large central station.

The result of this has been of great benefit to the local suburban community, in that they not only obtain the primary supply from a modern station giving the highest class of service, both as to reliability and efficiency, but also have at their command a skilled, specialized force to design and supervise the local distribution and operation.

To successfully and profitably operate a large scattered suburban load the construction of the distribution system must be the very best that can possibly be obtained, in order that an uninterrupted service may be given. This requirement is even more imperative than within the larger community, as the suburban system must to a considerable extent be automatic in its operation owing to the difficulty, time, and expense, necessary to restore interrupted service due to line failure at points remote from the operating headquarters. Combined with this requirement the annual overhead charges must be kept as low as possible in order to make the distribution profitable. These annual charges reach a minimum where the design and construction of the distribution system is such that a maximum life is obtained with a minimum capital expenditure. Failure to realize this point was the downfall of the early systems where every effort was made to "make it cheap," with the result that the life of the system was limited to but a few years. At just what point maximum efficiency results is hard to determine. Local conditions may make a design adapted to one locality an expensive one for another. The best materials may be selected to cover the mechanical construction, but an electrical system may be adopted which may be so expensive that the combined cost becomes prohibitive. Generally speaking, however, maximum economy has been reached where the interest charges equal the ones for depreciation. In other words, the cheaper you can get your money the more you can afford to spend to lengthen the life of the distribution system.

In addition to this the first cost of current plays an important part. In water-power plants or large turbine steam plants the cost of current at the bus bars is very low, and, consequently, the line losses in transmission may be made somewhat high to advantage, particularly in suburban work where the load factor is generally low. Right here, however, a word of caution is opportune. You can make your line losses between the source of current and the point where first load is taken off anything within reason; but between the nearest and furthest load your total drop in pressure, including both primary and secondary, as well as transformer drop, must not exceed five per cent. if you expect to give service in its true sense. You can't operate a feeder with a drop if anywheres from ten to twenty-five per cent. and start loading it at the city limits and leave off at Farmer Jones' half a mile beyond the next village. We all know this, but still seem to keep on trying, with results similar to our railway friends with their efforts to eventually make a single track line operate successfully without sidings.

If we analyze the cost of suburban transmission we find that the pole line (such systems being nearly always overhead) represents the greatest proportionate investment. We also find that this portion also has to carry the larger share of the depreciation, due to its limited life under ordinary conditions. We, therefore, intend to take up first of all this part of the work and endeavor to show where maximum economy can be obtained. In suburban and semi-suburban work a thirty-foot pole line is amply high enough where the run is free of trees or other obstructions. Special cases will, of course, require higher poles, but the average condition is covered by the sizes shown in table 1. The prices here apply to average conditions of labor and material costs in the vicinity of our larger cities.

The cost of pole in the rough is that of good clear B.C. cedar, with an increase in diameter of one inch for every ten feet. The cost of shaving, framing and treating covers shaving from ground line to roof, taper or wedge roofing, cutting and boring of gains and boring for steps and sockets. The treating, where same is included, consists of a double immersion of the butt, to one foot above ground line, in carbolinum oil. First immersion to be in hot oil and second in cold.

Painting is for one coat, in pole yard, of entire pole above ground line. This coat preferably to be of a light body paint or stain, such as shingle stain, which will penetrate into the surface for an appreciable distance. The object of painting is primarily to improve the appearance of the pole, as any pole line is objectionable from the public's standpoint and anything which renders it less so is a first-investment. In addition a coat of stain undoubtedly does act as a preservative to a considerable extent. The object of stepping and socketing the pole is also to prevent its being cut up by continual climbing with spurs, which not only spoils the appearance of the line, but leaves countless little holes or pockets to collect water and drain it right into the heart of the wood of the pole. Steps are, or should be, standard ⅝-in. by 9-in. hot galvanized and have a life far beyond that of the pole in which they are to be used. The best form of socket is a malleable iron or wrought iron thimble which will drive into a ⅞-in. hole. The hole in thimble will take a ½-in. lag screw or pin which is slipped in by the lineman when about to climb a pole, and taken out when he comes down. Four of these sockets are required for each pole, making the first step come seven feet from the ground. As the sockets are not readily removable after once driven, their life is, of course, that of the pole into which they are placed.

---

* Abstract of paper presented at the Twenty-second Annual Convention of the Canadian Electrical Association, Ottawa, June 19-21, 1912.

The cost of setting given in the table is that for average digging in hard clay or loam. This column for items 9 to 14 is original cost of setting plus the cost of cutting off, digging out old butt, and dropping down and retamping the balance of pole.

The life of pole is taken as that point where the butt rot at ground line has decreased the sound diameter to that of the top of pole. This life varies widely with different conditions of soil, climate, etc., but figures given represent a fair average. For treated pole the life is uncertain owing to lack of definite data. The writer has taken the increased life as being five years for a pole with 7-inch top, as poles so treated have been under observation for this length of time and some are starting to show signs of decay, while others are as good as the day they went into the ground. Where this decay has started there is no means of telling whether it is going to be the same as an untreated pole, or faster or slower. Five years increased life is, therefore, taken as the known increase.

No.	Size and Kind	Cost in Rough	Shaving Framing Treating	Hauling	Painting and Stepping	Setting	Total	Life (Years)	Annual Cost
1	30-6 Plain	$3.06	$1.10	$0.45	$1.36	$3.50	$9.47	6	$2.05
2	30-6 Treated	3.06	2.20	.45	1.35	3.50	10.56	11	1.49
3	30-7 Plain	5.00	1.10	.45	1.39	3.50	11.44	7	2.21
4	30-7 Treated	5.00	2.35	.45	1.39	3.50	12.69	12	1.69
5	35-7 Plain	6.00	1.30	.48	1.64	3.75	13.17	8	2.30
6	35-7 Treated	6.00	2.60	.48	1.64	3.75	14.47	13	1.84
7	35-8 Plain	7.50	1.30	.48	1.68	3.75	14.71	10	2.21
8	35-8 Treated	7.50	2.75	.48	1.68	3.80	16.21	15	1.89
9	35-7 Plain-Reset	6.00	1.30	.48	1.84	7.35	17.17	15	1.99
10	35-7 Treated-Reset	6.00	2.00	.48	1.89	7.35	18.67	20	1.71
11	35-8 Plain-Reset	7.50	1.30	.48	1.88	7.40	18.76	18	1.82
12	35-8 Treated	7.50	2.75	.48	1.88	7.40	20.31	23	1.76
13	35-7 Treated Retreated-Reset	6.00	3.80	1.39	1.69	7.33	20.12	25	1.67
14	35-7 Treated Butt Retreated-Reset	6.00	3.00	.48	1.69	7.35	19.07	23	1.65
15	35 Steel Pole Painted	8.75		.40	*7.50	5.00	21.65	30	1.61
16	35 Steel Pole Galvanized	12.75		.40		5.00	18.15	25	1.63

* Every 5 Years

Table I.—Investment and Annual Cost on Poles.

Table 1 shows sixteen sizes or combinations of poles suitable for suburban or semi-suburban conditions, fourteen of which are wood. In figuring the annual costs it is assumed that the value of pole will be entirely wiped out at expiration of given time. The steps can probably be used over again and the pole may have a slight resale value, but these at best will only cover removal costs. It will be noted that while the investment costs vary by over 100 per cent. the annual costs only vary about 35 per cent. Taking the average of these annual costs, which is $1.84 and eliminating all above the average we have the following to select from:—

	Cost.	Annual Charge.
[illegible] treated	[illegible]	$1.49
[illegible] steel	[illegible]	[illegible]
[illegible] steel	[illegible]	[illegible]
[illegible] treated butt retreated and reset	[illegible]	[illegible]
[illegible] treated, retreated and reset	[illegible]	[illegible]
[illegible] treated	[illegible]	[illegible]
[illegible] treated and reset	[illegible]	[illegible]
[illegible] treated and reset	[illegible]	[illegible]
[illegible] treated	[illegible]	[illegible]

[illegible] transformers, corner poles, etc. Assuming that every fifth [illegible] economy, and if such treatment should turn out to give a life as long as the makers of the carbolinium claim the economy will be very much greater. For this class of work the writer recommends the use of 30-ft. treated poles for branch secondary lines, using 6-inch for straight runs and 7-inch for strains and corners. For trunk lines requiring primary wires a 35-ft. pole should be used, 7-in. tops meeting all usual requirements. While the table gives the annual cost of such a pole as $1.84, the actual cost with above suggested arrangement is less owing to our having a good framed 30-foot pole left from the old 35-foot when it requires renewing at the end of 13 years. This brings the annual cost of the 35-foot pole down to $1.33 or less than the 30-foot poles. This saving would, however, not be possible unless we used 30-foot for standard branch lines, as otherwise the old cutoff 35-foot poles would be dead wood on our hands.

The theory of wood preservation must be clearly understood by those attempting the treatment if success is expected. Wood rot is caused by a living microbe, and to sustain life we must have all of three things—LIGHT, AIR and WATER. Each one of these microbes throws a tendril or thread to the point where all three of these conditions exist, and these tendrils may be many feet in length, as they are in the case of dry rot, or heart rot. Deprive these organisms of any one of the three essentials to life and we have solved the problem of preservation. If we keep our pole above ground in good condition to shed water, by filling all exposed end grains and preventing damage to the exterior surface, we have eliminated water from this part of the pole and insured against surface rot. A short distance below the ground line both light and air are eliminated, so that our danger zone is confined to a few inches above the ground and about one to one and one-half feet below the ground. It is this portion which requires preservative treatment and any compound which will permanently exclude the air fulfills the purpose, and it is not necessary that this extend entirely through the pole as the organism in going down through the heart can not obtain light and can not live. The only really successful compound for this purpose appears to be some of the coal tar by-products, of which the dead oil,

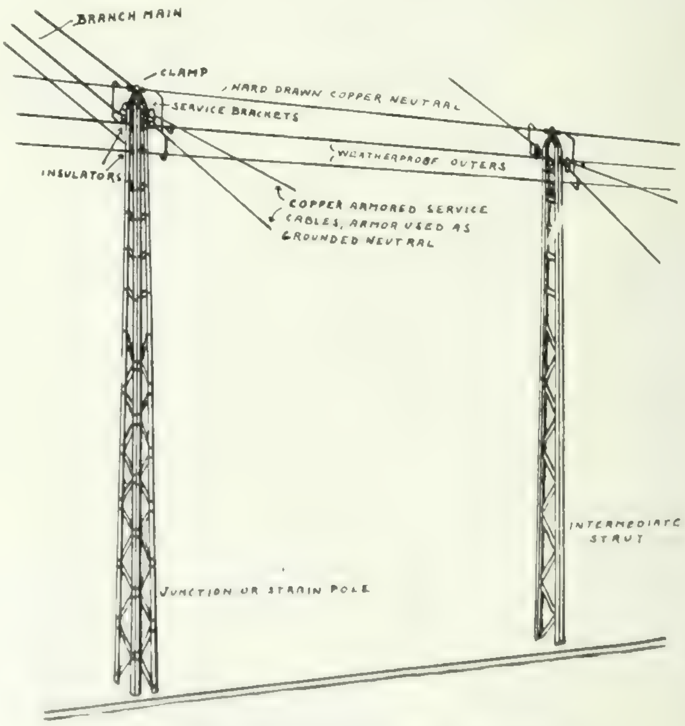


Fig. 1.—Steel Pole Secondary Distribution.

known to the trade as carbolinium, appears the best. A brush treating process can meet with but indifferent success owing to all timber being more or less filled with season cracks or checks, the interior of which can not be reached with a brush. The immersion treatment requires two open tanks, one for hot and one for cold oil, each capable of holding eight or ten poles, which are hoisted by a derrick and their butts set vertically in the tank. In addition a storage tank is desirable and a small circulating pump with suitable piping and valves connecting all three tanks. For heating the oil a furnace may be built under the hot tank, or, better still, a small steam boiler provided and steam coils immersed in the tank. Where current can readily be obtainable the heating can be done conveniently by means of low pressure resistance coils placed directly in the bottom of the tank, a suitable grid being placed to keep the weight of poles off the coils. Such an equipment should be installed for from $1,500 to $2,000, and will pay for itself in a very short time.

The growing scarcity of timber suitable for poles is rapidly forcing up the price until it seems that a few short years will make it necessary for us to use some other material with which to support our overhead lines. For voltages between those that can be handled with bare hands and those too high to handle alive a wooden or other form of insulated pole has its advantage. For high tensions transmission and for low tension secondary distribution, however, a metal pole has no objectionable features. It would seem, therefore, that we should conserve our remaining forests for use where wood is advantageous, and substitute some other material for the balance of our requirements. The past few years have seen many improvements along these lines, steel towers for transmission lines being used to-day almost exclusively. For trolley systems the tubular iron pole has been in use for urban lines for many years. Reinforced concrete has also been tried with varying success and gives promise of ultimately being successful.

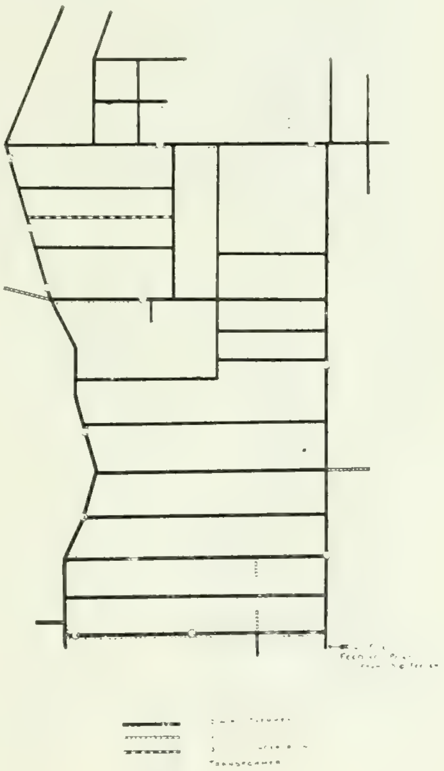


Fig. 2.

The concrete pole has been adopted for all secondary distribution by one of our larger Canadian cities, and we can well afford to wait and see how these work out before experimenting ourselves to any great extent. These poles are from 25 to 30 feet in height, of square section with beveled corners. They run about six inches at top and eight to nine at the butt. Reinforcement is with four one-half inch rods, one in each corner, about one inch from the surface. The cost in position is about the same as that of a treated cedar pole, and, theoretically, there should be no limit to their life. Personal observation, however, precludes their being recommended by the author. It is surprising the amount of rough handling these poles will stand and the extent to which they will bend without breaking. The peculiarity seems to be their failure after they are in position and the wires in place. Where they can be head-guyed so that practically no strain is placed on them they work admirably considered simply as props, with a vertical load only. Two forms of failure have been noted; first, that where the head guy has given and allowed a strain to come on the pole. In this case the beam has its fulcrum at the ground line and a tremendous leverage takes place, which draws the reinforcement, on the side under tension, right out of the concrete. This could be overcome by fastening the lower ends of the reinforcing rods in some kind of a plate, but would probably result in the strain breaking the rods instead of pulling them out. The other failure appears to be due to a torsional strain from uneven balancing of the wire pull at the top. In this case the outer shell of concrete near the top is entirely broken off and the rods with the concrete core piece twist around until the strain is equalized. On straight runs they may prove successful provided the use of numerous anchor guys is not objectionable; but in taking off service lines serious difficulties come up, as it is hardly practicable to side guy every pole where a service line is required.

Another apparent inherent defect in these poles seems to be the shrinkage cracks in the concrete. In many cases these are quite prominent and extend over three sides of the pole, being very pronounced on the side opposite the strain. It is very evident that the reinforcement is carrying all the strain and equally evident that water is getting at the rods, as well as air. As to just what effect this is going to have on the life of the pole time alone will tell.

The writer's idea of what would be a successful reinforced concrete pole would be to have a circular cross section, the reinforcement to be in the form of a tapered tube of either expanded metal or electrically welded mesh. To avoid deterioration this could be hot galvanized as a whole at small expense. The concrete would be moulded around this tube, which should be covered not less than one and one-half inches. To lighten the pole and save concrete a tapered mandril about two inches smaller than the inside of the reinforcing tube could be placed in the mould and withdrawn after the concrete had partially set. A pole of this kind would require pouring with the mould set on end, the entire proposition of development being one almost too great for any individual company to handle alone. Some of our enterprising manufacturers will, no doubt, eventually take up the development of such construction and put it in commercial shape.

Tubular steel poles up to 30 feet are now a standard product. A pole of this height and heavy enough for distribution strains can be set in concrete at a cost of about $30.00 each. Where provided with a reinforcing band at the ground line and the concrete carried up sufficiently above ground to act as a water shed the life should be at least 25 years. With this life and allowing for its scrap value the annual charge would be $2.46, or about two-thirds greater than for a wooden pole. At the rate the cost of timber is going up a few years will put iron and wood on an equal footing for such use.

Structural iron poles can be developed easily along the same lines as standard transmission towers, but on a smaller scale. One company is now making a light three-legged tower at very moderate cost and numerous designs could be brought out using galvanized standard shapes and giving a pleasing appearance with ample strength. A built up pole can be made at a cost in position not exceeding twenty dollars. The life should be at least twenty-five years with an annual cost of less than $2.00 or little greater than a wood pole line. In fact, the writer has in mind at the present time a system of construction in which about every fifth or sixth pole would be of the tower type (see Fig. 1), the intermediate poles being simply latticed struts set to take up a right angle strain due to service lines. The tops of these poles would be solidly connected by a hard-drawn copper wire which would act as a stay wire, and also a grounded neutral for the distribution system. The annual cost per pole for this idea will run approximately $1.60, or about the same as the wood pole line. These costs can probably be further cut down by bolting new ground sections to the old poles at the expiration of the original life, as little or no depreciation should occur above the ground if four test galvanizing is insisted upon.

Pole Fittings and Hardware.—The permanency, reliability and overhead charges of a distribution system depend probably more on the hardware and fittings used than upon any other item of construction. In the days of early development very light poles were the rule and their life was generally not over five years; consequently, any fitting which would last as long as the pole was considered good enough.

With the adoption of a treated pole giving a life of twelve years or more very different fittings are required. For high tension lines, or those of over 600 volts, the wooden cross arm is probably the best means of supporting the wires, as its insulating qualities are of considerable advantage. Cross arms of standard dimensions as specified in the overhead line committee's report of the National Electric Light Association, together with the hardware for cross-arm attachment as specified in this report, should be used by all electrical distribution companies where the wires are supported on cross-arms. The standard sizes are not only those which practice has shown to be suitable for the work; but, even with the greatest care, accidents are bound to happen and an acknowledged standard method of construction is of considerable advantage in defending a lawsuit. The ordinary cross-arm, however, even where of standard dimensions, is not good enough for use with treated poles unless specially selected and treated. An exception to this may possibly be made if the arms are of genuine hard yellow pine. This grade of wood is expensive and very heavy to handle, and, while strong, is not nearly as strong as its weight would seem to indicate. The softer woods, such as stock arms are generally made from, are absolutely worthless unless treated. These arms generally show heart rot first, and may appear perfectly good on the outside and actually be but a shell, which indicates that the weak point is the exposed end grain in the pin holes. To overcome this it naturally follows that any method of treatment must be before the pins are inserted and also that a brush treatment is useless. For treated cross-arms straight grain clear spruce is without doubt the best material. Arms of this [illegible] strong and tough for their weight. If treated with carbolinium oil the wood should be first kiln dried and then immersed in the hot oil until it refuses to absorb any more, several successive baths being given: the final one being in cold oil. The best [illegible] Kyanizing, in which the timber is rendered absolutely sterile and will [illegible] conditions. Kyanized timber is to all appearance the same [illegible]

arms only locust pins should be used and only those with 1½-inch shanks. Oak pins are just about as treacherous as stock cross-arms as they rot off at the shoulder in a short time. When it is considered that a broken pin may cause an interruption to an entire distribution system, and that the proportionate costs of the pins in comparison with total cost of the line is infinitesimal, any attempt at economy on this article is worse than poor engineering, and is, in fact, criminal if the pole line is on a public highway. For the same reason, too much dependence should not be placed on a single pin, and double arms should be used at all angles and junctions, and, preferably, also on the first pole on each side of a strain pole. These double arms should be provided with two spacing or spreader bolts in addition to that holding the arms in position. Various forms of spreaders have been tried out from time to time; but the writer has found the best form to be a wood block with a transverse hole to receive a standard through bolt. These blocks are frequently made in the field from a section of standard cross-arm, but a far better practice is to have them made from 3-inch by 4-inch surfaced stock, treated the same as the arm. The blocks may be made in lengths of from 18-inch to 24-inch, and can then be cut to proper length as required; the 11/16-inch hole being bored through the entire block at the mill.

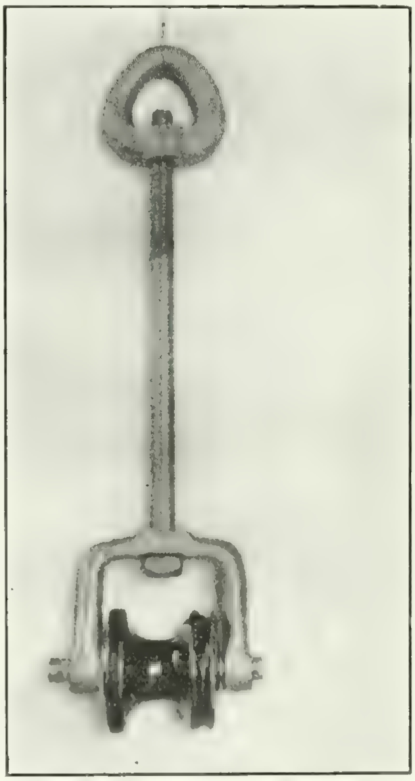


Fig. 3.—Dead Ending Clevis.

Locust wood suitable for pins is becoming so scarce, and, at best, a wood pin is the weakest point in our suspension system, that metal reinforcement or entire metal pins are being used more and more as the demand for permanent construction increases. These pins range all the way from the ordinary wood pin with a ⅜-inch iron rod inserted in it to the all metal pin. Attempts have been made to standardize a metal pin of malleable iron having a 1½-inch shank to fit the old style of arm. This style has not found favor, however, owing to the arm then becoming the weakest point. Malleable pins have also been found objectionable owing to the tendency to split the insulator due to unequal expansion between the iron and the glass or porcelain. In order to overcome this, metal pins with wooden tops are used extensively, the common form being simply the old wood pin cut off at the shoulder and bored to receive a [illegible]-inch carriage bolt. A similar style uses only the threaded portion of wood, the base being a porcelain spool which slips over the bolt. Probably the oldest style of metal pin is the Western Union, which has been standard for many years with telegraph companies. This pin has not, however, the necessary stiffness for electric light work.

(To be continued.)

PRECISE LEVELLING IN CANADA.*

By F. R. Reid, D.L.S.

While this paper has the rather comprehensive title of "Precise Levelling in Canada," it should be explained at the outset that it has special reference to the methods employed and the territory covered by the Geodetic Survey and it is intended to merely touch upon the work of other branches of the Government service along these lines. In this country, the only precise levelling of any extent, so far as I am aware, is that which has been carried out by the Government, though in the United States some of the railways, notably the Baltimore and Ohio and the Pennsylvania Railroad, has undertaken precise level lines of considerable extent on their own account.

This fact, namely, that some of the leading American railroads have gone to the expense of running precise levels for their own benefit, does much to prove the demand for levels of a high degree of accuracy; also, I might say, that while the work has been carried on for only a comparatively short time in Canada—the first work by this Department was done in 1906—and is therefore not very widely known, yet we have had a large number of enquiries for the results, from railway corporations, city engineers, suveyors, consulting engineers and others. While the work is of great use to the public at large it is of equal importance to the Geodetic Survey in the extension of its system of triangulation, and to the various topographical surveys carried on by the Militia and other Government Departments; also to the International Boundary Survey. The making of accurate contour maps of any country is very greatly facilitated by a line or a net of precise levels.

If any further proof were needed for the necessity of this work, a perusal of White's dictionary of "Altitudes in the Dominion of Canada," would furnish a good deal of it. This is a very comprehensive work and has been prepared with great care from the best available information, obtained from many sources. In this preparation, however, many very large discrepancies in the elevations of junction points of railways, &c., were discovered, which it was found impossible to overcome by the use of the information at hand. I will instance three or four cases on the main line of the Canadian Pacific Railway from Vancouver to St. John, N.B.

The elevation published for Donald, B.C., by levels from the Pacific Ocean is 2,586 feet above the sea level, and by levels from Lake Superior, 2,574, a discrepancy of 12 feet. At Cartier, the first divisional point west of North Bay, there is a similar descrepancy of 34 feet between the levels from Lake Superior and from Montreal. At two points on the line through the State of Maine, also, there are discrepancies, one of 18 feet and one of 7 feet. These discrepancies all have the same sign and therefore accumulate in the same direction, to the total amount of 71 feet. While there may be a slight difference in elevation between the Atlantic and Pacific oceans along the respective coast lines, it would certainly amount to but a small fraction of this difference, and an investigation by means of precise levelling would seem to be in order.

Precise levelling is, whenever possible, carried along railway track, rather than along highways or across country, the advantages of this practice being many. The rate of rise and fall of the track is usually fairly uniform and no steep hills are encountered, thus allowing longer average sights to be taken and allowing the backsights and fore sights to be easily kept of equal length. The rails furnish excellent support for the levelling rods and thus the time is saved which would otherwise be consumed in putting artificial turning points into the ground. The masonry structures—bridges and culverts—situated along the railways are utilized for placing permanent bench marks; this is of great advantage both to us and to the railway companies. Again, the use of a hand-car for going to and from work and for moving along from point to point during the day affects a great saving of time and labor, and the transportation of the camping outfit from camp to camp by freight is cheaper and more convenient than the method by horse and wagon. Against these and many other advantages may be set the fact that the refraction and boiling of the atmosphere in the heat of the bare ballast and rails of a track is worse than on a highway. Dodging fast trains coming through rock cuts and around curves lends a spice of danger and excitement to the work which would not be found on a country highway.

The levels of the Geodetic Survey in Ontario and Quebec have been started from a bench mark established by the United States Coast and Geodetic Survey at Rouse Point, N.Y. This bench mark is included in an elaborate net of precise levels and water transfers which are based on mean sea level at New York and its adjusted elevation is believed to be very close to the truth. At any rate it is the best available datum at present; eventually the Geodetic Survey may have a mean sea level datum of its own but this is something which requires several years of gaugings to determine accurately.

From Rouse Point two lines of levels have been extended, one westerly through Lacolle Junction, Coteau Junction, St. Polycarpe Junction, Kemptville, Prescott, Hamilton, London and Chatham to Windsor, with a branch from Hamilton to St. Catharines and Bridgeburg; the other line easterly through St. Johns and Sherbrooke to the International Boundary, 15 miles east of Megantic, Que.; branches have been extended from this line to the International Boundary from Farnham, Foster, Sherbrooke and Lennoxville, and from Megantic to the St. Lawrence River at Levis via the Quebec Central Railway. A considerable amount of levelling has been done in New Brunswick and Nova Scotia; starting from the town of St. Stephen a line has been extended northerly to the St. Lawrence River at Riviere du Loup, this line runs for most of its length within a short distance of the border of the State of Maine and branches have been connected at intervals so as to furnish accurate levels for the International Boundary survey. Easterly from St. Stephen the line has been extended through St. John and Moncton and through Nova Scotia as far east as Mulgrave, on the Strait of Canso.

All the elevations in the Maritime Provinces are based—provisionally— on a bench mark at St. Stephen, N.B., established by the United States Corps of Engineers; connections have been made at Riviere du Loup and Moncton with the precise levels of the Public Works Department of Canada which have been carried from Montreal to Halifax via the Intercolonial Railway; these levels are connected with the Rouse Point bench mark and also with mean sea level at Halifax. The fact that our levels agree very closely with theirs goes to show that the St. Stephen bench mark is very near correct and that the elevations of our bench marks throughout the Maritime Provinces are very close to the truth and of far greater accuracy than is necessary for ordinary engineering and surveying purposes. Last summer a start was made at levelling along the Grand Trunk Pacific Railway, from its junction with the Quebec Central Railway on the Megantic-Levis line to the town of Edmundston, N.B., on the St. Stephen Riviere du Loup line, a distance of some 25 miles — through a very rough country. It is hoped that this link may be finished during the present season and then all the bench marks in the Maritime Provinces may be corrected by a small constant quantity, which will reduce them to the same datum as those throughout Ontario and Quebec, and will form one net of levelling extending from the Maritime Provinces to Western Ontario.

---

*Paper read before the Ottawa Branch of the Royal Astronomical Society.

In Western Ontario, two circuits, composed entirely of our own levelling, have been completed, and the excellent results—shown by the small closing error—are a source of great satisfaction. As mentioned above, a main line of levels extends from Toronto to Windsor, along the Grand Trunk Railway through Hamilton, London and Chatham; a branch line leaves this at Toronto and extends along the Canadian Pacific Railway to Owen Sound, thence southerly along the Grand Trunk Railway, through Palmerston, Listowel and Wingham to a connection with the main line at Hyde Park Junction, 4 miles west of London. Another line leaves the Owen Sound-Hyde Park line at Lucan Crossing, 15 miles north of Hyde Park Junction, and extends through Sarnia to Chatham, where a second connection is made with the main line. The new elevation found for the bench mark at Hyde Park Junction is 0.15 feet higher than the original elevation and at Chatham 0.11 feet lower than the original. The length of the Toronto-Hyde Park circuit is about 436 miles and the length of the Toronto-Chatham circuit about 595 miles so it may easily be seen that the levelling shows a high degree of precision in actual practice.

In the spring of 1910 levelling was inaugurated in the Western Provinces. To secure a sea level datum for this work it was found necessary to go to the town of Stephen, Minn., about 45 miles south of the International Boundary at Emerson, Man. The precise levels of the United States Coast and Geodetic Survey having been extended to this point, furnished what was desired. It was necessary to carry the levels through United States territory to the International Boundary at Emerson, the boundary was then followed to Gretna, a few miles west, and the railways paralleling the boundary followed westerly from that point. As in the case of the Maine and Vermont boundaries, so here, branch lines have been run at convenient intervals for the benefit of the International Boundary Survey. The levelling, at the close of last season, had reached the village of Frobisher, Sask., about 27 miles east of Estevan, on the Canadian Pacific Railway.

Returning to Ontario, the programme for the present season, includes running from Bolton on the Toronto-Owen Sound line, towards Sudbury via Canadian Pacific Railway, and it is hoped that this line will eventually be extended west to connect with the line mentioned above as running west from Emerson; this will, however, be the work of several years owing to the great distance involved.

From a consideration of the various routes outlined above, it will be seen that the general policy has been to extend [illegible] lines of levels throughout the country as [illegible] for the immediate use of the [illegible]; as these lines are completed, duplicate lines may be run and circuits of levelling closed. In following routes between principal points it has been usual to follow the line which passes through the best settled country and possesses the greatest number of [illegible], except in a few cases the route has been [illegible] in order to connect with [illegible] published work done by the Public Works Department, as in the case of our line between Coteau Junction, Que., and Prescott, Ont., the Department had levelled from Coteau to Cornwall, consequently, to avoid duplication, the levels of the Geodetic Survey were carried around by St. Polycarpe and Kemptville an extra distance of about 19 miles.

The Public Works Department has conducted precise levelling at intervals since 1883. During the years 1904-05-06 a long line of levels, starting from the Rouse Point bench mark, was extended through Ottawa and Pembroke to North Bay, for use in the extensive surveys undertaken by the Department for the purpose of locating and determining the cost of the projected Georgian Bay Ship Canal; this line was checked by a line from Toronto to North Bay, starting from a bench mark at Toronto which had been established by means of water transfers from Tibbett's Point, N.Y., at the eastern end of Lake Ontario.

Precise levelling was carried on by the International Boundary Survey in connection with the survey of the 141st meridian, the boundary between Canada and Alaska, in 1908-09-10. Starting from White Pass, B.C., levels were carried along the White Pass and Yukon Railways to White Horse and thence by wagon road to Dawson and over the glacier trail to the 141st meridian; the total distance levelled was in the neighborhood of 500 miles, but this distance does not give a proper idea of the amount of labor involved, owing to the fact that most of the work was not on a railway track but on rough trails through an uncivilized country.

The instruments and methods employed on this work were practically the same as those in use by the Geodetic Survey, modified when necessary to suit the different conditions under which the levelling was performed.

Bench Marks.—In the foregoing, mention has been made of the bench marks established; it will now be in order to say something of the nature of these—the only permanent field records of the work performed.

The standard bench mark established by the Geodetic Survey, previous to the year 1908, consists of a copper bolt ½ inch in diameter and 4 inches long, stamped on the end with the letters "B.M., D.A.O." (Bench Mark, Dominion Astronomical Observatory). During 1908 and since then the standard bench mark has been a copper bolt, ¾ inch in diameter and 4 inches long, stamped on the end with the letters "G.S.C., B.M.." (Geodetic Survey of Canada, Bench Mark). In either case the bolt is sunk horizontally in rock or masonry, a hole being drilled of the exact size of the bolt or a shade larger and the latter hammered in till it completely fills the hole, the end being flush with the surface of the masonry or projecting slightly; properly put in, it is impossible for anyone to remove it without destroying the surrounding rock or masonry. After the exposed end has been planed to a smooth surface by means of a file it is stamped with a steel die containing the above mentioned letters; then a horizontal cross mark is made with a cold chisel, upon which the elevation is taken; finally a number is stamped with other steel dies. The question is often asked "Why do you not indicate the elevation of the bench mark also?" In reply to this I would say that the elevation of a bench mark in a precise levelling net may never be finally determined; the closing of circuits and introduction of new cross lines will always call for adjustments which will make changes of greater or less magnitude in the elevations; it would therefor be impossible to place more than an approximate [illegible] upon it. Also the computation of the elevations from the field notes is a work of some magnitude and would delay the operations of the parties were it performed in the field, and is therefore left to be done in the office after the notes have all been carefully checked. I might say also that an engineer would not usually attempt to look for the bench marks haphazard, but would secure descriptions of their locations, when getting these, the elevations can always be secured at the same time without difficulty. Bench marks are placed in the stone and concrete structures along the railways, sometimes in large boulders and in rock cuts, and when towns or cities are situated within a reasonable distance of the line, branch lines are run to them and bench marks placed in public buildings such as post offices, court houses, and churches. Levellers are instructed to place bench marks at distances of three miles apart, or less. It has been found impossible however, in many cases, to secure good locations for bench marks at anything like this distance apart, so the expedient was adopted by us in Manitoba in 1910, and in this part of the country in 1911, of building concrete piers, specially for bench marks.

These piers are 6′ 3″ high, 9″ square at the top and 15″ square at the bottom, resting on a 6″ concrete footing; the whole pier is buried to within about 9″ of the top and the copper plug built in, near the ground surface, having been previously stamped and numbered. The piers are usually built on the railway right-of-way, within 3 or 4 feet of one of the fences and on fairly level ground, where they will not be exposed to danger from future alterations in the railway grade. The concrete consists of a mixture of one part cement, 2 parts sand, and 5 parts gravel, the latter ingredients can often be secured by sifting the ballast on the track. Portable wooden forms are employed which can be removed after the concrete has set and used over again; the total time consumed building a pier, including the excavating, removing the forms and back-filling, averages between half a day and one day, probably nearer the latter.

The piers are not built at any definite distance apart; it is left to the discretion of the leveller to put them in where they appear to be necessary.

Temporary bench marks are placed at intervals of one mile or thereabouts, they consist usually of spikes, driven horizontally into telegraph poles, and, as their designation implies, they are used only for convenience while the work is progressing; they are not embodied in the final office record.

The permanent bench marks above described are neat and unobtrusive, not likely to be discovered and defaced by unauthorized persons, but easily found by anyone furnished with a description, and are therefore well adapted for use in a settled country like that in which most of the work of the Geodetic Survey has been carried on.

For use along the Alaska Boundary, however, they were not considered suitable, owing to the absence of masonry structures and for other reasons, so a different form of bench mark was employed, being a circular copper plate 4″ in diameter with a stem at right angles to the plate and about 3″ long; the plate was placed flat on top of a surface of rock, the stem being solidly cemented into a hole drilled for that purpose; the elevation was taken on top of a knob at the centre of the plate. When suitable rock could not be found the copper plate set on the top of an iron post which was firmly planted in the ground, projecting a short distance above the surface. Bench marks were put in at distances of 10 miles or thereabouts.

The bench mark used by the Public Works Department is similar in form to that of the Geodetic Survey, but contains no mark on its exposed surface but the cross mark upon which the elevation is taken, the number of the bench mark is cut in large Roman numerals upon the masonry adjoining it.

Instruments.—The instrument adopted is a precise level very similar in design to that used by the United States Coast and Geodetic Survey. It may be described as a modification of the engineer's dumpy level in that the telescope is firmly attached to its supports and is not removable as in a wye level. The materials used are nickel-iron, an alloy consisting of 36 parts nickel and 64 parts iron and nickel-steel (or Invar) an alloy of the same proportions of nickel and steel. The latter alloy is used for the mountings of the level vial, for the collars, diaphragms, adjusting screws and any other parts required to retain their relative positions as nearly as possible. The co-efficient of expansion of these alloys—especially nickel-steel is exceedingly small.

The instrument base is a single piece of hard and finely grained cast-iron and is supported by the three levelling screws. The instrument centre is of unusual length and passes down through a hole in the tripod head, thus allowing the telescope to rest low down—near the tripod— and giving greater stability to the instrument when used in a wind. The telescope itself is completely enclosed in an outer tube in which it is allowed a small motion vertically; it is supported at the object glass end by a horizontal pivot and at the other end rests on the point of a fine micrometer screw by means of which it may be raised or lowered by an exceedingly small amount. When the instrument is not in actual use and is being carried from station to station the telescope tube is lifted from the point of the micrometer screw by means of a small lever; this keeps the telescope pressed tightly against the upper part of the casing and saves the point of the screw from wear. At the lower end of the screw a drum or micrometer head, subdivided by a hundred graduations, is provided. The upper part of the outer casing has cast into it a rectangular opening with a framing surrounding it; a piece of plate glass fitted into this framing in grooves closes the opening against dust or air currents, but can be quickly removed, when necessary, for the purpose of adjusting the level. The tube containing the level vial is set within this opening, as close to the line of collimation as possible. This position of the vial has the advantage of protecting it, to a large degree, from sudden changes of temperature. A small rectangular mirror placed above and parrallel to the level tube, reflects the bubble into two prisms placed in a tube immediately to the left of the telescope tube. By this means the observer is enabled to watch the action of the bubble with his left eye while reading the rod with his right eye; that is, he can transfer his attention instantaneously from the one to the other. The level vial is constructed with a small chamber at one end communicating with the body of the vial by an opening at the edge of the tube; by tilting the instrument so as to raise one end of the vial the spirit can be raised to run to or from the chamber; in this way the length of bubble used may be kept constant throughout the varying temperatures of the day or the season. This adds to the refinement of the work, as the grinding of the vial is more accurate near the centre and it is consequently not well to allow the bubble to lengthen out too much. One division on the level vial has a value of about 2½ seconds in arc.

Three cross wires of fine spider web are placed in the diaphragm, in order that three readings of the rod may be made at each observation. Two eye-pieces, of different powers of magnification, are provided; the high power to be used under ordinary atmospheric conditions, and the low power when the trembling and boiling of the atmosphere, due to heat waves, is unusually severe.

Great care has been expended on the construction of the rods used up on this work. They are built up of separate pieces of white pine giving a cross section in the form of a symmetrical cross so as to prevent bending and warping; they are boiled thoroughly in paraffin which tends to keep them of constant length under varying conditions of atmosphere and temperature. Silver plugs are inserted in the face of the rod approximately at the three, six and nine foot points and the exact position of these points marked by a fine scratch on the face of the plug; the rod is then subdivided into feet, tenths and hundreths in alternate white and black spaces of one one-hundreth of a foot. When observing the rod the readings are made to thousandths, the hundreth spaces being subdivided by estimation. As it is impossible to subdivide a black space accurately at the distance the rod is usually observed, two sets of graduations are placed, side by side, one on each side of the centre line of the rod, the white spaces of one adjoining the black spaces of the other; thus the observer has always a white space to subdivide by reading on the right hand or the left hand set of graduation marks, as the case may be. The bottom of the rod is formed of a cast steel foot block with a hemispherical knob on the bottom, suitable for holding on flat surfaces.

Another piece of apparatus which can hardly be classed under the heading of instruments, but which is very necessary nevertheless, is a large carriage umbrella with a handle about 8 feet long, provided with a spike at the end to insert it in the ground. The umbrella is used whenever the sun is shining while observations are in progress to shade the instrument from its rays; without this the parts would become unequally heated and irregular and unreliable action of the bubble would follow.

While carrying the instrument between sights a cover of duck or cravenette is used for the same purpose, this also is used to protect it when working during a light rain; in a heavy rain the work has to be discontinued.

Field Operations.—A precise levelling party consists of 7 men, the observer, the recorder, umbrella man, two rodmen, cook and railway man, usually a section man or brakesman, to pilot the hand-car. Camps are made at the stations along the line, the distance apart of camps varying from ten to twenty miles according to the location of towns and villages and to the condition of the intervening track or to grades. The levelling is carried continuously forward, day by day through the camp and to a point about half way to where the next camp ahead will be; permanent and temporary bench marks being put in so as to divide the line into sections of one mile or less. From this point backward levelling is commenced and carried along to the point where the line was taken up, probably about half way from the previous camp, all bench marks being checked upon on the backward run.

I will quote from the general instructions issued to levellers:—"All lines are to be levelled twice, in opposite directions called forward and backward levelling. Backward shall in every respect be independent of forward levelling and the same tuning points shall not be used. If the forward levelling is made in the forenoon, the backward—over [illegible] In this respect the opposite conditions as to intensity of light [illegible] When [illegible] in the thread intervals, or any other error is discovered, even [illegible]

[illegible]

[illegible] led anew, both forward and backward, until two measurements within the limit of error are secured. In this way, four, six, or more measures are made, the mean of all being taken and the individual residuals determined. Reject all those results whose residuals are greater than 0.015 feet; then take a mean of the remaining measures for a final result."

This requirement, that the discrepancy shall be within 0.017 times square root of the distance in miles has been adhered to as closely as possible through out the work; this means that for 1 mile forward and backward levels shall correspond within 0.017 foot, for 4 miles within 0.034 foot, for 100 miles within 0.170 foot and so on. Quite frequently the total discrepancy of a line shows a constant, and often unaccountable, tendency to accumulate in one direction. Various precautions are used to guard against this. If, when reading from the successive instrument stations, or set up points, the rear rod were always read first and the forward rod last, any settlement of the level between the backsight and foresight would have a constant tendency to make the foresights too small in comparison with the backsights, and on the backward levelling this effect would be repeated, causing the discrepancy to accumulate rapidly; this is obviated by reading on the rear rod first at one station and on the forward rod first at the next station so that any settlement at one will be counteracted by the settlement at the next; this method also has the advantage of eliminating the effect of a uniformly changing refraction in the atmosphere, such as usually occurs most noticeably in the early morning and late afternoon hours. It of course has the effect of holding back the progress of the work considerably, a at every second set up the leveller has to wait for the front rodman to reach his turning point, and afterwards wait for the rear rodman to ovetake him before going forward (these remarks are intended to apply where the levelling is carried along a railway track and a hand-car used between sights). However, in precise levelling, accuracy is the first consideration and speed is secondary.

(To be continued.)

EDMONTON INVESTIGATES TOFIELD'S GAS SUPPLY.

A heavy flow of natural gas has been struck at the town of Tofield, on the main line of the Grand Trunk Pacific, forty miles east of Edmonton. The town has been conducting boring operations as a municipal enterprise for about a year past. For some time strong indications of gas were evident, and it was obtained in comparatively small quantities, and could not be considered a commercial proposition until a few days ago, when there was encountered an enormous flow under very heavy pressure. The volume of the flow is variously estimated at from 1½ to 2 million feet per day. Edmonton city council has taken action with a view to obtaining expert information as to the practicability of piping this gas into the city. The city is about to embark on the installation of a municipal gas plant. The work will be immediately proceeded with so far as the mains are concerned; but action on the ordering of the generating plant will be suspended until the possibilities of the Tofield discovery have been investigated.

Practically at the same time a strike of gas in large volume and under heavy pressure was made at Pelican Rapids, about 175 miles north of Edmonton, on the Athabasca River. Boring has been going on there for oil in the interests of a syndicate of Edmonton capitalists, and will be proceeded with, with the expectation of finding oil in strata below.

ELECTRIC POWER FOR ST. JOHN, N.B.

An engineer has stated that a head of 100 feet of water could be got at Silver Falls on the line of the city waterworks system, and a constant pressure secured by the construction of storage dams. The city council is considering the question of generating electricity at this point, in order that the city might provide its own electric light system. The council has awarded contracts for permanent paving on portions of several streets, and this policy will be continued from year to year. City government under the commission plan is thus far working out satisfactorily in St. John, and much more so than the old city council system with ward representation.

Mr. D. McNicoll, general manager of the Canadian Pacific Railway, visited St. John last week and stated that the plans for the new million-bushel elevator had been completed, and the contract would be awarded very soon. A crib-work has been constructed, and the Maritime Dredging Company has been awarded the contract to fill in a section of the shore flats at West St. John, where the elevator will be built.

At East St. John the sub-contractors for the breakwater and the excavation for the drydock have just installed the heaviest construction plant ever seen in St. John. It was brought from Ohio and includes a steam shovel weighing 110 tons. Hundreds of men are now employed there. At West St. John Contractor Michael Connolly has brought from Quebec a complete modern plant for concrete wharf construction, and has the heavy crib-work foundations for the new wharves which he is to build well under way.

The Furness steamer Rappahannock has just taken from St. John a shipment of fifty thousand bushels of grain for London. It is expected that each steamer of this line during the summer will take about the same quantity, and this will be a test of the suitability of St. John as a summer port for grain shipments.—W.E.A.

◆

PERSONAL.

MR. DE GASPE BEAUBIEN has been appointed as representative of the city of Montreal on the Electric Service Commission, to succeed Mr. Beaudry Leman.

◆

CORRECTION.

In May 9th issue of The Canadian Engineer, on page 636, the formulae should read as follows:

$$\frac{\left\{\frac{A'B' + A''B''}{2} \times A'A''\right\} + \left\{\frac{C'D' + C''D''}{2} \times C'C''\right\}}{2} \times$$

$$\frac{(C'C - A'A) + (D'D - B'B) + (D''D - B''B) + (C''C - A''A)}{4}$$

$$\times \frac{62.5}{2{,}000} = \text{Displacement in tons.}$$

which can be expressed in a somewhat simpler manner:

$$\frac{\left\{\begin{matrix}\text{Area of boat}\\ \text{on loaded water lines}\end{matrix}\right\} + \left\{\begin{matrix}\text{Area of boat}\\ \text{on light water lines}\end{matrix}\right\}}{2} \times$$

$$\left\{\begin{matrix}\text{distance}\\ \text{between the}\\ \text{two planes}\end{matrix}\right\} \times \frac{62.5}{2{,}000} = \text{Displacement in tons}$$

INTERNATIONAL GEOLOGICAL CONGRESS.

The International Geological Congress, on the joint invitation of the Government of Canada, the Provincial Governments, the Department of Mines, and the Canadian Mining Institute, will hold its twelfth meeting in Canada during the summer of 1913.

For purposes of organization, a meeting of representatives from various scientific bodies of Canada was held in Toronto, Ontario, on December 2nd, 1910.

Field Marshal, His Royal Highness the Duke of Connaught, Governor-General of the Dominion of Canada, has graciously consented to become honorary president.

It is proposed to hold the meeting of the congress in Toronto, beginning on or about the twenty-first day of August. The congress will continue in session for eight days.

Since the first meeting of the congress in Paris, in 1878, meetings have been held in Italy, Germany, England, the United States of America, Switzerland, Russia, Austria, Mexico and Sweden. At the last congress held in Stockholm, in 1910, there was on attendance of 850, and it is expected that this number will be exceeded in Canada next year.

An extensive series of excursions is being arranged to illustrate the typical geology and mineral resources of Canada. These excursions will take place during August and September and will extend from Cape Breton and Halifax on the Atlantic to Prince Rupert and Victoria on the Pacific, and from Niagara Falls on the southern boundary to Dawson City near the Arctic Circle.

Geologists from every quarter of the globe will attend the congress, and for many it will be their first visit to Canada. They will include professors from the leading universities and mining schools, officers of the various government geological surveys and mining departments, and geologists and mining engineers in private practice.

Topics for Discussion.—The following topics have been selected by the executive committee as the principal subjects for discussion:—

1. The coal resources of the world.
2. Differentiation in igneous magmas.
3. The influence of depth on the character of metalliferous deposits.
4. The origin and extent of the pre-Cambrian sedimentaries.
5. The sub-divisions, correlation and terminology of the pre-Cambrian.
6. To what extent was the Ice Age broken by interglacial periods?
7. The physical and faunal characteristics of the Palæozoic seas with reference to the value of the recurrence of seas in establishing geologic systems.

The executive committee of the eleventh congress, held in Sweden, compiled and published a comprehensive report on the Iron Ore Resources of the World. The present executive has undertaken the preparation of a similar monograph on the Coal Resources of the World. In order to make the work as complete as possible the co-operation of all the principal countries of the world has been invited. This invitation has met with a cordial response, and it is hoped the volumes will be ready for distribution before the meeting so that they may constitute a basis for discussion at the congress.

The secretary will be pleased to answer all enquiries regarding the arrangements for the congress. Correspondence should be addressed as follows:

The Secretary, International Geological Congress,
Victoria Memorial Museum, Ottawa, Canada.

THE NEW CHIEF COMMISSIONER OF THE DOMINION RAILWAY BOARD.

Henry L. Drayton, K.C., one of Canada's representative attorneys, was born at Kingston, Ontario, Canada, April 27th, 1869. His father, Philip Henry Drayton, K.C., is of English birth and ancestry, and came to Canada as captain of the 16th Rifles of England, being stationed at Kingston, Ont. He retired from the Rifles in 1871, moving to Barbadoes, residing there until 1874, when he returned to England, and in 1877 moved to Toronto, entering the law firm of McMurrick and Drayton. He is at present official arbitrator of the city of Toronto. On the maternal side Margaret S. (Covernton) Drayton, is of Irish-Canadian lineage.

Henry L. Drayton was educated at the schools of England and Canada, and began his career as a law student in 1886, at Toronto, with the legal firm of Lount & Marsh. He was admitted to the Bar of Ontario in 1891, and at once entered in the practice of his profession. In 1893 he became assistant city solicitor, under C. R. W. Biggar, K.C., and subsequently under Sir William Meredith, K.C., and J. S. Fullerton, K.C. In September, 1900, he retired and went into partnership with Charles J. Holman, K.C. On the 29th of January, 1904, he was appointed county crown attorney for county of York, resigning from that office in November, 1909, to resume the practice of law with C. J. Holman, K.C. On January 20th, 1908, Mr. Drayton was appointed a K.C.

Mr. Henry L. Drayton, K.C.

[illegible] he was appointed counsel to corporation of Toronto, [illegible]. He was appointed by the Ontario Government a member of the Toronto Power Commission on May 11, 1911.

He is a member of Toronto Club, Toronto Hunt Club, Ontario Jockey Club, Rosedale Golf Club, Glen Major Fishing Club, Toronto Racquet Club, and Engineers' Club, of Toronto.

Mr. Drayton was married to Edith Mary (Cawthra) [illegible], of [illegible], September 14th, 1892, and they are the parents of three children, Grace Drayton, Nora Drayton and Margaret Drayton.

Mr. Drayton will take up his duties as chief commissioner of the Dominion Railway Board about September 1st.

WESTERN CANADA IRRIGATION ASSOCIATION.

SIXTH ANNUAL CONVENTION.

The Western Canada Irrigation Association will hold its sixth annual convention in the city of Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16. The meeting will convene on the evening of the 13th, at 8 o'clock.

An excellent programme of addresses has been arranged, papers having been promised by the following:—

Professor Alfred Atkinson, Department of Agronomy, Montana Agricultural College and Experimental Station, Bozeman, Montana, "The Irrigation of Alfalfa."

Rev. E. McQueen Gray, foreign secretary, National Irrigation Congress, professor University of New Mexico, Albuquerque, N.M., "Foreign Government Reclamation."

William Pearce, former president of the association, and member of present executive.

Professor C. I. Lewis, State Agricultural College, Oregon, "The Relation of Irrigation to Fruit Growing."

P. H. Moore, superintendent Government Experimental Farm, Agassiz, B.C., "Stock and Dairying, with Special Relation to Irrigation Farming."

M. L. Dean, State Horticulturalist, Missoula, Montana, "Apple Culture and the Baldwin Spot."

A. E. Ashcroft, chief engineer, White Valley Irrigation and Power Co., Vernon, B.C., "Public Ownership and Irrigation Systems."

R. D. Prittie, superintendent Forestry, Department Natural Resources, C.P.R., Calgary, "Irrigation as Applied to Forestry."

R. M. Winslow, Provincial Horticulturist, Victoria, B.C., "Some Climatic Conditions Influencing the Duty of Water in British Columbia."

Professor Elliott, Superintendent of Agriculture, Department of Natural Reosurces, C.P.R., Strathmore, Alberta, "Irrigation and Intensive Farming."

F. H. Peters, Commissioner of Irrigation, Dominion Government, Calgary, "The Proper Duty of Water and the Necessary Irrigating Head in Western Canada."

N. E. Webster, with Messrs. Niles and Niles, public accountants, New York, "Irrigation Accounting."

John T. Burns, executive secretary, International Dry Farming Congress, Lethbridge, Alberta.

Dr. Samuel Fortier, chief of irrigation investigations, Experimental Station Branch, United States Department of Agriculture, one of the foremost irrigation experts on the continent, whose advice in connection with administration of water matters in British Columbia has been solicited, will address the convention.

A list of delegates should be sent in to the secretary, P.O. Box 1317, Calgary, as early as possible, which list should contain, in addition to the names, the post office address and occupation of each delegate. Norman S. Rankin, permanent secretary.

OBITUARY.

CECIL B. SMITH, Ma.E.

By the death of Cecil B. Smith, Canada has lost one of her most promising civil engineers; taken suddenly just at the stage when his reputation in the special field of hydro-electric development was being recognized as international.

Mr. Smith was born at Winona, Ont., in 1865, his father, Sylvester Smith, being a respected farmer of Wentworth county. His first education was received at the Collegiate Institute, at Hamilton, whence he went to McGill University. He graduated in 1884, receiving first honors and being awarded the Governor-General's medal.

He at once entered on his chosen field in which he was to achieve such distinction. Beginning with railway work as resident engineer on the Northern and Pacific Junction of Ontario (now a section of the C.P.R.) he took work on the construction of the St. Catharines and Niagara Central Railway, and then, attracting the attention of the late W. T. Jennings, was offered work on the C.P.R. at London, Ont. He was next appointed locating engineer of the Toronto, Hamilton and Buffalo Railway in 1888-9. Having in the meantime done some work on the Welland Canal, under the late Thomas Munro, and on the Montreal harbor works under John Kennedy, Mr. Smith sought a wider field of railway experience in the United States, where, between 1889-93 he was divisional engineer of the C.C. & C.R. of Tennessee; chief assistant engineer of the Roanoke Southern Railway of North Carolina, and assistant engineer of the Baltimore and Ohio, in charge of construction, at Morganstown, West Virginia. Returning to Canada in 1893, he was appointed assistant professor of civil engineering at McGill University, being a lecturer on engineering and having charge of cement testing and strength of materials. In the following year he received the degree of Master of Engineering, and in 1895 he began a series of articles on railway work in *The Canadian Engineer*. These articles were in such request that they were reprinted in book form in 1899, under the title "Railway Engineering." This work won immediate recognition by being adopted as a text book in various universities and technical colleges in Canada and the United States. Mr. Smith's ambition could not be confined within college walls, and in 1899 he came to Toronto as assistant city engineer in charge of the sewage system. In 1901 he entered the hydro-electric field, having been appointed construction engineer of the Canadian Niagara Power Co., then one of the three greatest power installations of America. His clear insight into the problem of electric power and its distribution for public use led him to outline plans which, through the courage of Hon. Adam Beck, brought about in later years the Hydro-Electric Commission, which made Ontario the pioneer in legislative experiments in electric transmission. Mr. Smith himself became chief engineer of the Hydro-Electric Commission, and, though not personally in favor of the whole programme afterwards carried out, was a member of the commission through which electrical power was furnished to municipalities in Ontario under government auspices.

Upon the defeat of the Ross Government *The Canadian Engineer*, joined by many men of practical experience, advocated the abolition of political appointments in the control of the Ontario Government railways, and Mr. Smith was happily appointed to take charge of the Temiskaming and Northern Ontario Railway. Here his grasp of problems of railway operation, as well as of construction, were demonstrated, and he soon brought order out of confusion and established this road as the first profit-making government railway in Canada. In 1905 he was appointed chairman of the commission formed to manage this line, and held the post till 1907.

Mr. Smith's services were now in wide demand in hydro-electric work, and he was chosen by the council of Winnipeg to lay out the 60,000 horse-power transmission plant for that city. Having in the meantime formed the engineering firm of Smith, Kerry and Chace, Toronto, he and his associates laid out and, in some cases, financially organized various power plants, among which may be mentioned the Trenton Power Co., the Seymour Power Co., Sydney Power Co., Nipissing Power Co., British Canadian Power Co., supplying power to mines in Cobalt region; the Calgary Power Co., the municipal power plants at Lethbridge and Revelstoke, and other places. He also organized the Mount Hood Railway and Power Co., of Portland, Ore., of which he was general manager and vice-president; and the Crane Falls Power and Irrigation Co., of which he was president, and by which a great tract of heretofore arid land in Idaho is now being converted into a garden by irrigation, while urban comforts are distributed through the new settlement by electricity. Mr. Smith was managing director of the Calgary Power Co., and president of the Nipissing Power Co., as well as a director of other companies.

He was a member of the Institution of Civil Engineers of Great Britain, and a member of the American Society of Civil Engineers. He was a past vice-president of the Canadian Society of Civil Engineers, and among his contributions to this society was a paper describing the Canadian Niagara Power Co.'s plant, which was awarded the Czowski medal of the society. Mr. Smith was not a voluminous participant in the discussions of the society, but his contributions were marked for their pertinence, simplicity of language and clearness of statement. He was president of the Engineers' Club of Toronto, but did not seek the presidency of the society as he held that such honors should be reserved for the elders of the profession.

The Late Cecil B. Smith, Ma.E.

In 1887 Mr. Smith married Miss Mary M. Dempsey, of Hamilton, whose grandfather was the first settler at Milton, Ont., in 1818. He is survived by his widow and two sons, now growing to manhood. His only brother is Mr. E. D. Smith, formerly M.P. for South Wentworth, who has attained a distinction in the Canadian fruit industry corresponding to that of his brother in the engineering field. Mr. Smith leaves also four sisters, Mrs. Shortt, wife of Dr. Adam Shortt, chairman of the Civil Service Commission, Ottawa; Mrs. H. Coon, Weston, and the Misses Gertrude and Violet Smith, of Hamilton.

Mr. Smith's death was comparatively sudden. During the last year or two he had complained of internal pains, but they did not affect his work till, on a trip to the Pacific Coast three weeks before his death, he was taken ill at Los Angeles and a specialist being consulted his malady was pronounced to be cancer and the specialist warned him that an operation would be fatal, as the cancer had invaded the liver and almost completely blocked up the stomach. On his return to his home in Toronto the best medical advice was sought but no hope could be held out that human skill would avail to prolong his life. Thus, a man in the very zenith of his intellectual powers, on the threshold of a world-wide fame, is cut down when the prizes of life are all within his grasp—an event that must humble the ambitious, and leave the mind in awe of the mysterious dispensations of Providence.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan, Kennedy; Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton, Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy.-Treasurer, John T. Moore, Red Deer, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., ex-Mayor, Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secretary, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy.-Treasurer, Reeve Cardale, Oak Lake, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phoenix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg

Volume 23 Toronto, July 18, 1912

Contents of this issue on page 187

The Canadian Engineer

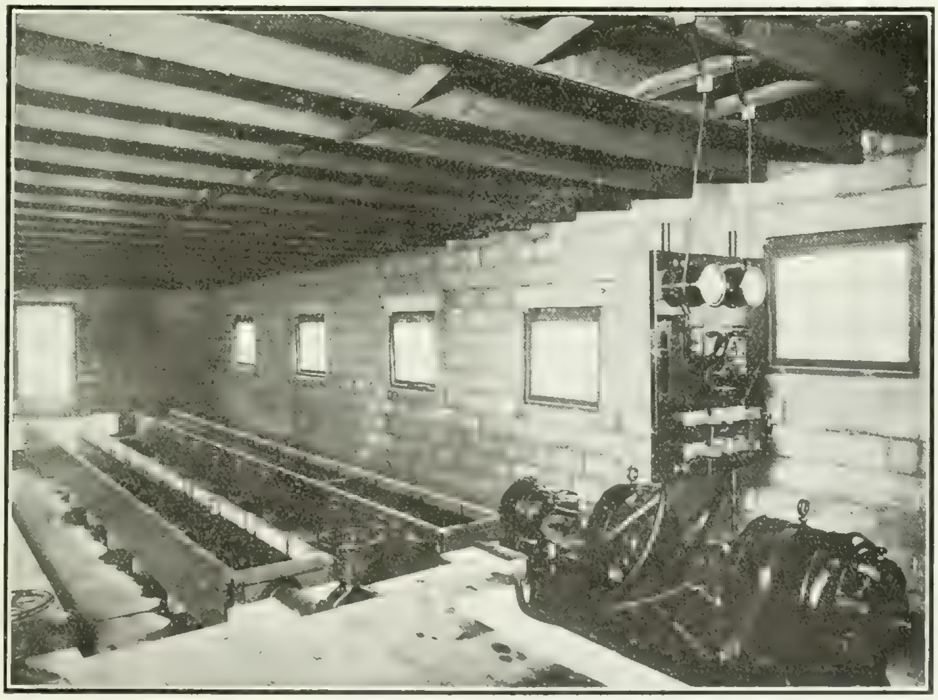
An Engineering Weekly

AN ELECTRICAL SEWAGE DISPOSAL PLANT.

By C. L. EDHOLM, Los Angeles, Cal.

In order to render odorless and innocuous the sewage of a city, a system has been perfected for treating it by the electrolytic process, at slight expense and with complete success. Two such plants are in operation in the West, and a third, of three times the capacity, is being constructed at a cost of $45,000, so that the device is no longer in the experimental stage. These plants may be seen in service at Santa Monica, near Los Angeles, California, and in Oklahoma City, and in the latter town a second plant was ordered after a thorough trial of the one now operating.

The purifying of water by electrolysis has been known for some time, but it was only in late years that experiments were successfully made with the view of destroying the disease germs in sewage and eliminating offensive odor by the use of electrodes.



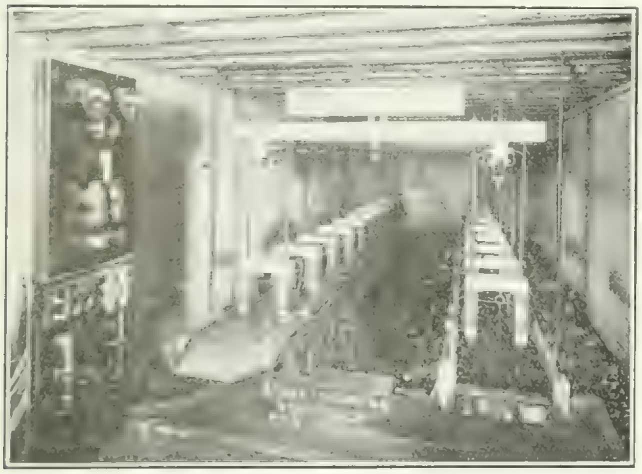
Interior of Oklahoma City Plant.

The process may be described briefly as follows: The raw sewage is allowed to flow through wooden flumes having a length of thirty feet, width of 22 inches and depth of 18 inches. Ten sets of electrodes are placed in each flume, being composed of cast iron plates set half an inch apart and having the dimensions of nine inches by 24 inches, and a thickness of 3/16th of an inch. These electrodes receive a current of two to three volts and seven to eight hundred amperes, and as the sewage flows slowly through the flumes it is speedily purified. The odor is instantly "killed," so that there is no offence to the nostrils, even to one standing directly over the flumes. But this is not all, the liquid is clarified as well and practically all the germs are destroyed, preventing further putrefaction and making it possible to discharge the sewage into a river or upon land for irrigation purposes without danger to health. This is not a case of the germs being electrocuted, but is due to chemical changes brought about by the decomposition of the metal in the electrodes. Just how this is done has been determined by chemical analysis, but the results are plain to the most casual observer.

The electrical equipment of the Oklahoma City plant is described by Howard V. Hinkley, consulting and supervising engineer, as follows: "The drive consists of a 7½ h.p. alternating current motor using commercial current at 220 volts. This motor is direct connected, under the switchboard, to a 3 kw. multipolar direct current generator and exciter, all resting on a single bedplate 2 x 5 feet. The combination is designed and built for this special service and delivers to the copper cable conductors of 1,000,000 circular mills 800 to 900 amperes at a voltage of 1½ to 3, these being the limit between which the desired results are obtainable, varying somewhat with the character of the sewage. A double pole, double throw knife switch allows the reversal of the current at pleasure and a knife switch at the upper end of each flume cuts on or off the current for that flume. Owing to the high amperage as compared to the low voltage the switches and conductors are necessarily heavy. If only one flume is used the ammeter is set at 270 or 300."

The Santa Monica plant has in addition a centrifugal pump, which is operated by electricity, and used for raising the sewage from a reservoir to the level of the flumes, but this is caused by local topographical conditions, as elsewhere it might be convenient to construct the plant on a lower level than the basin.

The cost of current will vary in different cities, but the electrodes need but little (the bill for an entire year at Santa Monica was only $152.95) and the expense of repairs and replacement of plates is slight. One attendant can care for the plant, or even two or three if they were conveniently located for going back and forth between them, as they require hardly any work.



Santa Monica Plant, as Originally Built. The Magnets Over the Flumes Have Since Been Discarded and Another Flume Added.

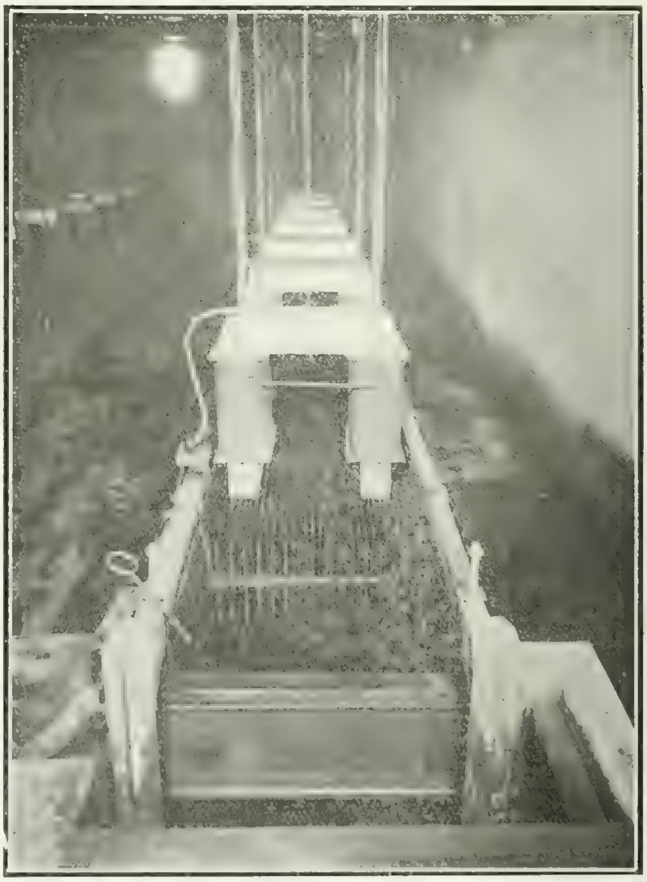
Cleaning of the plates is done by means of reversal of the current, while the use of a garden hose a few minutes each day cleans out the flumes and washes off the plates.

Very limited space is sufficient to house such a plant. In Oklahoma City a building 18 x 50 feet and 10½ feet high encloses a system of three flumes that handles three-quarters of a million gallons a day. In Santa Monica [illegible]

Interior Oklahoma City Plant, Showing Electrodes in Empty Flume, and Flow in Another.

raw sewage discharged into the ocean. Protests were heard at once from visitors and residents, but when it started again, all complaints ceased. In Oklahoma the conditions were quite different, as the outfall was in a dry gulch which was shunned and its vicinity rendered useless for any purpose. Now that the discharge has been electrolytically treated, the air is not contaminated. In fact such water could be used for irrigation and its great proportion of fertilizing content put to good use.

The two plants described can be reproduced for $15,000 each. Many costly features have been eliminated since the first one was installed. The heavy and expensive magnets, once considered necessary, have been discarded, and an elaborate system of cleaning the electrodes by high pressure steam was abandoned when it was found that the reversal of the current would give better results. The cost of the plates has been greatly reduced, by the substitution of cast iron for the aluminum which was first tried. The aluminum plates gave good results, but they were very costly and decomposed so rapidly that their expense was prohibitive. The cast iron [illegible] and by [illegible] the upper edge of the plates with copper, excessive decomposition was prevented.



Electrodes in Place, Santa Monica Plant. The Heavy Magnets Have Now Been Discarded, Reducing Expense.

Aside from its sanitary importance, this novel use of the electric current may add materially to the world's wealth in saving the millions of tons of valuable fertilizer that are [illegible] into the [illegible] each year. Thoughtful men have deplored this waste, and many years ago Victor Hugo, in writing a description of the sewers of Paris, referred to such [illegible]. In some parts of Germany and in China, the soil is so depleted that raw sewage is used [illegible] to renew the exhausted land. By the modern method it may be treated and used on fields, [illegible] their value and being an [illegible] of a menace to health.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close			Noted in issue of
7-10	Supply of electrical machinery and sewage disposal works, Battleford, Sask.	(P. & S.)	6-27
7-20	—Concrete Arch, Stratford, Ont.	(P. & S.)	7-4
7-20	Concrete work on bridge and dam at Georgetown, Ont.	(P. & S.)	7-11.

(Battleford plans and specifications are also on file at The Canadian Engineer Offices, Montreal and Winnipeg.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
High River, Alta., pump house, machinery, etc.	July 16.	June 27.	68
Kindersley, Sask., waterworks and electric light	July 22.	June 27.	80
North Toronto, Ont., pavements	July 30.	June 27.	80
Ottawa, Ont., Hudson Bay Rly.	Aug. 1.	June 20.	80
Ottawa Ont., designs for monument	Oct. 1.	Apr. 18.	60
Point Grey, B.C., plans for university	July 31.	Feb. 7.	60
St. Catharines, Ont., rifle range	July 10.	June 27.	68
Toronto, Ont., opera chairs	July 22.	June 20.	68
Watrous, Sask., waterworks materials	July 15.	June 27.	68
Watrous, Sask., pump house, machinery and well	July 31.	June 27.	68
Winnipeg, Man., cast-iron water pipe, etc.	July 15.	June 27.	68
Toronto, Ont., pavements and storm sewers	July 30.	July 4.	78
Guelph, Ont., pavements	July 13.	July 4.	78
Stratford, Ont., concrete arch	July 20.	July 4.	78
Brockville, Ont., paving	July 15.	July 4.	78
Kingston, Ont., pavements and curb	July 16.	July 4.	78
Vernon, B.C., fuel oil	July 15.	July 4.	78
Moose Jaw, Sask., pumps and equipment	July 15.	July 4.	80
Township of York, concrete sidewalk	July 15.	July 4.	80
Moose Jaw, Sask., steam-electric machinery	Aug. 1.	July 4.	80
Buchanan, Sask., schoolhouse	July 15.	July 4.	67
Duck Lake, Sask., town hall	July 15.	July 4.	67
Edmonton, Alta., steel pipes and specials	July 31.	July 4.	67
Edmonton, Alta., gas holder and tank	Aug. 9.	July 4.	67
Estevan, Sask., waterworks materials and sewage disposal works	July 10.	July 4.	67
Lethbridge, Alta., freight elevator	July 15.	July 4.	68
Point Tupper, N.S., engine house and annex, etc.	July 10.	July 4.	68
Reeds' Point, N.B., breakwater	July 24.	July 4.	68
Windsor, N.S., sea wall	July 18.	July 4.	68
Richmond, N.S., extension to pier, etc.	July 16.	July 4.	68
Regina, Sask., drain	July 13.	July 4.	68
Winnipeg, Man., high pressure plant, etc.	July 17.	July 4.	68
Regina, Sask., addition to Regina Institute	July 20.	July 4.	68

◆

TENDERS.

Calgary, Alta.—Tenders for the construction of three reinforced concrete bridges, aggregating some 25 spans, across the Bow and Elbow Rivers, within the city limits of Calgary, will be received until July 31st, 1912. Plans and specifications can be seen at the office of the City Engineer in Calgary. J. M. Miller, City Clerk.

Clan William, Man.—Tenders for the erection of a two-roomed brick veneer school building for Grey, S.D. 1356, will be received until July 15th, 1912, by R. A. McQuarrie, Secretary-Treasurer, Grey S.D., 1356, Clan William, Man. Plans and specifications may be seen at the office of the Architect, W. W. Blair, 400-2 Nanton Building, Winnipeg.

Edmonton, Alta.—Tenders for all trades in connection with the erection and completion of the Civic Office Building at the corner of Queen's Avenue and Elizabeth Street, Edmonton, will be received until July 15th, 1912, by the City Commissioners. Plans, etc., at the office of the City Architect, Johnson Block, Second Street, Edmonton.

Estevan, Sask.—Tenders will be received until noon of July 16th, for the erection and completion of a four-roomed public school at Estevan. Plans and specifications at the office of Messrs. Storey and Van Egmond, architects, Regina, Sask., and the office of L. A. Duncan, Secretary-Treasurer, Public School Board, Estevan, Sask.

Guelph, Ont.—The time for receiving tenders for the concrete work for the combined bridge and dam at the Paper Mills, Georgetown, has been extended to noon of July 20th. Jas. Hutcheon, Engineer, Guelph (See advt. in The Canadian Engineer.)

Hamilton, Ont.—Tenders will be received by the Mayor, Chairman Board of Control, up to July 15th, for the following trades required in the erection of a Children's Hospital on the City Hospital grounds, Barton Street, Hamilton. Mason and brickwork, reinforced concrete, carpenter work, painting, plumbing, steam heating, iron work, plastering, electric wiring, galvanized iron and roofing, ceramic tiling, sewer work. Plans and specifications to be seen at the office of H. H. New, Architect, Spectator Building. S. H. Kent, City Clerk, Hamilton.

Hamilton, Ont.—Tenders for supplying the corporation of the city of Hamilton with four units of synchronous motors for direct connection to turbine pumps, with switching apparatus and accessories complete, for the High Level and Mountain pumping systems, will be received by G. H. Lees, Mayor, Chairman Board of Control, Hamilton, until noon of July 24th, 1912. Specifications at the office of the City Engineer. S. H. Kent, City Clerk. (See advt. in The Canadian Engineer.)

Islington, Ont.—Tenders will be received up to noon of July 23rd, for the construction of a 24-inch storm sewer, about 1,040 feet in length with manholes, catch basins and junctions, on Plan No. 1602, County York, near the village of Islington. Plans, etc., at the office of J. A. L. Macpherson, Engineer, Islington.

Kingston, Ont.—Tenders will be received until July 16th, 1912, for the construction of 7,200 square yards of asphalt block or vitrified brick pavement and 3,000 lineal feet concrete curb. Plans and specifications may be seen at the office of R. J. McClelland, City Engineer, Kingston.

Lasalle, Que.—Tenders for the construction of an aqueduct in the town of Lasalle, will be received by J. S. Ashby, Secretary-Treasurer, town of Lasalle, until July 17th, 1912. Plans and specifications can be seen at the office of V. H. Dupont, Town Engineer, 62 St. James Street, Montreal, or at the office of the Secretary-Treasurer.

Medicine Hat, Alta.—Tenders are called for the erection of a 5-room brick school building for the Medicine Hat School District No. 76. Tenders close July 15th. Plans and specifications may be seen at the office of the architect in the Porter Block, Medicine Hat, Alta. R. M. Napier, Secretary, Medicine Hat School District No. 76.

New Westminster, B.C.—Tenders for paving eight streets in the city of New Westminster, B.C., will be received until July 15th. Plans and specifications and full particulars can be obtained from J. W. B. Blackman, City Engineer. W. A. Duncan, City Clerk, City Hall, New Westminster.

Ottawa, Ont.—Tenders for the construction of a landing pier at Ste. Felicite, County of Rimouski, Que., will be received at the Department of Public Works, Ottawa, until July 31st, 1912. Plans, etc., at the Department, the offices of A. R. Decary, Esq., District Engineer, Post Office Building, Quebec. J. A. Tremblay, Esq., District Engineer, Montmagny, P.Q., and on application to the Postmaster at Ste. Felicite, Que.

Ottawa, Ont—Tenders for dredging required at River Bourgeois, N. S., will be received until July 30th, at the Department of Public Works, Ottawa. Specifications, etc., at the office of the Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—The Department of Indian Affairs, Ottawa, is open to receive tenders for the erection of a boarding school building on the Pas Reserve on the Saskatchewan River, up to noon of August 19th, 1912.

Ottawa, Ont.—Tenders for the erection of an Indian boarding school and a hospital at Norway House, Man., will be received up to noon of August 19th, 1912. Separate tenders for each building must be submitted. Plans, etc., may be seen at the Indian office, Winnipeg; the office of the Indian Agents at Selkirk and Portage La Prairie; the office of the Agent of Dominion Lands, Brandon and the Post Office, Kenora. J. D. McLean, Assistant Deputy and Secretary, Department of Indian Affairs, Ottawa.

Ottawa, Ont.—The Department of Public Works, Ottawa, is open to receive tenders until July 24th, for the construction of a wharf at Boisdale, Cape Breton County, N.S. Plans, etc., at the Department, also at the offices of G. A. Bernasconi, Esq., District Engineer, North Sydney, N.S.; C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S.; and the Postmaster at Boisdale, N.S.

Ottawa, Ont.—Tenders for the construction of a model and gun shed at Royal Military College, Kingston, Ont., will be received until noon of July 20th. Specifications, etc., may be seen at the office of the Officer Commanding the No. 3 Divisional Area and the Commandant Royal Military College, Kingston, Ont., and of the Director of Engineer Services, Headquarters, Ottawa. [illegible], Acting Deputy Minister, Department of Militia and Defence, Ottawa.

Ottawa, Ont.—The Department of Public Works will receive tenders until July [illegible], for the construction of a wharf and approach at the town of Orillia, Simcoe County, Ont. Plans, etc., can be [illegible] at the office of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, and on application to the Postmaster at Orillia.

Ottawa, Ont.—[illegible] will be received until July [illegible], at the office of the Secretary of the Department of Public Works, Ottawa. [illegible] District Engineer, [illegible] District Engineer, [illegible] and on application to the Postmaster at Seaforth, N.S.

Ottawa, Ont.—Tenders for dredging required at Arnold's Cove, Halifax County, N.S., will be received until July 17th, 1912. Specifications, etc., at the office of the Secretary, Department of Public Works, Ottawa. R. C. Desrochers, Secretary.

Regina, Sask.—Tenders for the erection of a court house building at Yorkton, Sask., will be received up to noon of July 20th, 1912. Plans, etc., at the office of the Yorkton Times, the Builders' Exchange, Winnipeg, and the office of H. S. Carpenter, Acting Deputy Minister, Department of Public Works, Regina.

Swift Current, Sask.—Tenders for cement concrete curbing, sidewalks and crossings, will be received until July 16th, 1912. Geo. D. Mackie, Town Engineer. (See advt. in The Canadian Engineer.)

Toronto, Ont.—Tenders will be received at the Department of Public Works up to noon of July 19th, for building lighting area, roadways, cement walks and iron fences on the grounds to the north of Osgoode Hall, Toronto. Plans and specifications at the Department. H. F. McNaughten, Secretary, Department of Public Works, Ontario, Toronto.

Toronto, Ont.—Tenders wanted on railroad contract. 12,000 cubic yards earth excavation. Plans and specifications at office. Toronto and York Radial Railway, Toronto.

Welland, Ont.—Tenders are invited for the building of one large concrete arch over Lyons Creek and several smaller ones. Description, etc., may be had at the office of Reeve O. A. McKenney, H. L. Pratt, Township Clerk.

Winnipeg, Man.—Tenders for the supply of a quantity of water meters will be received up to noon of July 18th, 1912, by M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for plank sidewalks, grading, or gravelling, will be received up to noon of July 16th, 1912. Full particulars may be obtained from D. R. Baribault, Municipal Engineer, 607 Builders' Exchange. Chas. J. Drake, Clerk, Rural Municipality of Fort Garry.

◆

CONTRACTS AWARDED.

Hamilton, Ont.—The Canadian Westinghouse Company, Limited, has secured a contract from the Shawinigan Water and Power Company, Shawinigan Falls, Que., for one 15,000 K.W. 2-bearing water-wheel type, 60 cycle generator, which is the largest water-wheel generator to be installed in Canada. This will be the third unit which the Westinghouse Company will have furnished from their Hamilton Shops for the new power house of the Shawinigan Company, the other two units being of slightly smaller capacity, viz., 14,000 K.W.

Montreal, Que.—The position of consulting engineer for the new technical school was awarded to the Canadian Domestic Engineering Company of Montreal. There were twelve applications, but the Montreal firm was highly recommended.

Ottawa, Ont.—The contract for the construction of the new treasury vaults to be installed in the recently completed extension to the finance department in the east block goes to the Goldie and McCulloch Company, of Galt. The undertaking is of considerable magnitude, the estimated cost of the vaults being in the neighborhood of $[illegible].

Winnipeg, Man.—Messrs. Worswick Bros., have the contract for the erection of a $150,000 school building. J. B. Mitchell, commissioner of Winnipeg schools, is the architect.

Winnipeg, Man.—Messrs. Laing Limited, are building a four storey brick warehouse costing $[illegible]. F. J. Green [illegible] is the architect and Carter-Hall-Aldinger Company, Limited, the contractor.

$Dolarway
Pavement

"It is permanent because it is concrete."

The Last Word
In Street Pavements

The Dolarway Pavement is popular with City Officials, Highway Engineers and Property Owners because:

It is low in first cost.
Its maintenance cost is lower than that for any other permanent form of Pavement.
No paving plant is required to either construct or maintain it.
It is noiseless, dustless and resilient.
Its traction qualities for both the Horse and the Automobile are of the best.

For full particulars address

DOLARWAY PAVING COMPANY

95 Liberty Street, New York City   510 Title & Trust Bldg., Chicago, Ill.

Applying Dolarway Bitumen on Concrete Base, Central Park, N.Y. City.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, Que.—An electric railway between Ottawa and Kingston, is being promoted by Mr. T. R. Clougher, of London, England. A bond issue will shortly be placed in England to finance the road.

New Westminster, B.C.—The harbor by-law has been approved by the citizens. Mr. A. O. Powell, is the engineer who has prepared the plans and he will have charge of the work.

Prescott, Ont.—It is announced that the Grand Trunk Railway shops and roundhouse at present located in Brockville will be moved to Prescott in the immediate future.

Sault Ste. Marie, Ont.—The Algoma Central and Hudson Bay Railway has finished laying steel between the Sault Ste. Marie and Hobon Station. The ballasting, however, will not be complete for some months.

Toronto, Ont.—It is reported that the Grand Trunk Railway will organize a subsidiary warehousing company to relieve the freight congestion in Toronto yards.

◆

LIGHT, HEAT AND POWER

Kingston, Ont.—Mr. R. S. Kelch, Consulting Engineer, Montreal, has advised that the city add to its present steam plant to secure increased capacity. It will be remembered that the Ontario Hydro-Electric Commission and the Electric Power Company, Limited, have been competing for the new business. The Civic Utilities Committee of the City Council has decided to follow the advice and will proceed with the ordering of additional machinery for the necessary extensions to the plant.

Kingston, Ont.—Mr. R. S. Kelch, in a report to the municipal council of this city advises that the city's present steam plant, with certain additions, can take care for a number of years of the local demand for power, and can furnish it cheaper than it could if it took the supply from the Commission or the Seymour Company. Mr. Kelch's report will be adopted by the City Council, and his recommendation to the steam plant will be made this year.

New Westminster, B.C.—In a short time, the question of the installation of a municipal gas plant will be taken up, as soon as litigation pending is settled. A by-law has been passed giving the necessary authority to the city council.

Ottawa, Ont.—At a conference here July 3rd attended by Hon. Adam Beck, representing the Ontario Hydro-Electric Commission; Hon. S. N. Parent, Chairman of the Quebec Commission on running waters; and J. A. Ellis, M.L.A., representing the city of Ottawa, the question of joint development of the Chats Falls power on the Ottawa River was considered. It was decided to instruct the engineers of both the Ontario and Quebec Commissions to [illegible]

Province of Ontario.—The Ontario Hydro-Electric Commission has issued instructions to its engineers to survey [illegible] for a transmission line to furnish power to Collingwood, Coldwater and Barrie. The big chute plant of the Simcoe Power Company will furnish power. Mr. P. W. Sothmann, Toronto, is the chief engineer [illegible]

Tofield, Alta.—The ratepayers will vote on expending [illegible] throughout the municipality. Should the ratepayers vote in favor Mr. Elder will [illegible]

Welland, Ont. [illegible]

◆

CATALOGUES WANTED.

Mr. John R. Eagle, [illegible] Eagle Manufacturing Company, Limited, Dauphin, Man., is very [illegible]

Walter Sangwin, [illegible]

GARBAGE, SEWAGE AND WATER.

New Westminster, B.C.—The city has just passed a by-law to provide funds for the improvement of the waterworks system. Mr. J. W. B. Blackman is the City Engineer.

New Westminster, B.C.—No time is being lost in making a start on the harbor improvements for which ratepayers expressed themselves in favor of voting half a million dollars. Preliminary work on the scheme is to commence at once, and it is expected that an actual start can be made on the temporary piling for the concrete work by next September. Mr. G. A. Powell, of Seattle, is the engineer in charge.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Blair, Que.—The Dominion Government, Department of Militia and Defence, Ottawa, contemplate the erection of an up-to-date military school.

Edmonton, Alta.—Plans have been prepared and work will commence shortly on the erection of a large business block in this city. The block will be built by Kenneth A. McLeod, the architect is John R. Dow. Estimated cost of building, $500,000.

Fort William, Ont.—Work will be started shortly on the big government elevator to be erected here. It is understood that the capacity of the elevator will be 3,250,000 bushels.

Montreal, Que.—Plans are being laid for the construction of a mammoth new department store at the corner of St. Catherine and Bleury Streets. It is reported that the Scroggie firm are interested.

Port Arthur, Ont.—The new Roman Catholic Cathedral will be situated on the corner of Algoma and Arthur Streets. It is to cost $[illegible].

Port Arthur, Ont.—The municipal engineer, L. M. Jones and staff will proceed with the building of the civic market.

Prince Albert, Sask.—The municipal council will erect a police station at a cost of $[illegible].

Sherbrooke, Que.—The Board of School Commissioners contemplate the erection of a new high school building.

St. John, N.B.—General Manager McNicoll, of the Canadian Pacific Railway, stated last week that the plans for the company's new million bushel elevator at St. John had been completed and that the contract for its erection would be given very soon.

Thorold, Ont.—The Montrose Paper Mills Company, Limited, intend building another paper mill at Thorold, Ontario. They have ordered practically all the necessary machinery. The building will cost $100,000.

Toronto, Ont.—The swift Canadian and the Harrris Abattoir Companies will erect a large tannery at West Toronto.

Toronto, Ont.—A new civic abattoir will in all probability be [illegible] erected. The cost will be about $200,000. Alderman O'Neil is pressing the matter in the City Council.

Vancouver, B.C.—A reinforced concrete, six-story rooming house will be erected on Pender Street. The structure is being built for Mr. John Walker by Mr. F. J. Langer, after plans prepared by Messrs. Braunton and Leibert, architects of Vancouver. Cost of building will be over $[illegible].

Vancouver, B.C.—The Norton Griffiths Steel Company are erecting a six-story reinforced concrete, brick faced, stone dressed warehouse building for Messrs. Crane and Company. Estimated cost, $[illegible].

Vancouver, B.C.—Work will be started shortly on the new Y.M.C.A. building. Estimated cost, $350,000.

48 in. CONTINUOUS STAVE LINE.

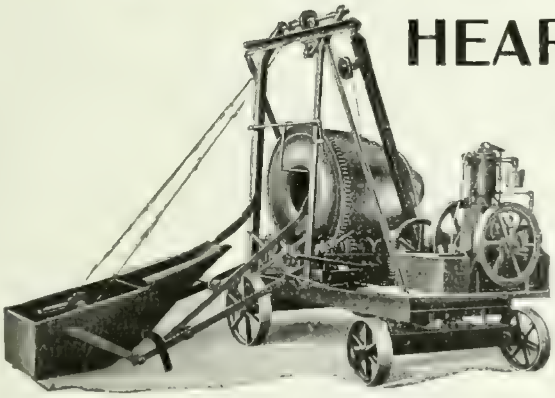
Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
RESERVOIR TANKS
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

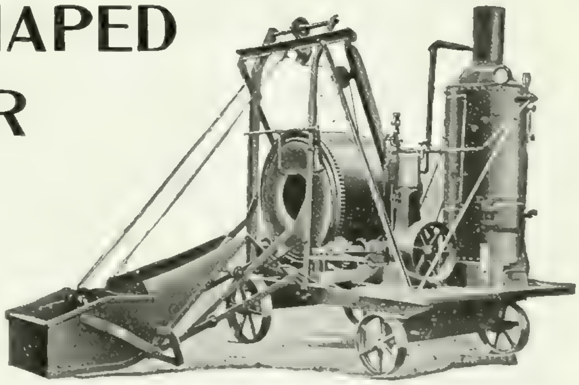
PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER

HEART-SHAPED MIXER



Write for 1912 Catalogues.



A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT
DETROIT, MICH. BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

BRIDGES, ROADS AND PAVEMENTS.

Coboconk, Ont.—The plans for five new culverts for the Township of Bexley are under consideration. A. Taylor, Clerk.

London, Ont.—City Engineer Wright has reported to the Board of Works that $25,000, the amount voted on, is not sufficient to build West London bridge, that $45,000 is needed to construct a proper bridge, and at least $20,000 more will have to be voted on.

New Westminster, B.C.—A great deal of street paving is to be done here. Many by-laws are being submitted on the question now. J. W. B. Blackman, is City Engineer.

Pointe Claire, Que.—The town contemplates the laying of cement sidewalks, renovating the river front from Lachine to Ste. Anne, and establishing boulevards and driveways.

Niagara Falls, Ont.—The Grand Trunk Railway Company propose to replace the wooden bridge on Victoria Avenue, by a steel one.

Saskatoon, Sask.—Arrangements have just been completed with the City Council for a new traffic bridge over the river, which will also provide accommodation for a double line of street cars.

North Vancouver, B.C.—The passing of the district of North Vancouver's $150,000 by-law will give cities and municipalities interested control of the Burrard Inlet Tunnel and Second Narrows Bridge Company.

Simcoe County, Ont.—Plans are now being prepared for five new bridges to be built this summer; one of these is to be of the concrete truss type, and will be located near the village of Nottawa, near Collingwood. The other four will be steel structures. Mr. Frank Barber, 57 Adelaide Street East, Toronto, is consulting engineer.

Vancouver, B.C.—For the construction of the proposed Georgia-Harris Street Bridge, plans from nine engineering firms were examined by the bridges and railway committee of the city council.

All the designs were referred to the city engineer to report. The bridge is to be 2,740 feet in length, and it is expected that the work could be completed in about eighteen months. The designs were from the following:

Cartwright and Matheson, Vancouver, $611,000; steel.

Waddell and Harrington, Vancouver, $510,000 (two plans, both in regard to steel construction); another plan, $508,000, steel; and a fourth plan at $524,000, reinforced concrete.

E. A. Stone, Vancouver, $514,000, with a plank surface, and $521,000, with creosoted wood blocks on the surface, steel.

C. A. P. Turner, Winnipeg, $404,950 (with deck span), and $504,950, reinforced concrete.

Gardner and Taylor, Vancouver, $539,730, concrete.

H. Sydney Hancock, Vancouver, $500,000, concrete.

Dutcher, Maxwell and Company, Vancouver, $442,938, concrete.

[illegible], Vancouver, $[illegible], steel.

Van Sielen and Macomber, Vancouver, sent in plans, [illegible]. The designs were for both [illegible] and concrete.

◆

FIRES.

Winnipeg, Man.—[illegible]

Montreal, P.Q.—[illegible] by fire to the extent of $[illegible].

Temagami, Ont.—[illegible]

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the Office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending June 24th, 1912. Additional information may be obtained from the Department of Trade and Commerce, Ottawa.

A Liverpool firm of sack manufacturers desire to get into touch with importers and users at Montreal, Vancouver and other ports in Canada.

A London firm makes inquiry for the names of Canadian exporters of Canadian birch wood ready cut up for use in the manufacture of hammock chairs, etc.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.

A London firm is open to purchase upon a cash basis supplies of best white beech dowels, cut to specification, and invites quotations from Canadian manufacturers. They are also buyers of maple mangle rollers.

A North Country manufacturer of paraffin and crude oil engines desires to arrange for their sale in Canada.

A Lancashire firm manufacturing contractors' and engineers' supplies, also rails, switches and crossings, are open to appoint suitable Canadian resident agents.

◆

PATENTS.

The following is a list of patents recently granted to inventors in Canada. The list is furnished by Messrs. Fetherstonhaugh and Company, Patent Barristers, Solicitors, etc., 10 King Street East, Toronto.

T. M. Kirkwood, railway rails, B. F. Osbow and F. C. Mason, tube retarders, J. H. Rodgers and W. J. Spence, tripping device for power presses and analagous machines, J. P. Beaudoin, railway signal torpedoes, J. A. Bergmann, illuminated signs, C. F. Broadhurst, means for clearing chimney flues, I. E. Cornwall, gramaphones, O. R. Johnston, grain picklers, A. Mackay, necktie formers, E. Richard, steam valve mechanisms, J. F. Ross, cans, J. R. Saye, multiple duplicating check books, F. X. O. Trudel, food products and processes of obtaining the same.

◆

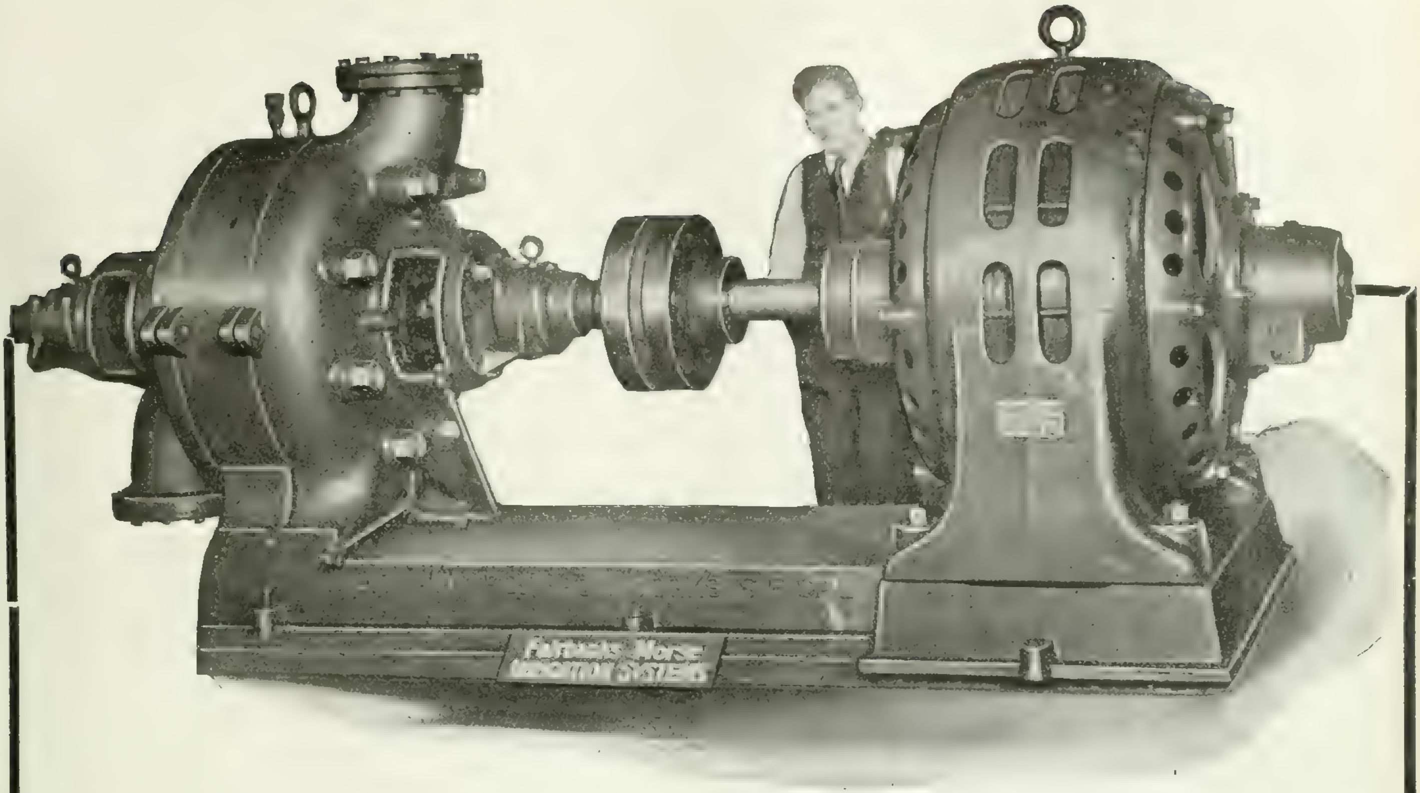
LOSSES CAUSED BY ENGINE SPARKS.

A heavy loss by fire each year is caused by sparks from locomotives. The United States district forester for Montana and Idaho estimated a loss to government and adjoining timber of 6,000,000,000 feet, or a total of $21,500,000, caused by 1,679 fires, 56 per cent. of which started on the railroad rights-of-way and in spite of good co-operation by the railroads.

The great forest fires in Minnesota during 1910, which caused such loss of life and suffering in the towns of Spooner and Beaudette, with a million dollars worth of valuable property and timber, were due to four fires, three of which were started by locomotive sparks.

Four fire insurance companies which make a specialty of insuring flour mills and elevators paid more than $160,000 in 1910 for losses due to this cause. The Cotton Insurance Association if Georgia has reported that 90 per cent. of cotton fires in transportation are due to locomotive sparks. A grain dealers' mutual fire insurance company reports each year from 17 to 28 per cent. of its losses due to the same cause.

The fire records of manufacturing risks which have been published in the quarterlies of the National Fire Protection Association show a very material percentage of fires from locomotive sparks, and yet, taken as a whole, we would not consider manufacturing risks as particularly susceptible to the spark hazard. The record of fires in 15 classes of manufacturing risks showed about 3 per cent. to be due to this cause.



The Largest Direct Connected Centrifugal Pumping Unit in British Columbia.

The Vancouver Power Company have recently installed at their works at Coquitlam Dam, B.C., the largest direct connected centrifugal pumping unit in British Columbia. This outfit is to operate in parallel with a number of other pumps that are to furnish water under pressure for sluicing into place the material for their new dam.

This pump is a 10-inch, class "F," two-stage centrifugal, with bronze inpellers and renewable bronze diffusion vanes. It has a normal capacity of 1833 imperial gallons per minute when operating at 1160 r.p.m. against a total head of 355 feet or an equivalent pressure of 154 lbs. per square inch. It is mounted on a common sub-base with a 300 h.p. type "B," Fairbanks-Morse squirrel cage, induction motor, 2200 volts, 60-cycle, 3-phase, 1160 r.p.m. at full load, being direct connected thereto by means of a flexible leather link coupling.

The motor possesses a feature in rotor construction that is unique. The end rings are welded on to the rotor bars by a new process, making a perfect joint, free from the troubles common to the purely mechanical or riveted joint, such as oxidation, working loose, and solder-throwing. This improvement marks a long step forward in the elimination of rotor trouble.

Our Vancouver Branch supplied and assembled this complete pumping unit. We are in a position to quote on the necessary equipment for any pumping requirements on receipt of specifications.

The Canadian Fairbanks-Morse Co., Limited

Fairbanks Standard Scales, Fairbanks-Morse Gas Engines
Pumps Safes Vaults

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

UNITED STATES GOVERNMENT HEARING ON FLANGE FITTINGS.

The Navy Department, Bureau of Yards and Docks, Washington, D.C., held a hearing June seventeenth, for the purpose of giving certain manufacturers an opportunity to give reasons why they do not recommend the use of the 1912 United States Specifications on Government work.

The Government had representatives present from the following departments,—Army, Navy, Auditing, Purchasing Department, Bureau of Yards and Docks, Bureau of Standards; the manufacturers represented were:—Crane Company, Walworth Manufacturing Company, McNab and Harlan, Best Manufacturing Company, Kelly and Jones; and the Societies responsible for the 1912 United States Standard were represented by Mr. Henry G. Scott, member of the Council of the American Society of Mechanical Engineers, and Mr. Henry B. Gombers, Secretary of the National Association of Master Steam and Hot Water Fitters. Mr. Carl L. Carlson, Corps of Civil Engineers of the United States Navy, presided.

During the first part of the meeting the manufacturers' representatives, of which Mr. A. M. Hauser, of Crane Company, and Mr. Evans, of Best Manufacturing Company, were the spokesmen, put in their protest against the adoption by the Navy of the 1912 United States Standard. After this, Mr. H. B. Gombers, of the National Association of Master Steam and Hot Water Fitters, replied, outlining the efforts of the committees of the two societies for the past year and a half by conducting extraordinary correspondence with the principal companies manufacturing fittings in America and in every way trying to establish a standard which would best represent the interest of all, which resulted in the 1912 United States Standard. Mr. H. G. Stott, who is Superintendent of Motive Power of the Interborough Rapid Transit Company of New York, presented the desirability of adopting the new standard from the engineering point of view. By making use of a set of temperature and expansion curves the principal points emphasized were that the factor of safety in the ordinary pipe line is from 16 to 20, while the factor of safety in the bolts is two or less, so that everything possible should be done to bring up the factor of safety in the bolts, flanges and fittings, especially in view of the enormous strains encountered due to change in temperature. By comparing the 1912 United States Standard with the proposed Manufacturers' Standard, the British and German Standards, it was shown that the 1912 United States Standard was the heaviest and strongest of all. Another important feature of the 1912 United States Standard was shown to be the interchangeability of parts, where the proposed manufacturers' schedule has different face to face dimensions, and that the changes referred to extra heavy work and to sizes above nine inches only.

The consensus of opinion at the hearing was in favor of the 1912 United States Standard.

The chief objection the manufacturers made was the enormous cost to them. It developed, however, from the testimony of one of the manufacturers present, that the cost of the change to the new standard would be practically very little, because they had already been through the experience [illegible] and the lack of expense was due to the fact that they did not use iron patterns or special tools in their work, but did all their facing on lathes and facing machines.

During the remainder of the hearing the discussion settled [illegible] necessary [illegible] could be supplying material according to the 1912 United States Standard, and the general consensus of opinion seemed to be that within two years the new standard would probably be- [illegible]

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible]

[illegible]

[illegible]

16872—June 26—Authorizing C.P.R. to open for carriage of traffic its railway from Coldwater, at mileage 12 to Bethany, at mileage 88.2—76 miles, (G. B. & S. Ry.).

16873-74—June 26—Relieving C.P.R. from erecting and maintaining fences on its Boundary, Nakusp & Slocan and Lardo, also Okanagan, Shuswap, Mountain & Arrow Lake S. Divisions.

16875—June 25—Authorizing C.P.R. to construct spur for Alberta Clay Products Co. at Dunmore, Alberta.

16876-77—June 25—Authorizing C.P.R. to construct ballast pit spur across highway near Elcan, Alta., and its Pheasant Hills Branch across highway at mileage 17.3, McAuley S.D.

16878—June 25—Relieving C.P.R. from further protecting crossing at mileage 90.5 from Switzer Jct., Arcola S.D., Manitoba.

16879—June 26—Approving location of C.P.R. station at North Transcona, Manitoba.

16880—June 26—Extending until July 31, 1912, time for installing derails on Union Stock Yards Branch, Toronto, by G.T.R.

16881-82—June 26—Authorizing G.T.R. to construct spurs for Dominion Canners, Ltd., near Forest Station, Ont., and for N. J. and W. G. Smart, near Collingwood, Ontario.

16883—June 25—Approving changes in side track and stockpen of G.T.R. in village of Priceville, Quebec.

16884—June 26—Authorizing G.T.R. to construct spur for Benson & Bray, Midland, Ontario.

16885—June 26—Dismissing application of residents of Druid, Alta., to compel G.T.P. to install station near C.P.R. station, application may be made for transfer track.

16886—June 24—Authorizing G.T.P. Ry. to cross highway at mileage 176.9, Cassair District, British Columbia.

16887—June [illegible]—Authorizing C.N.O. Ry. to cross public road at Cote St. Michel, County of Hochelaga, Que.

16888—June 25, 16889—June 26—Approving revised location of C.N.O Ry. industrial branch from Oshawa station to town of Oshawa, and authorizing it to cross side-road in Twp. of Mara, Ont.

16890—June 26—Approving revised location of Toronto Eastern Ry., Twp. of Pickering, and Ontario.

16891—June 25—Rescinding paragraph 2 of the operative part of Order 15727, dated December 19, 1912, and leave is reserved to G.T.P. Ry. to apply to Board for approval of station site which will give adequate facilities to Hazelton, B.C. Application, Robert Kelly, Vancouver, B.C.

16892—June 27—Amending Order [illegible], by striking out "Montreal Tramways Co." in 8th line of operative part and substituting words "City of Montreal."

16893—June 26—Directing Dominion Atlantic Ry. to show cause within 10 days why it should not furnish at Kentville, N.S., adequate and suitable facilities for housing and repairing of its engines and cars under penalty of $25 per day.

16894—June 26—Authorizing Mun. of County of Compton, Que. to construct highway crossing over Maine Central Ry.

16895—June 25—Authorizing J. B. Damphouse, of Stony Point, Ont., to construct farm crossing over G.T.R.

16896—June 24——Naming express delivery and collection limits for city of Montreal, Que.

16897—June 26—Approving revised location of G.T.R. new track in town of Cobourg, Ont., lands of W. J. Crossen, and estate of J. G. Field.

16898—June 27—Authorizing C.P.R. to construct spur in town of Lasalle, Que., for N. K. Fairbank Co., Ltd.

16899—June 28—Authorizing South Ontario Pacific Ry. to open for carriage of traffic its line from Guelph Jct. and Hamilton, mileage 0 to 16.3.

16900—June 27—General Order re matter of indicating changes in freight, passenger and express tariffs.

16901—June 28—Authorizing G.T.R. to construct siding into premises of Congregation of Grey Nuns, Parish of St. Laurent, Que.

16902—June 27—Approving proposed change in siding track on Charles Street, in town of Berlin, County of Waterloo, Ontario.

16903—June 27—Authorizing G.T.R. to construct spur into premises of A. E. Rogerson, in Toronto, Ontario.

16904—June 26—Authorizing C.N.O. Ry. to construct across public road in Twp. of Ross, County of Renfrew, Ont.

16905—June 28—Approving location of C. N. Branch Lines Co. through Twp. [illegible], Range 4, west [illegible] M., Saskatchewan.

16906—June 28—Approving revised location of Kettle Valley Ry. Co. station 0-00 to 53-07.6, west of Penticton, B.C.

[illegible]—June 27—Approving clearances of Canada Malting Co.'s grain unloading shed at Winnipeg, Man., C.P.R., and G.N.R.

[illegible]—June 28—Authorizing V. V. & E. Ry. to construct highway crossing at Ashnola siding, B.C., for B.C. Government.

[illegible]—June [illegible]—Authorizing Esquimalt & Nanaimo Ry. to construct highway crossing between 2nd and 3rd streets in Duncan, B.C., at expense of city of Duncan, B.C.

[illegible]—June 28—Authorizing city of Hamilton to construct subway under G.T.R. at Birch Ave., near Sherman Inlet, Hamilton.

[illegible]—June 28—Authorizing Campbellford, Lake Ont., & Western Ry. (C.P.R.) to cross [illegible] highways between mileage [illegible] to [illegible] in Twp. of Hope, County of Durham, Ontario.

[illegible]—June 28—Approving location of Campbellford, Lake Ont. & Western Ry. from mileage [illegible] to mileage [illegible], and authorizing it to take railway lands of G.T.R.

[illegible]—June [illegible]—Authorizing C.P.R. (A. R. & I. Co.) to cross [illegible] highway, and approving location of branch line of railway from a point at mileage [illegible] A. R. & I. Co. to [illegible], known as Stirling Branch, Alberta.

[illegible]

[illegible]

[illegible]

[illegible]—June [illegible]—Authorizing C.P.R. to construct spur for Edwin Steele, [illegible] County of Prescott, Ontario.

[illegible]—June [illegible]—Authorizing C.P.R. to open for carriage of traffic its [illegible] at mileage [illegible], Saskatchewan.

[illegible]—June [illegible]—Authorizing C.P.R. to construct spur for Canada Lumber Co. [illegible], Ontario.

THE CONSTRUCTION OF DISTRIBUTION SYSTEMS FOR OUTLYING SYSTEMS AND SMALLER PLANTS.

By S. Bingham Hood.
Toronto Electric Light Company.

(Continued from last week.)

The best metal pin designed to pass through the arm is undoubtedly a design which has been placed on the market within the past year. This is of high carbon steel with bolt ½-inch in diameter. The shoulder is increased in diameter and drawn square, which not only stiffens the pin, but provides a wrench hold. The contact point with the arm is swaged out to form a good-sized shoulder, and the insulator thread is formed of a steel wire spiral which slips around in the insulator thread when expanding and contracting. This absolutely prevents insulator breakage and also that very annoying property of insulators to unscrew and become loose on the pin. These pins cost about three times that of a locust pin, but are an excellent investment, as, being hot galvanized, there is practically no limit to their life, and, while they may be bent, they will never break and drop the line. Another feature that makes them an economy is the small amount taken out of the arm for the pin hole. A wood pin leaves only 2 inches of wood out of a total of 3½ inches, while the steel pin leaves 3 inches, or 50 per cent. more, which not only adds to the strength of the arm, but also materially to its life. For heavier strains the same makers have recently brought out a clamp pin made of a bend of ¾-inch channel. A "U" bolt of flat steel is used to clamp this to the arm and insulator support is their usual steel spring thread. Such a method of fastening effectually does away with any possibility of the arm spliting and for heavy or important feeder lines makes an excellent job at very moderate increase in cost, the pin and clamp averaging complete about twenty cents.

For dead ending a line, particularly with large wire, the best pin made is an unsafe proposition and for such use some form of strain insulator with bolt right through the double arms should be used. The writer has not located up to date a device which can be purchased in the open market and which meets the requirements. We are using, however, a malleable iron clevis adapted to take a standard ⅝-inch bolt and using a porcelain spool insulator held in position by a ⅝-inch pin with cotters in each end (see Fig. 3). These can be made up cheaply in any shop and make a dead end that can't get away. We also use a ⅝-inch eye-nut where it is desired to head guy the arm, this placing no strain on the arms other than actually holding up the weight of the line.

The balance of pole hardware is now standardized, but, above all, should be hot galvanized only; plain iron for bolts or braces being both an expensive and dangerous proposition for use with treated poles, as they will not outlast the pole which should be the first part of the line to give out from age.

For taking off services and branch lines we are all familiar with the wooden side block and the reverse or buck arm. For junction poles at important corners the latter may be necessary, but for other places either is such an eye-sore that their use should be condemned in the strongest terms. For this purpose some form of metal spreader bracket should always be used. Various styles of malleable iron brackets have been on the market for years, but have defects which are too well known to need mention here. Fortunately it is now possible to obtain a full line of wrought steel brackets to meet every possible need. These are unbreakable, of light weight, and have a spring thread similar to the metal pins mentioned above. As the heaviest pattern of three-pin bracket costs only about one-half dollar, and a light two-pin about 20 cents, the cost is low enough to make their use general. For attaching to buildings the same line of brackets are available, together with a number of other styles adapted to building use only. With such fittings available there is no longer any excuse for unsightly and shipshod methods of taking off or attaching service leads.

A method of running secondary distributing mains which is finding favor within the past few years is that of dispensing with cross-arms altogether. The three wires of the system are carried in a vertical plane on brackets fastened directly to the pole (see Fig. 4). A three-pin metal bracket for this purpose will cost erected about 50 cents, which is less than the cost of a cross-arm. With this method of suspension the lines cannot swing together, and consequently, can be placed on very short spacing, decreasing the inductive drop on A. C. lines. A further advantage of this method is the ability to take off service lines directly from the line pins without crosses in the line. For dead ending these lines a three-spool insulator bracket is used, secured to the pole with two ⅝-inch through bolts, forming an anchorage which will stay as long as the pole holds up. As we have a number of 500,000 C. M. mains carried on this type of bracket some idea of their strength can be realized. Reference to the illustrations will demonstrate the vast gain in appearance which can be made with this type of construction in comparison to the old cross-arm method.

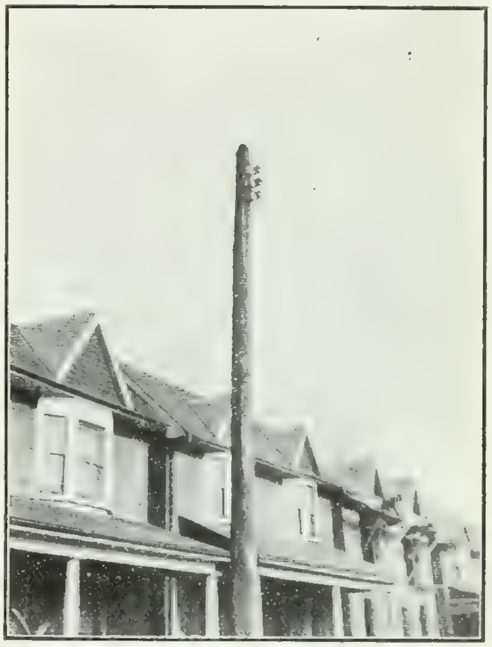


Fig. 4.—Vertical Secondary Distribution.

Before going into the question of wires a few words on the subject of joint poles may be opportune. Aside from the beneficial effect of minimizing the number of poles on the highway, as regards public opinion, the joint use of poles offers great economy both as to first cost and upkeep expenses. The telephone or telegraph is found practically every place where electric light or power is required, and there is no valid reason why both classes of public service companies can not beneficially co-operate to utilize each other's investment to the maximum. Where both systems are on the same street, as they must be to supply service, there is always the chance of the two systems becoming crossed owing to falling wires. This is equally true irrespective as to whether they are on separate pole lines or on a joint pole. For ordinary distribution under suburban conditions of load density a pole heavy enough to properly carry either system will just as safely carry both. This is due to the strength of a pole considered simply as a prop being far greater than the maximum load it must bear. With the wires and services of two systems on the same pole the bracing effect would be materially greater than where each system has its own pole line. With up-to-date construction where the lighting secondaries are carried in a vertical plane on brackets and the telephone is either lead cable carried on a messenger wire, or drop wire carried in rings for short branches, the appearance of the line can scarcely be considered as an objection beyond that which is an unavoidable evil made necessary by advance in our civilization.

From the financial standpoint we will assume for argument that the one company selects as a standard a 30-foot by 6-inch treated pole costing $10.56 in position and having an annual charge against it of $1.49. The other company must cross and re-cross the first line and finds these conditions require a 35-foot pole with 7-inch top, costing $14.47, and having fixed charge of $1.84 per year. The total expense to both companies is then $25.03 per pole, with a total annual charge of $3.33. The average charge would then be $12.52 and $1.66 respectively. Now, the joint pole line proposition, using the 35-foot by 7-inch pole, would only cost each company $7.24 capital expenditure and $0.92 annual charge, a clear saving to each of about 42 per cent. in investment and 44 per cent. fixed charge. In actual practice it is not necessary or desirable to have any real joint ownership. All that is required is a working agreement between the companies, giving the methods of construction necessary to make a uniform standard, and some provision as to notification when one company desires to utilize a pole belonging to the other. Having such an agreement compensation can be based on a yearly rental. By referring to Table 1 it will be at once evident that, under ordinary conditions of suburban distribution a rental of one dollar per year per pole would average about right and require little or no bookkeeping to keep the accounts straight. It is fair to suppose that, where true co-operation exists, as it should, one company would use the other company's poles about equally, so that any excess or deficit in the rentals would be wiped out by the law of averages. Indeed, were it not for the standing given any joint pole agreement due to a definite compensation being established, there would be no real reason for establishing any charge whatever between the respective companies.

Having selected the various fittings which combine to form a uniform method of construction the actual running of the wire is a simple matter. Any economy to be gained here is largely that due to the selection of a distribution system adapted to the requirements of the load to be served. As to the kind of wire to use, copper is the only choice. Aluminium wire may offer economies for transmission work, but for ordinary distribution it is unsuitable owing to the large span dip necessary to avoid overreaching the tensile strength of this metal. This extra dip would usually mean a higher pole, the cost of which would offset the saving in metal. In addition, aluminium, owing to its light weight, and greater sag for large conductivity, will swing and whip [illegible] in a wind to an extent that introduces all kinds of complications where space will not permit wide separation of the conductors.

The [illegible] [illegible] [illegible] [illegible] only A.C. systems. The frequency is based upon that of the generating [illegible], which generally [illegible] is planned. This is generally already fixed before local distribution is considered and may be anything from 25 to 60 cycle. For lighting 60 cycle has undoubtedly some advantages, but the idea that frequencies as low as 25 cycle are impractical for this purpose is entirely in error, provided your generators have a wave from approximating a smooth true sinu-soidal curve. Low wattage metallic filament lamps show a very bad flicker on frequencies below 30, but it is so easy to educate the public to the use of higher candle power units for the economical lighting of rooms, in preference to several small units, that this objection is not serious. In lighting large areas indoors, for amusement places principally, where large numbers of small units are used, the "25 cycle flicker" is very pronounced as soon as the illumination exceeds a certain critical point. In this case the flicker should be welcomed as a warning that the bounds of good illumination are being exceeded; the flicker being a sure sign, if noticeable, that the eye of the observer is under undue strain owing to excessive amount of light entering the retina; consequently it is unable to adjust itself to the variations in intensity between cycles. For arc lighting low frequencies are objectionable, but as the arc for interior illumination is now practically obsolete, having been replaced by tungsten clusters with greater all round reliability and efficiency, low frequencies do not introduce serious complications here either.

Taking all these points into consideration there is no reason for complicating the system by introducing frequency changers. If the frequency is not already selected, and rotary converters are not intended to be operated on the system to any great extent, then 60 cycle is probably the best standard to adopt. If the bulk of the output will be used for power purposes then a lower frequency may offer some advantages, and, for American practice, 25 cycle would be the standard. Unfortunately this particular frequency does offer some slight disadvantages from a lighting standpoint, as mentioned above. Experiments have shown, however, that just slightly above 25 cycle these defects disappear. With this in mind a running frequency of about 27½ is a marked improvement and can be obtained by simply running standard 25 cycle apparatus proportionately overspeed.

For the generating equipment there is no question but what multiphase current is necessary. This may be either two or three-phase with the latter far in the lead as regards efficiency of distribution. For this reason only the three-phase system will be considered. This system is commonly operated delta connected, but of late years the star connection is finding more and more favor where distribution networks cover large areas. In fact, the writer ventures a prediction that the next decade will see all our systems operated star connected with a solidly grounded neutral. If we stop to consider that, under operating conditions, our insulation strain is nearly always that between phase wire and ground, and not that between wires, it is at once clear that operating at only 58 per cent. of the voltage which our insulation is designed to stand is pretty poor economy. We can reconnect the same apparatus in star and operate the same line to transmit three times the power. In order to operate successfully in this manner it is imperative that the neutral points of the star be solidly grounded, not only at the ends, but at frequent intervals on the line. With this grounding there will always be more or less earth current which may cause interference with adjacent telephone or telegraph companies. To minimize this it is advisable to run a neutral conductor throughout the network, so that under only abnormal conditions will the earth be called upon to carry current. As ground lines have been demonstrated to be advantageous for lighting protection, and are quite generally in use on transmission systems, it is only necessary to substitute a wire capable of carrying the maximum neutral current in phase of the ground wire, the added expense being slight.

The question of grounding is one which has been under discussion for years past, but to-day is still being argued. The advisability of grounding below 250 volts is seldom questioned, the problem being simply that of getting a permanent ground. Here, however, the problem is supposed to be one of life hazard only, and the increased efficiency and reliability of a system when its position in relation to earth potential is definitely established appears to have been entirely overlooked. Any electric circuit, unless effectually grounded at some established potential point, is like a lost soul floating around in space. Its potential to earth may vary by thousands of volts, irrespective of its normal working voltage.

It has been a fixed law of the universe from the days of the creation that all things must start from the earth's surface, either up or down. The writer is firmly convinced that electric circuits are no exception to this law, and, unless we firmly anchor them to the earth, sooner or later something will happen with disastrous results. This subject is one which alone could be made to cover a paper as large as the Good Book we all try to follow, and, as the proof of the pudding is in the eating, those who have not tried grounding can get all the proof needed by adopting this method. By "grounding" we mean, however, SOLID GROUNDING, and not driven pipes, plates buried in coke, so-called grounding cones, limiting resistances and what not. A pipe forming a portion of a buried piping system is the only successful ground the writer has so far discovered. Our results following grounded operation lead us to believe that every electric circuit should be grounded, irrespective of the voltage at which it operates. In transmission circuits the objection to solid grounding has always been that a ground on any of the three-phase wires renders the system inoperative. This is undoubtedly true, but if the system has normally operated ungrounded, will not some unexpected weak point break down when subjected to full potential to ground? In this case, and it will be true in many cases, the system will fail to operate anyhow. It is very nice from an operating standpoint to hang on to our load to the limit. But, as engineers, it is good policy to continue in operation a system after it has developed what is known to be an abnormal and dangerous fault?

With the three-phase four-wire system, having solidly grounded neutral, there is one advantage which particularly applies to suburban distribution where the lighting load forms a large proportion of the whole. This is the ability to operate two of the phases after the third has developed a fault which renders it inoperative. The load of faulty phase can be transferred to one of the good ones and the lighting and single phase motor load carried until permanent repairs are made.

For suburban and semi-urban distribution it does not follow that because our generating system is three-phase the entire distribution must be the same. For lighting circuits the simplest and best secondary distribution is the single-phase three-wire system. In order to permit of inter-connection of these secondaries into a network covering a considerable area a single-phase primary is desirable. With this in mind it is now almost uniform practice to distribute lighting by single-phase sub-feeders, either balancing on different phases at the main bus or at selected points on a three-phase feeder line. For power distribution it used to be considered necessary to have multi-phase currents, but recent developments have overcome this for motors of small size, say up to 15 horse-power. For these the modern single-phase motor fulfils all requirements and greatly simplifies the distribution and metering problem. Motors on suburban lines seldom exceed five horse-power and up to this size they can usually be operated off the lighting network, unless frequent starting and stopping is necessary and their use extends regularly over into the lighting peak. In this case, and in motors of larger size, individual transformers are desirable. Where these are necessary they should have their neutral point connected to the lighting neutral, which, of course, is solidly grounded. If this point is overlooked we do not properly protect our power customers against high tension crosses or leakage.

As to the point where it pays to distribute three-phase from the sub-station or generating station in preference to single-phase, neglecting demands which may arise for large motors. This is where the investment for copper, in position, for the three-phase (four-wire) feeder equals that for a single-phase line. As No. 4 wire is the smallest which should be used for distribution and give the requisite margin of mechanical safety, it will be found that a No. 0 single-phase line is the largest that should be run. In fact, if No. 0 is requires then preference should be given to the four No. 4 wires operating three-phase grounded star.

Fig. 5.—Four-Wire Common Neutral System.

After having overreached the economical bounds of single-phase feeder distribution and having adopted three-phase, the question comes up as to at what limit the latter becomes uneconomical when operated at the utilization voltage, or the voltage at which the distribution transformers are operated. This limit has been increased three-fold by the adoption of the four-wire system, and it is now possible to transmit at the working voltage a considerable amount of power over a considerable distance. A No. 2/0 circuit will deliver about 300 kw. a distance of ten miles without exceeding economical limits of line loss under ordinary suburban load conditions and average initial power costs. This is sufficient to feed a pretty well developed suburban town.

A rough rule which has been used for some years is to allow 1,000 volts per mile. This is simply a rule of thumb, and is disproved right in the above case where this rule, if applied, would demand a transmission voltage of 10,000 in place of 4,000 as shown.

In the transmission of moderate amounts of power the craze for high voltage transmission lines can very easily get the best of one's common sense if we are not careful. The general rule in this regard is that the annual cost of energy lost in the line equals the annual cost for depreciation and interest on the line when maximum economy has been reached. In those cases where the selected voltage requires either step up or step down transformers, or both, the cost of these, together with their switching arrangements, must be included in the line investment. In many cases the cost of these, if put into additional copper, would carry the same amount of power with equal economy and cut out just that many links in the chain of trouble.

In designing any line the prospective future growth of the territory must be considered, and if this is promising and will eventually overreach the economical limits for 4,000 volts, then the line should be designed for high tension operation. In doing this it is as well to go the limit, which for this class of work is about 25,000 volts. The extra cost for wider spacing and larger insulators is so small that the extra investment is certainly warranted if future prospects look anywhere good. Such a line can be operated at 4,000 volts until such time as it becomes loaded. Step up or down transformers can then be installed and the change over made. There is no good reason for operating higher than reasonable requirements demand, and, consequently, the transformers should be purchased with double primary coils and operated at half voltage until the full pressure is required.

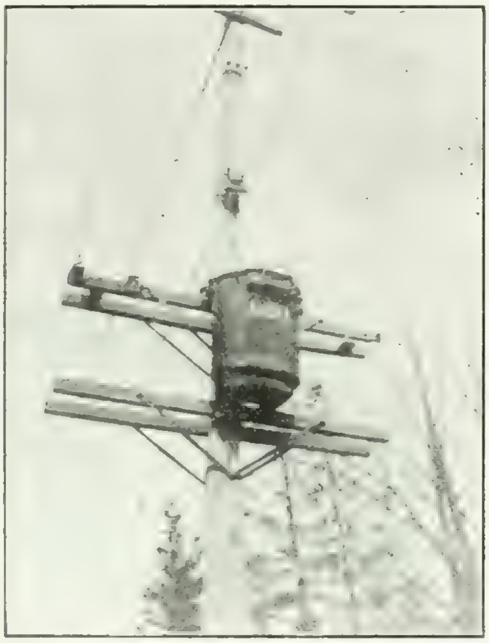


Fig. 6.—Single Primary Fuse Block.

For distribution over a large area from a central generating station the writer particularly favors a method which is only made possible with the adoption of a solid grounded neutral three-phase four-wire system. This is the use of auto-transformers in preference to the regular double coil type. It will be shown later on how these work out for general distribution, and their use in transmission will now be explained. With the grounded neutral system and using step down transmission, we would have in the complete system, under ordinary practice, no less than three neutrals; the secondary, the primary, and the transmission. Each one of these being solidly grounded is to all intent and purpose one wire as far as potential is concerned. The natural thing to do is to combine them mechanically as well as electrically. The neutral current distribution is somewhat [illegible] and while capacity must be provided to carry the greatest unbalanced load in practice the currents are very small. In using a common neutral for all systems a single wire of the same cross section as the larger of the three separate neutrals will fulfil all requirements. The current distribution in such common neutral is somewhat peculiar in that the [illegible] appears to be only that due to [illegible] and not that of the combined currents flowing. The [illegible] may be that due to the combining currents [illegible], as under certain conditions, the neutral current from one system will flow in the opposite direction to that in the other and consequently tend to neutralize it. This is one of the great economies made possible by a solidly grounded neutral.

As regards the auto-transformers, as used for transmission. Take a single coil transformer having its winding split up into four equal sections, each having a voltage of 2,300. As a regular transformer assume this to have a capacity of 100. Connecting these coils two in parallel and the two sets in series we get an auto-transformer of 1:1 ratio. One end of the coil goes to neutral, the middle to the distribution phase wire, and the other end to the transmission phase wire. Here we transmit approximately 8,000 volts on the delta and step down to 4,000 volts for distribution, the star voltages being respectively 4,600 and 2,300. The capacity of this auto would then be 200 and the investment for transformers but one-half that for the straight transformer connection as now used generally.

By connecting two of the sections in series and these in turn in series with the other two coils in parallel we get a ratio of 2:1 and transmit at approximately 12,000 volts delta with a capacity of 150, the transformer investment being but two-thirds that of the old method. A transformer of this kind would be insulated for 7,000 volts between coils and core and proportionately between coils; but at no time would but a small portion of the winding be operated under this pressure, which would drop uniformly, throughout the winding, from maximum to zero.

The same principle can be carried out up to the highest limits of transmission voltages, but, of course, the economy in transformer investment becomes less as the ratio between distribution voltage and transmission voltage becomes greater. In very high voltages a further saving in transformer costs may be effected in that the maximum insulation need be only that for the star voltage and this insulation can then be shaded down from this to a very small amount at the earthed star connection, only one high tension bushing being required, as it will never be necessary to reverse the windings in order to get the star voltage distribution to come right.

Another point of economy in the grounded neutral is that where a portion or all of the circuit is carried through lead covered cables. With a neutral not solidly grounded a four-core cable is necessary. With the solid ground it is not even necessary to pull in a bare conductor in the ducts as we already have a lead sheath capable of carrying, in a 3-core, 250,000 C. M. cable, about 100 amperes without heating enough to interfere with capacity of the cable. By bonding all sheaths together a combined capacity far in excess of any normal requirement is obtained.

In operating this grounded common return system the first requirement after erecting the pole line is, of course, the running of this common return wire. For all ordinary cases of local distribution a wire of the equivalent of No. 4 copper is ample in size. From an operating standpoint it should be insulated with regular weatherproof insulation and supported on glass insulators if wooden poles are used and high tension wires are on same poles. This is not to insulate the return wire, which electrically can just as well be bare, but to prevent linemen working on the poles and handling high potentials coming in contact with the grounded conductor. An insulated wire is also of some benefit if a high potential wire falls over it, that is provided the other wire is also insulated and potential to ground does not greatly exceed 2,300 volts. In other words, for potentials up to 4,000 volts delta use insulation on all lines, and above this point omit insulation on the high potential and do not depend on it as a protection against crosses between the high potentials and the adjacent low potential circuits. Insulation which is not a protection is a death trap, and its omission is both a safeguard and an economy. This common return main must, as already stated, be permanently and effectually grounded. This condition can only be obtained by attaching to an underground piping system at a number of points. Fortunately, but few towns of even small size are to-day without their local water supply systems, and even the farmers quite generally have their own piping systems leading from a well to the various buildings. This makes it comparatively easy to get good ground connections.

In introducing services good practice demands some form of sealed service box in order to prevent theft of current and prevent the consumer inserting service fuses dangerously large for his installation. This makes it imperative to enter the building through conduit, and the natural place to enter in this manner is the basement or ground floor. The fire underwriters require these conduits to be grounded to a piping system, and, by so doing, have made it very easy for us to get our common neutral grounded at every conduit service at a cost of but a few cents each. The process consists simply of placing a jumper between the conduit ground wire and the service wire which connects to our common return on the pole. This may be done at the service cutout and requires but a few inches of wire and a few moments of time. The various distribution neutrals should be cross connected as often as possible in order to form a series of neutral rings throughout the system. This makes it impossible to open the neutral or leave it unprotected by grounds, and, incidentally, permits of economic utilization of a cross section greatly in excess of that on any one street.

Transformers connected to this common return system are of the usual standard type, stepping down from 2,200 to 110/220 volts. The primary supply requires, however, but a single wire, which can advantageously be attached to an insulator on steel pin placed directly in top of pole. This type of pole construction, using a three-wire secondary main supported on steel vertical bracket, makes an unusually neat, as well as economical, design (Fig. 5). In making extensions the three-pin secondary bracket is installed throughout the run and the common neutral placed on centre pin. The outer wires of secondary are then extended both ways from the transformer as required, and, when they meet, are interconnected. This makes possible a secondary distribution interconnected throughout even in new districts, the rule to apply being to extend secondary beyond the primary or in preference to installing additional transformers up to the point where the annual charges for outer wires of secondary system would equal the fixed charges of an individual transformer, giving careful consideration to the point that copper wire has a well fixed scrap value on which to base depreciation, whereas a transformer may last two years and may last twenty.

In connecting the transformer for standard ratio of 10 and 20 to 1 but one primary lead is used, being protected by a single pole fuse block (Fig. 6). The other end of primary coil is connected inside the case to the neutral secondary lead. This connection may, of course, be made outside, but it is neater and better if made inside. This same transformer may be connected to either boost or crush 5 per cent. by simply tapping the other end of primary to one or the other outer leads of the secondary instead of the neutral. This gives, when connected to boost, an increased capacity of 5 per cent. The ratios thus possible to obtain without primary tappings are 19:1, 20:1 and 21:1. For transformers regularly supplied with 5 and 10 per cent. taps additional ratios of 17:1 and 18:1 may be obtained. This makes an ideal system for suburban distribution, as the transformers in various towns may be so connected that their ratios bear an approximate relation to their distance from the main generating station and fair peak load regulation should be possible without individual feeder regulators, bus regulation being used entirely. For first-class distribution, however, the automatic induction regulator for each feeder is the only solution. These are fairly expensive, but their cost is well warranted by the results obtained, particularly in the case of a feeder supplying several small towns or separate load centres. For a single feeder this condition requires very heavy wire between the load centres in order that the difference in primary pressure may be very low. This frequently makes it necessary, where local regulation is not used, to run separate feeders to each centre. With an automatic regulator installed at each load centre absolutely uniform pressure may be obtained in every town, even if several are supplied from same feeder. The local substation need be but a small building and requires very little attention, a visit once per week to clean and inspect the regulator contacts being all that is required. This plan of supplying each load centre from a small substation is of further advantage in that automatic protective devices may be conveniently installed here to cut off this particular section in case of trouble. The regulator is supplied by its own potential and current transformers, and a single phase 5 ampere integrating secondary wattmeter may be installed on the same transformers, thereby measuring at very small expense all the current delivered to this particular section. This is of particular benefit to both the distribution and commercial departments, as it enables them to check up the line losses and also the revenue obtained from any one load centre or district.

In selecting the size of pole transformers and the type of secondary distribution, local conditions must be studied carefully. Unless the load is very badly scattered, relatively large transformer units feeding a large interconnected secondary network makes the most economical as well as most reliable system. Transformers may be confined to three sizes, 5, 10, and 15 kw., the latter used for large concentrated loads and for feeding the networks. The small size will be found useful in feeding isolated loads and to help out the tail ends of a network while the business is growing, being changed when load conditions warrant for the larger size. The intermediate size will be found useful in networks of moderate size, as not less than three transformers should ever be interconnected, and small villages will frequently not warrant the installation of three 15 kw's.

The outer secondary leads of all transformers should be protected with low tension fuses, the neutrals, of course, being connected solid. In networks a fuse may also be inserted in the mains half way between transformers; in fact, this is necessary unless the primary feeding the network can be disconnected in case of trouble. Unless this is done the transformers banked can not be re-fused if they blow out under load. In large networks the better practice is to connect solid and depend on the heavy current available to burn off faults, etc. Just a word of caution, however, in regard to these secondary fuses. They are exposed to the weather and an ordinary lead and copper tip fuse will disintegrate. Use cast brass or copper contact posts and wing nuts and copper fuses. A plain copper wire supported on about four-inch centres makes an ideal fuse for exposure to the weather. No. 18 B. & S. gauge will carry about 100 amperes, No. 16 150 amperes, and No. 14 about 200. An ideal distribution is shown by Fig. 2.

In high-class suburban districts occasional demands arise for underground distribution. This can be cheaply and reliably handled by simply laying the cables solid in the earth, covering them if desired with a treated plank to prevent mechanical damage. The common neutral may be a bare copper wire or plain weatherproof insulation. This type of construction for secondary distribution does not greatly exceed the cost of a first-class overhead line when upkeep and replacement costs are considered, and, being laid usually under unpaved streets or grass plots, can be opened up for repairs or extensions at minimum cost. Service taps are taken off through a small cast metal box enclosing the joint and afterwards filled with compound. The actual tap is usually made through a single strand of copper wire which will fuse under short circuit conditions and disconnect the defective service. If single branches are made the box should be of non-magnetic metal, to avoid inductive effects. If made of cast iron the box must enclose all wires of the main, and these must enter through a non-magnetic bushing. Lead makes the best metal for this purpose. On extensive underground networks junction points should be sectionalized in a pillar box placed near the curb at intersections. These would have somewhat the appearance of the ordinary stone carriage steps which used to be so common and do not constitute an eyesore to the general public.

It must be self-evident that a system on the foregoing lines can be installed with less upkeep cost than former methods, and, having fewer parts to cause trouble, must perforce be more reliable. As to just what savings are possible can only be determined by figuring actual cases; this saving is, however, very considerable, as has been proven by actual operation of such a system.

◆

CANTILEVER FORMS FOR CONCRETE RETAINING WALLS*.

By Thomas J. Kelly.†

The accompanying sketch shows the cantilever system of concrete forming that is being used on lock walls at Mayos Bar, Coosa River, Ga. The first section is a stationary form, which is braced from the ground, the concrete being put in in lifts of 6 ft. each. In the second and succeeding lifts, bolts ¾ in. x 30 in., with nuts on each end, are put in the concrete 10 in. above the bottom and 10 in. below the top of the lift, and 4 ft. apart, leaving enough of the bolts outside of the concrete to go through the lagging, uprights and wales.

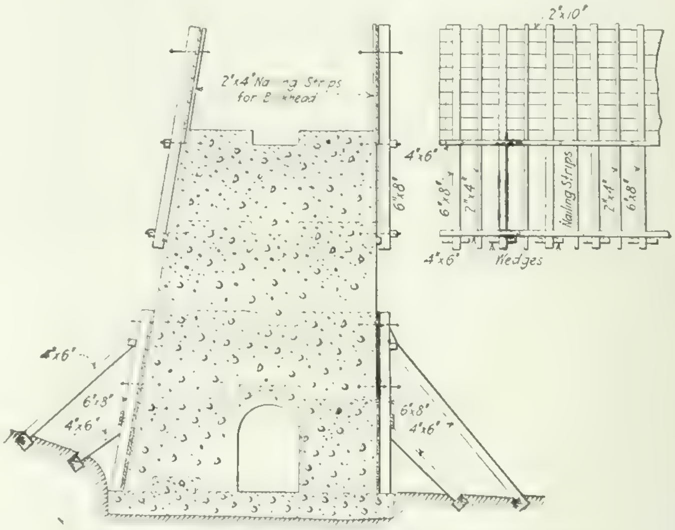
When the concrete has sufficiently set, the lower form is removed and holes bored in the walls to correspond with each bolt. The wales are then put on the bolts and uprights are put in between the wales and concrete, first putting one piece of lagging on top of the upper bolts, next to the face of the concrete; wedges are then driven near bottom end of the uprights, between the face of the concrete and the uprights, these wedges being used to line the forms and keep them rigidly in place.

The bolts should be left outside the forming, as shown in the upper left-hand of the cut, until just before the concrete reaches this point; they should then be greased with [illegible] and [illegible] to the proper position.

Sometime during the next day the bolts should be given a few turns with a wrench, so they will be loose in the concrete and can be removed at any time, and the holes plugged with neat cement. Nailing strips, 2 x 4 in., are used to tack the lagging together, and a strip of the same size is also used to secure the bulkhead or end forming, in place.

After the form has been used for the first time, the [illegible] can be taken up bodily with the derrick, and lifted to the next position, being allowed to rest on the top bolts [illegible] the wales are being bolted on [illegible] the upper row of bolts can be removed and used repeatedly, with only the loss of one nut each time, which loss is inexpensive.

In the writer's opinion, this is the most economical system of forming in use to-day, both as to cost of material and cost of erection, for the lumber and other material can be used over and over repeatedly.



Details of Cantilever Forms for Concrete Walls.

This system can be used to advantage on all classes of heavy masonry, such as lock and dam work, bridge piers and retaining walls; especially so where cyclopean masonry is used, as there are no rods or braces to obstruct the laying of large stones or in handling concrete buckets, and these forms can be used at a height of 100 ft., or more, as easily as at a height of 20 ft.

◆

TESTS OF TILE AND CONCRETE WALL-SECTIONS.

The National Fireproofing Co. has recently had made for it a series of tests on sections of tile wall, varying from 4 to 10 in. thick and from 8 to 37 in. long, all about 12 ft. high. The tests were made by a well-known firm of engineers. In each test the crushing load, and the lateral deflection and vertical compression under various loads were recorded. Wall sections of concrete, reinforced concrete, and brick, and interlocking tile, were included in the series, with the walls of plain tile laid both horizontal and vertical.

The results of the tests are summarized in the table below. In arranging this table we have computed the failure load in pounds per square inch of gross cross-section of wall, this being the quantity usually taken into consideration in designing.

TESTS OF TILE, BRICK AND CONCRETE WALL-SECTIONS

Tests of Walls About 12 Ft. High					Comparison Tests of Single Tile	
Material	Age days	Horizontal dimensions, inches	Failure load lb. per sq. in. of gross cross-section		Bottom area, and position	Failure load, lb. per sq. in. gross sec.
Brick wall	47	8 x 43½	248			
Concrete wall	40	8 x 30	1610			
Reinforced concrete walls	55	8 x 30	2000 1st loading 1020 2d loading	no signs of failure		
Interlocking tile wall, side	13	8½x37	288		8x12, side	600
Monarch tile pier (laid up of 4x8x8 tile on end)	25	8½x 8½	2685		4x8, end	8350
Monarch 4" wall	25	4 x 43½	2500*			
Monarch 8" wall	47	8½x47	1200		8x12, end, av. of three	2700
Monarch 8" wall	45	8½x47	1140			
Monarch 8" wall	20	8½x40½	1080			
Natco 8" wall	28	7¾x45	570		8x12 end, av. of two	3050
Natco 8" wall	44	8 x40½	1220			
Natco 8" wall, side	28	7¾x40½	280		8x12 side	350
Natco 10" wall, side	44	9¾x40½	415		10x12, side	395

*Buckled

Tests of single tile were made, one for each tile wall section. We give the results for comparison with the strengths developed by the walls. The great variations of ratio between wall strength and tile strength are to be noted.

---

*From Professional Memoirs, Corps of Engineers, United States Army and Engineering Department at Large, [illegible]

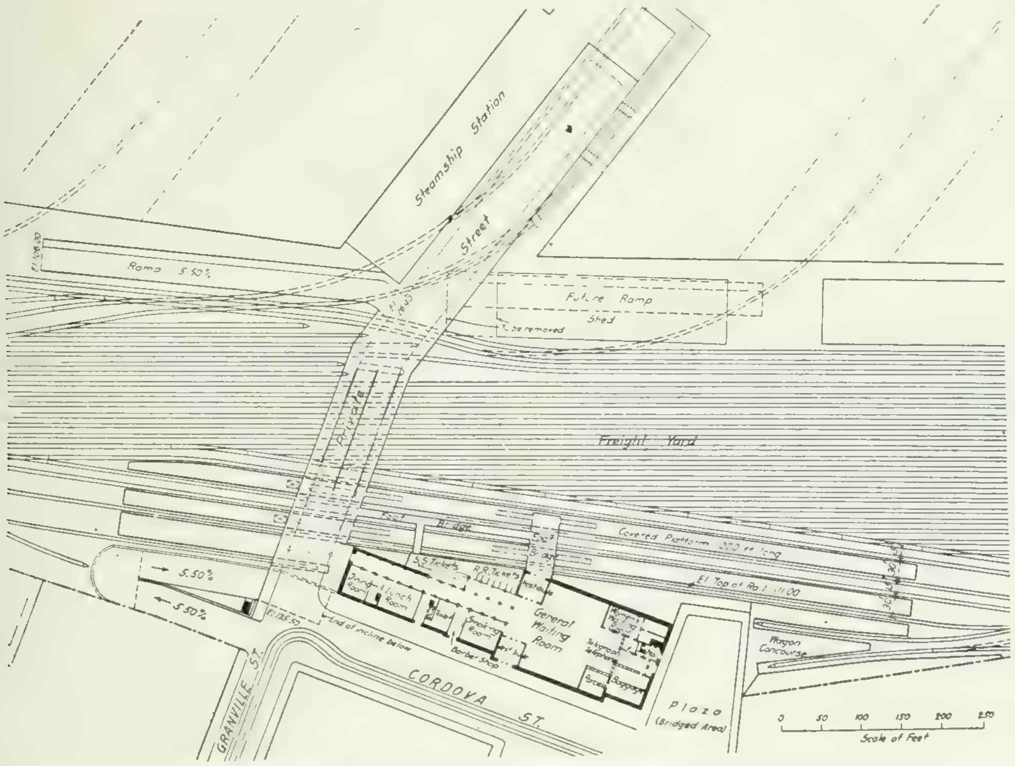
†[illegible]

PASSENGER TERMINAL AND OFFICE FACILITIES, CANADIAN PACIFIC RAILWAY, VANCOUVER, B.C.

Plans have been prepared and work is now under way on certain improvements in connection with the Canadian Pacific Railway Company's passenger terminal at Vancouver, B. C.

The present passenger station of the Canadian Pacific Railway at Vancouver is located at the foot of Granville Street, near the shore line of Burrard Inlet. The station was built about fourteen years ago, and except for minor alterations, is unchanged from its original plans. The general waiting room and ticket offices are at the street level, and the baggage room on the track level which is about thirty feet below the street.

Along the water-front across the local freight yard tracks are located the steamship wharves. There are two large sheds on a jetty pier of recent construction used by the Trans-Pacific Steamship Lines; also five sheds adjoining the longitudinal wharves used by the Seattle, Victoria Alaska and other steamship lines of the Canadian Pacific Railway.



Plan of the passenger Station of Canadian Pacific Railway at Vancouver, B.C.

Between the wharf sheds and the passenger tracks adjoining the passenger station certain of the freight tracks serve the several sheds, and other tracks are used for drilling and storage. The yard tracks extend along the harbor front about one and a half miles.

By reason of its favorable location and the transportation facilities afforded by the enterprise of the Canadian Pacific Railway, Vancouver has grown from a trading camp to a well established city with over 125,000 inhabitants in about twenty-five years time. All business lines are represented in the commercial field centering at the city. Situated at the terminal of the first, and still the only, Canadian Transcontinental railway line on a fine natural harbor and with other favorable surroundings, its growth has been based on advantages which insure continued growth and permanency and there is every indication that its population will be not less than 300,000 at the end of the next decade.

The past growth has rendered inadequate the present facilities for handling the terminal business of the railway company and the general plan shown herewith has been adopted to relieve the present congestion, as well as to provide for reasonable growth in the near future.

The general scheme embraces a passenger station and office building suitably located on available land immediately east of the present passenger station. There will be four passenger tracks with provision for more when required, separated by wide platforms, between the station and the present freight yard. The passenger tracks are to be raised about five feet above the present track level to reduce the difference in level between the street and the tracks to about twenty-five feet.

In order to avoid an inconvenient grade crossing and delays to traffic between the city and steamship wharf a bridge on the line of Granville Street extended, is to pass over the passenger and freight tracks to the steamship pier and connect directly with passenger accommodations on the pier. An incline is also to be built leading from the west side of this bridge to the wharf giving access to the lower deck of the pier and freight sheds and the water-front.

Another viaduct over the tracks is to be built on the line of Burrard Street extended northerly with an incline giving access to the present Trans-Pacific pier and other portions of the water-front.

The main entrance of the passenger station will be on Cordova Street with the main waiting room located centrally in the station on the street level. Ticket offices serving the several classes of railway and steamship passengers are located at one end of the waiting room, and the baggage checking room, lunch and dining room, parcel room, women's waiting room, men's smoking room, news booth, information booth and other facilities are all placed immediately adjoining the main waiting room.

On the lower floors of the station are located the baggage rooms, express company's space, immigrant rooms, supply rooms, and other station facilities not directly used by passengers. Stairways and lifts connect the two levels of the station and also afford communication with the office floors above. A separate foot bridge is carried over the passenger tracks directly connected with the waiting room at one end and with stairways leading to the track level, giving access to platforms without crossing tracks at grade.

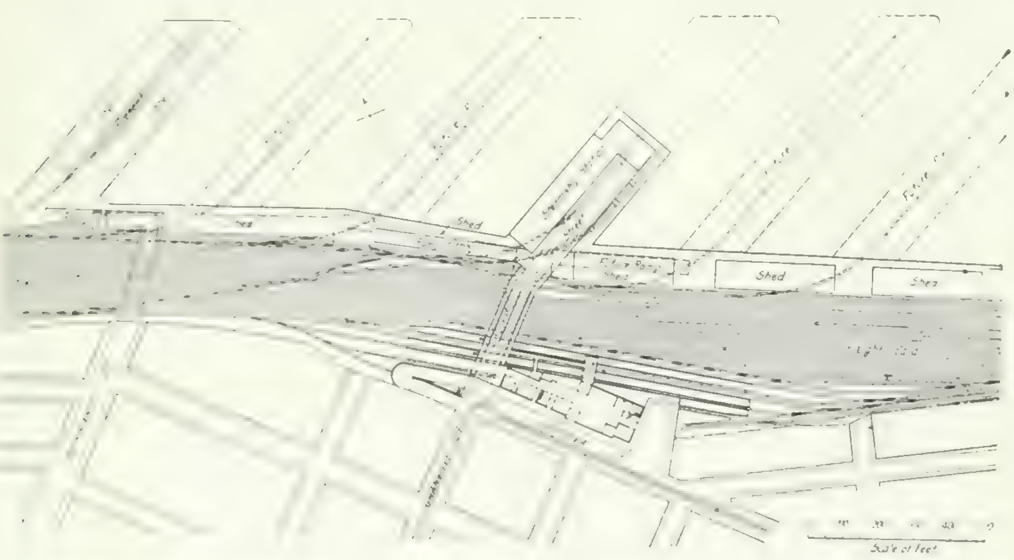
The track platforms are 1,000 feet in length, and are to be covered with shelter sheds of the umbrella type. The platform adjoining the station will be used only for baggage express and supplies.

Above the public rooms of the station building the space will be devoted to the general offices of the railway company. The interor arrangement of the office space will be adapted for a unit system of sub-division; that is, eac panel will have heating and lighting facilities so that partitions may be placed or removed at will in order to provide for changes in arrangement of office accommodations which may be desired from time to time.

The proposed steamship station on the pier is a two level building, the upper floor being devoted to the passenger business and offices and the lower floor to freight, baggage and express. There will be double level gangways on the west side of the pier, which will be used for the Victoria and Seattle service, the lower gangway being used for freight and the upper for pasengers; these gangways to be supported on floating pontoons to maintain the landing at constant level with respect to the boats.

On the passenger or upper level of the pier are provided waiting rooms, ticket offices, baggage checking room, customs office and other conveniences. Separate rooms are provided for outgoing and incoming passengers. Two tracks will be placed on the surface of the pier within the shed, and one track on the outside of the building for the direct handling of freight between cars and steamers.

The essence of the general design has been to secure easy lines of communication between the railway trains, steamers and the city. The traffic conditions at Vancouver are unusual as compared with other large terminals on account of the absence of suburban business. The aggregate number of trains is not large but they are long and frequently are run in several sections and contain a number of sleepers in trains.



General Plan Showing Layout of New Canadian Pacific. Passenger Station, freight Yards and Piers at Vancouver, B.C.

The designs for the terminal have been prepared by Messrs. Westinghouse, Church, Kerr and Company, Montreal, Calgary and Vancouver, in co-operation with the officials of the Canadian Pacific Railway and the construction of the station and facilities is now being carried out by the same engineers.

The capacity of contact beds diminishes in proportion to the length of time the beds are in service. In a paper before the British Institution of Municipal and County Engineers, Mr. T. C. Cook gives some figures regarding the [illegible] of capacity of contact beds at the sewage disposal works at [illegible]. In [illegible], five years after they had been placed in service, the secondary beds had a capacity of [illegible] per cent. of their original capacity; in [illegible], [illegible] per cent.; [illegible] per cent.; in [illegible] [illegible] per cent., and in [illegible] [illegible] years.

THE BUYING OF COAL.

Manufacturers and others who use coal in considerable quantity will be interested in Bulletin 41, of the United States Bureau of Mines, on the subject, Government Coal Purchases under Specifications. This bulletin, which has just come from the public printer, was prepared by George S. Pope, engineer in charge of fuel inspection for the government, and contains chapter on the fuel inspection laboratory of the bureau by Joseph D. Davis, chemist in charge. The bulletin is the fourth of a series showing the results of the purchase of coal by the government.

Mr. Pope, in his introductory says: "The purchase of coal on the dealer's statement as to quality, or on the reputation of the mine or district producing the coal is gradually being discontinued. At present most coal-purchasing contracts make definite provision regarding the desired heating value of a coal and the composition as shown by analysis. The heating value is usually expressed in British thermal units and the composition specified is that shown by proximate analysis. The price to be paid for delivered coal is made to depend on whether the analyses and heating-value of samples representing the delivery shows the quality to be above or below the quality set forth in the contract.

"Large coal consumers are beginning to appreciate more and more the importance of the cost of power as a factor in the cost of producing a finished article. The endeavor to increase the efficiency and the economical operation of a power plant calls for an intimate knowledge of the quality of the coal being used. The purchase of coal under specifications insures the purchaser getting what he pays for and the coal being of the quality guaranteed. In addition, the analyses and tests of the delivered coal furnish data whereby the power-plant results can be comprehensively studied and a continuous check maintained on the conditions of operation.

"The replies to a circular letter sent to the mayor of every city of over 100,000 population in the United States brought out the fact that about 55 per cent. of the cities replying purchase coal under specifications, many of which are similar to those used by the government. A great many industrial concerns are likewise purchasing coal under specifications. The numerous requests received by the Bureau of Mines for authentic information concerning purchase of coal under specifications, or according to its heating value, attest the growing interest in the subject.

"The purchase of coal on a specification basis is an important step toward the conservation of the mineral resources of the nation, for it results in the increased use of the lower grades of coal. The poorer grades find a market by competing with the better grades, not as to the price per ton, but as to the cost of an equal number of heat units.

"The purpose of this paper is to explain in general terms the method that the government has found most satisfactory for the purchase of a large part of its coal supply, including the consideration of bids, the awarding contracts, and the analyzing of samples on which the price corrections are based.

"In this report, for the information of prospective bidders or government contracts, a list of the coal contracts in force during the fiscal year ended June 30, 1911, is furnished. General averages of the analyses during the fiscal year 1908 to 1910, inclusive, are tabulated for the various sizes of anthracite and also for the several kinds of bituminous coal purchased for government use, and the results for the fiscal year ended June 30, 1910, are shown in detail by months. It is hoped that this information will be of value to both coal dealers and coal consumers."

Copies of this bulletin may be obtained by addressing the Director of the Bureau of Mines, Washington, D.C.

PRECISE LEVELLING IN CANADA.

By F. R. Reid, D.L.S.

(Continued from last week.)

Another source of error would be a systematic rising or settling of the rod supports, this would have a similar effect to the movement of the level, and cannot be guarded against in the same way, so it is essential that rod supports should be as solid and immovable as possible; luckily, in running along a railway the most solid supports are also the most convenient, namely the top of the rails. The rodman holds the rod with its semicircular knob on a cross made on top of the rail about one foot from the joint; this has been found by all levellers, I think, to be more satisfactory for a turning point than anything else; upon a track in ordinary condition the passage of a train appears to have no effect, the rail may rise and fall an inch or more under the passage of the wheels, but careful comparison of the elevation of the point with some solid point to one side, before and after a train has passed, shows that the rail returns to precisely the same elevaton. Of course when the track has been freshly ballasted and is consequently likely to settle under a train, a turning point is taken to one side when a train is known to be approaching. When following a highway, as when running branch lines into a town, suitable steel pins, driven solidly into the ground, are used. The verticality of the rod whilst readings are in progress, is maintained by means of a small spirit level. With regard to rod supports I will quote from the 1907 report of Mr. J. F. Hayford, Inspector of Geodetic Work of the United States Coast and Geodetic Survey. He says:—"In August, 1903, the experiment was made of using a point marked on the top of the rail of the railroad track as the rod support. The most prominent effect was to change the rate of accumulation of discrepancy between the forward and backward lines. This is a clear confirmation of the theory that the accumulated discrepancy is due mainly to a systematic rising or settling of the rod supports. This theory is based upon the frequently observed fact that when a change is made in the method of rod support or in the habits of the rodman, a change is liable to take place in the rate of accumulation of discrepancy between the forward and backward lines.

"The evidence showed clearly that the use of the rail for the rod support increased both the speed and accuracy of the levelling, and the practice has been adopted in all Coast & Geodetic Survey levelling since that time.

"Two uncertainties in connection with the method of rod support will occur to anyone who considers it carefully, namely, the uncertainty as to whether the rodman holds the foot of the rod for both foresight and backsight on precisely the same spot on the slightly rounding and sometimes inclined surface of the top of the rail, and the uncertainty as to the recovery by the rail of its former elevation after a train has passed over it.

"The first of these uncertainties is very small provided the rodman is careful. No difficulty was found in marking the exact spot on the rail which was used in such a way, with chalk or steel, so that the mark was recoverable, even after a train had passed over it.

"Direct observations have indicated that, as a rule, the rail rises to sensibly its former elevation quickly after a train passes. Doubtless there are exceptional cases. The best proof available that such cases are comparatively rare for the conditions under which the rail was used as a rod support, and that the systematic permanent settling of the rail caused by the passage of a train is exceedingly small, is furnished by the comparison given in Appendix 6—Report for 1904—of the accuracy of the levelling by each party before and after beginning the use of the rail as a rod support, and this has been confirmed by the good results obtained on later lines."

When a reading is to be made upon a permanent bench mark a chisel about one foot long and 1 inch wide, levelled to a flat edge at one end, is inserted in the cross mark in the end of the copper bolt, with the sharp edge at the top, that is, the upper surface of the chisel and the cross mark lie in the same horizontal plane; one man holds the chisel steady and maintains its horizontality by means of a hand level while the rodman rests the rod upon the top of it the same as he would upon the rail.

Foresights and backsights of approximately equal length are used, so as to counteract the effects of refraction and curvature, and of a possible lack of adjustment of the level; this equality is secured by having the rodman count the number of rails from the last turning point to the instrument and from the instrument to the next turning point, the instructions are that backsights and foresights should differ by not more than 30 feet.

At this point it will be necessary to say something about the programme of observation followed in the field. The observer sets up the instrument, levels it—as nearly as may be—by means of the three levelling screws, then points it on one or other of the rods and moves the object glass slid in or out till prefect definition of the rod is obtained, he then turns the drum of the micrometer screw, which is under the eye end of the telescope to the left or right, as may be necessary, to bring the bubble exactly to the centre of its run, watching it carefully all the while with his left eye. He then makes the three rod readings corresponding to the three cross wires as rapidly as possible, consistent with accuracy, still being careful to see that the bubble maintains its exact centre position; these readings are recorded by the recorder and the thread interval between the first and second and between the second and third obtained by subtraction; if these do not correspond within a certain limit—fixed for the particular instrument at the beginning or the season by careful observation under the best conditions— the readings are repeated until they do correspond; the mean of the three readings is used to ascertain the differences of level; the use of three readings usually shows up any mistake in reading feet or tenths which might be made in a single reading. The thread intervals obtained as above evidently will correspond to the length of sight, or in other words, the stadia method of obtaining distances is used; in a column headed "Sum of Intervals" these thread intervals are summed continuously from a bench mark, on the left hand page for the backsights and on the right hand for the foresights, this furnishes a ready means of equalizing the sights, if from any cause, they should become uneven, by setting the level behind or ahead— as the case may be—of the centre point between the rods; thus at the end of a section the total backsights and foresights may be made as nearly equal as desired.

When running up steep grades, the point read on the forward rod is much nearer the ground than that on the rear rod, consequently the effect of refraction, or boiling of the atmosphere, is to distort the foresight more than the backsight; by taking very short sights and thus keeping the line of sight away from the ground as much as possible, the effect is minimized but not by any means eliminated. The only way of doing the latter would be to wait for cool cloudy weather when there is no perceptible refraction. If one makes the forward levelling in such weather and the backward in a bright hot sun or vice versa the discrepancy is usually very noticeable; if both measures were made under the unfavorable conditions the results would show a good accordance, but both would be in error; however, the error would be compensated for on the next down grade provided the conditions were the same, so in the aggregate effect upon a line, I think this class of errors should not be classed as cumulative, the more so as in observing during a large number of days one will probably encounter good weather and bad weather combinations indiscriminately upon forward and backward running and upon up and down grades. My own experience has been that the grades have little effect as to causing the total discrepancy to accumulate. Atmospheric refraction affects the readings on the levelling rods most noticeably in two ways:—Firstly, when the ground is being rapidly heated by the rays of the rising sun, the lowest stratum of air becomes in its turn heated by the ground and begins to flow upward; this has the effect of making the readings appear to rise and fall vertically, and even to remain for a minute or so in quite abnormal positions; such conditions are unsuitable for observations. Secondly, when the air is bubbling the graduations on the rods appear to dance or vibrate; they are then difficult to subdivide, but no systematic error is to be feared.

The length of sight taken depends upon the atmospheric conditions; under the influence of a bright sun, without any breeze, especially when following a cold night, the boiling of the atmosphere is so severe that the divisions on the rod often cannot be subdivided with the proper degree of accuracy at a greater distance than 200 feet. Under average conditions, sights vary from 300 to 360 feet; on a very favorable day these may be lengthened to 500 or 550 feet or even more; with one of our instruments having a particularly good object glass, sights of over 700 feet have been obtained. The observer is left to use his judgment as to the length of sight he shall use; if he attempts to read farther than he should, the thread intervals will become irregular and time will be lost in taking readings over; in any case the gain in speed in taking sights of over 450 feet or thereabouts is not very marked owing to the time lost in waiting for the [illegible] to catch up.

The above remarks apply, naturally, to a level or almost level [illegible] grade, sights of [illegible] feet could not safely be exceeded in the best of weather.

Owing to these varying conditions it is very hard to [illegible] an average full day's work; probably [illegible] between [illegible] and [illegible] miles, [illegible]. In the course of a month, a few days and parts of days are lost from bad weather and [illegible] and relevelling and other causes of delay [illegible] about [illegible] per cent. of completed [illegible]

[illegible] full working days, [illegible] miles levelled per day [illegible]

line (levelled both forward and backward) is considered good progress.* These are supposed to be average conditions and are greatly exceeded sometimes under exceptionally good conditions, as over 12 miles have been done in a single day, and in one month, 87 miles of levelling were completed.

The amount of relevelling required should not amount to more than 10 or 15 per cent. provided weather conditions are at all favorable.

This class of work is so dependent for speed and precision upon the weather that it is found necessary to discontinue it in the autumn when the weather gets cold and wind storms become prevalent; the usual season for work is from some time in April till the end of October or the early part of November.

When carrying the line of levels along the railways the elevation of the top of the rail is taken opposite each station house and at the diamond crossings of all intersecting railways; these are tabulated in the office in a separate form of record from the bench marks and are useful as giving permanent records of the work in addition to those furnished by the bench marks; they are also very useful to the companies as they furnish a means of comparing their profiles with our levels without the necessity of making any actual connections on the ground as is usually necessary in the case of bench marks.

The elevations furnished in this way are not in any degree precise, and are only calculated to the nearest tenth of a foot, but they furnish a very practical record, nevertheless, and are in demand by engineers and others.

Adjustment of Instruments.—The collimation adjustment of the precise level is made in a manner very similar to that employed for the Dumpy level. Two solid points suitable for turning points are selected at, say, 360 feet apart and the level set up and carefully levelled at a point half way between them. The readings on the rods are made, and by subtracting them the true difference in elevation is known, regardless of whether the instrument is in adjustment or not. It is then set up with the ocular directly over one of the points on which the rod was held and the distance from the point to the centre of the aperture of the ocular is measured with a steel tape. By adding to or subtracting from this the difference of elevation of the two points, the result will be the true reading upon the rod held on the other point. Upon making this reading, should it not be within 0.01 foot of the true reading, the micrometer drum is to be turned till the centre wire intersects the proper point upon the rod as indicated by the true reading, then, by turning the adjusting nut at one end of the level vial the bubble is brought again to the centre of its run and this adjustment is complete.

The line of collimation is made to revolve in a plane at right angles to the vertical axis of the instrument as follows: the bubble is brought to the centre of its run, the telescope is turned 180 degrees in azimuth, half the error—if any—is corrected by the micrometer screw and half by the foot screws. For convenience the telescope may be placed so that the ocular is over one of the foot screws. The position of the zero of the micrometer drum after this adjustment is made—should be noted and used when setting up the instrument at a station; the drum may be placed at this reading before using the foot screws for "levelling up." In this way the adjustment of the level will be kept constant.

So well do the precise levels hold their adjustments that it is not often necessary to adjust them more than once in several weeks, though the adjustment is tried at intervals to see that it is all right. As the backsights and foresights are kept of equal length and no intermediate sights are ever taken, it is not a very serious matter if the level should be slightly out of adjustment in collimation. However, it is well to have it in adjustment if only for convenience.

Adjustments of Nets of Levelling.—When circuits of levelling are closed and when connecting links are run, it is obvious that new elevations will be obtained for bench marks at junction points, unless all work were performed with absolute accuracy, a condition which is, of course, never attained in practice. The question then arises "How much change will be necessitated in the published elevations of bench marks on the original lines of levelling?" I will again quote from the 1907 report of Mr. J. F. Hayford. He says:—"It is a great convenience to have fixed assigned elevations for bench marks—standard elevations, so to speak—to which all other elevations in surrounding regions shall be referred and to make no changes in these values unless necessary. Every change in the assigned elevations of the principal bench marks is liable to cause inconvenience to engineers outside the survey, as well as to the survey, by making extensive changes necessary in computations based upon these assigned elevations. On the other hand, however desirable it may be to have fixed values for the elevations of the principal bench marks, and so to make no changes in those which have already been given to the public in print, it is not desirable to keep a value for an elevation unchanged, when later levelling gives a value differing from it greatly which is determined with a higher degree of accuracy. Therefore, it is never possible to adopt a final standard value for the elevation of any bench mark unless it is positively known that no more precise levelling connected with the net will be done, or else that, if done, it will not be utilized to improve the existing assigned elevation, for all new levelling, besides giving elevations for points not previously determined, affects, by its connections, many elevations in the net as already adjusted, the effect being necessarily greater in the vicinity of the new levelling than in regions more remote. But if all new levelling is to be utilized to the fullest extent in securing elevations of the highest degree of accuracy in every part of the net, then whenever new levelling forming links in the net is secured, the whole net must be readjusted and the old adjusted elevation must be completely superseded by the new.

"Neither of the radical plans indicated above—either to hold all old elevations without change and merely to fit new levelling to the old, or to supersede all old elevations by new ones seems desirable. But a conservative procedure, intermediate between the two is possible.

"If after a complete re-adjustment of the level net the change in the published elevation of any junction point required by the new adjustment is very small, or in other words, elevations from the old and new adjustments agree closely, it seems best to hold the elevations already published. Especially does it seem certain that whenever the change called for by the new adjustment is much smaller than the uncertainties in the new adjusted elevations, no change would be made. So, also, when for any link in the net the new adjustment gives a difference of elevation far within the limits of uncertainty of the new adjusted difference, it seems that th old difference of elevation should be held without change, even though a constant correction to the elevations along the line is found to be necessary."

In India, where a system of levelling has been carried on since 1858, a complete report has lately been published by the Great Triangulation Survey in which a thorough adjustment of all precise levelling up to 1900 is made, by the method of least squares; before this publication, arbitrary methods of adjustments were adopted, in most cases by giving infinite weight to the older lines and then fitting the new levelling into the old. Such discrepancies arose, however, that a complete readjustment, by a scientific method was found to be necessary. I will quote from this volume as follows:—

"It is necessary to point out that in the future we shall have to relapse again into arbitrary methods that we are denouncing and abandoning. In this volume the circuit errors will be adjusted and the heights of all bench marks erected between 1858 and 1900 will be fixed. Any level lines subsequently observed will have to be fitted to the adjusted level net. The lines forming the level net will thus be accorded a greater weight than those observed subsequently to the reduction of the level net; from a scientific point of view this is not quite satisfactory, seeing that the future lines of levelling which should be more accurate than the old, will be subordinated. But we are in the same dilemma as our predecessors and we cannot postpone publication of results, or wait for a finality which is unattainable. Topographers and engineers, who make use of our bench marks, only ask us to eliminate contradictions and to provide them with accordant values of height, such as they can regard as final; they deprecate frequent modifications and disturbances of values.

"This volume will therefore furnish values of heights sufficiently reliable to serve all purposes for at least half a century. In 1958 it will be open to our successors to reconsider the question and to readjust the level net of India. By that time there should be a second level net superimposed on the first; the second will consist of all lines observed between 1908 and 1958, and will be attached to new open coast tidal stations which have not as yet been connected with the levelling net work. The second level net (1908-1958), will be a more scientific work than the present one (1858-1908). It will then be interesting to see what differences in value will occur in the heights of those bench marks that are common to both nets."

In the adjustment of this Indian level net the weights assigned to the different lines were made proportional to the reciprocals of the length of the lines. There were 86 lines of levels forming 29 circuits, which were tied to mean sea level at 9 points; these 9 tidal points were given infinite weight in the adjustment, and the elevations of all the junction points in the net were computed by the method of least squares. The correct elevation of the junction points and of the terminals of lines being given, the corrections to the observed heights of intermediate bench marks on the main lines were interpolated betwen the terminal points. In the interpolation on any particular line the corrections were assumed to vary at a uniform rate along the line. For any branch line that terminated without a second connection with a main line or with sea level, a constant correction was applied throughout, equal to the correction applied to the height of its junction point with the main line.

The problem of making adjustments has not come up as yet with us in Canada, for, as was mentioned earlier in this paper, only two circuits of our own levelling have been closed—in Western Ontario—and they were only completed at the end of last season. It is satisfactory to note that there are no large errors of closure to be disposed of there.

Mean Sea Level.—As all elevations are derived from mean sea level it is important that this should be accurately determined and that the points selected should be such that the sea level at them will not be affected by local influences. In this connection let me quote again from the report of the

Great Triangulation Survey of India:—"The mean level of the sea is the zero or datum surface from which the elevations of the bench marks of India have been measured. In 1909 a selection had to be made of the tidal observatories, which were to form the basis of the levelling net, and which were to furnish data for the determination of mean sea level. There were three alternative courses open, namely:—

1. One reliable tidal observatory could have been chosen, and the height of the whole level net could have been based upon the mean sea level at this point; or

2. The values of mean sea level, derived from all tidal observatories connected with the level net, could have been introduced into the levelling adjustment; or

3. The results obtained from selected tidal observatories could be retained and those from other observatories rejected.

The first alternative was not considered satisfactory. The mean sea level at any point may be permanently influenced by winds and currents; and the tidal observations may be affected by instrumental errors. At no station does the annual determination of mean-sea-level reproduce the values obtained in former years. As these uncertainties exist, it seemed inadvisable to base the whole net upon the measurements at one port.

"The second alternative plan by which all tidal observations were to be included, was investigated and rejected. The levelling operations have shown that the mean-sea-level in certain confined places, such as the Gulf of Cutch and the mouth of the Hooghly, is abnormal, and permanently deformed. At these points the mean water level differs from the mean surface of the open sea by amounts greater than the probable errors of levelling, and it was considered incorrect to force the levelling into accord with the tidal determinations.

"So long as the error of a determination of mean-sea-level is clearly larger than the error accumulated in the levelling, the rejection of the tidal result may be considered advisable. But in the case of some tidal observatories the evidence is very doubtful. The selection or rejection of tidal stations then becomes a difficult question, and one that can only be settled arbitrarily. It must be remembered, that the tidal stations are required to form the foundations of the levelling net, that they are expected in fact to give to the levelling in their respective localities more reliable values of height than the levelling can bring from any distant tidal observatory. It is futile then to endeavor to test their reliability by means of levelling results, which they themselves are intended to control. We must either accept one or the other as the more correct; we cannot utilize each in turn as the test of the other.

"If the observed difference of elevation between the mean-sea-level at different ports, connected by levelling, is considerably greater than the error to which levelling is ordinarily liable, it may be assumed that the two sea levels do not belong to the same level surface. But no definite conclusion can be drawn, when the observed difference of elevation is only small. In such a case the two sea levels have not been proved to belong to one level surface. The [illegible] be [illegible], and due to the [illegible] having the same [illegible] and effect as the actual difference of sea levels, or to the levelling errors [illegible]

"The selection of tidal observatories on which to base the levelling net has been therefore governed by general principles, and not by any observed accordance of results. It has been settled firstly to retain open-coast stations at which [illegible] annual determinations of mean-sea-level have proved accordant, and secondly, to reject tidal observatories situated in channels, gulfs, creeks, or rivers, and those at which annual determinations of mean-sea-level appeared discordant.

"The variations of mean-sea-level—When we refer to variations of mean-sea-level we mean always variations relative to the level of the land surface. The movements of the earth's crust are of two descriptions—the gradual and the sudden; there are, firstly, the slow imperceptible elevations and subsidences of possible immense areas, and, secondly, the sudden change caused by earthquakes.

"The Branch line of levels from Saharanpur to Mussooree is the only line in India that has, so far as we know, been disturbed by an earthquake. We have moreover no evidence that any of our bench marks have been disturbed by slow gradual movements of the earth's crust;.................. we have the annual determination of sea-level made at nine different tidal observatories, and we have been unable to detect in them any tendency to constant change in one direction. The mean-sea-level has been shown, it is true, to vary annually, but it seems to oscillate from year to year about one mean position."

These conclusions will have to be taken into consideration when determining upon a mean-sea-level datum for the Geodetic Survey of Canada, if it is decided to abandon that of New York, which we take up at Rouse Point.

Progress—and Publication of Results.—Levelling operations are at present being carried on vigorously by this Department; during the last two seasons three completely equipped parties have been in the field, in 1910, 812 miles of completed levelling was accomplished and during 1911, 893 miles. The total amount to date is 2,627 miles, that is to say, this distance has been run forward and the same distance backward, no account being taken of the additional relevelling done.

748 bench marks (all of the copper bolt variety described above) have been established since the beginning of the work, this number does not include any that are known to have been since destroyed, but only those actually in existence and connected to the lines of levels.

The question of publishing the results of the work for the benefit of the public was not taken up till about the beginning of last year, as it was desired to have the work on a sound basis and to have some connections with other datums before doing so. The Chief Astronomer's report for 1910, now in course of preparation, contains the complete descriptions and elevations of bench marks and rail levels at stations from 840 miles in Ontario, Quebec and New Brunswick and the 1911 report will probably contain additional results to the amount of 850 miles or thereabouts.

◆

STANDARDIZATION OF FITTINGS AND VALVES.

At a meeting of the committee of manufacturers on standardization of fittings and valves, held at No. 30 Church Street, New York, N.Y., July 10th, 1912, the "Manufacturers" 1912 schedule of flanged fittings and flanges was adopted to take effect October 1st, 1912. There was practically no opposition among the manufacturers present to the adoption of this schedule, but one vote being recorded against it. Copies of this schedule will be printed and distributed to the manufacturers and the trade generally as soon as possible. New list prices for brass and iron body swing check valves, standard and extra heavy, were adopted at this meeting, to take effect October 1st, 1912, copies of which will be printed and distributed to the trade as promptly as possible.

THE CHARACTERISTICS OF COPPER AND ALUMINUM OVERHEAD LINE CONDUCTORS.

By E. V. Pannell.

The assertion has been made that in the sequence of processes involved in the production, distribution and utilization of electric power the weakest link is in the transmission line; the same being far more liable to electrical or mechanical failure than any of the generating, transforming, or converting apparatus. Whether this statement be justifiable or no, it is certain that until recently considerably less attention and care have been devoted to the line than to the electro-dynamical plant, and only of late has the former received its due share of attention. In this country, of course, long-distance overhead transmission is only in its embryonic stage, and little in the way of operating data is available. When, however, the time is ripe, we shall undoubtedly profit by the experiences of transmission engineers in Europe and America who have accomplished the pioneer work in this field. Such engineers have by no means neglected to study the relative utility of various conducting materials, and it is far from being the claim of the author to have opened up a new subject. The object of this article is, however, to set forth a few rules by the use of which a comparison of line conductors may be readily made, and to attempt a few deductions from the same as far as apply to our British conditions.

In the field at the present day there may be said to be two active competitors as conducting materials, viz., copper and aluminum. In preference to the latter metal in its pure state, alloys have often been experimented with. Bearing in mind that the tensile strength of aluminum may be increased upwards of 60 per cent. by judicious alloying without a very great decrease in conductivity, this would seem to be justified. It is, however, found in practice that no such alloy is as resistant to corrosive effects as pure aluminum, and this disadvantage is sufficient to discount the use of alloys for bare overhead conductors. For abnormally long spans, stranded cables of steel have frequently been used both in Europe and America, but the drawbacks to their general use are quite apparent. To take advantage of the high tensile strength by spacing the supporting structures farther apart would result in so great an expenditure on the latter as entirely to off-set any saving on the conductors.

The comparative physical properties of copper and aluminum have been detailed at length on several occasions, and need not be dwelt on here. Such properties are relevant to this investigation are set out in Table I. below. It should be noted that the physical constants are such as to apply to stranded cables in both cases, as all schemes transmitting appreciable quantities of energy now use stranded conductors. This is more than usually true in this country, where it is doubtful if legislation will permit of the use of such high line voltages as render the use of a small solid conductor preferable to the equivalent stranded cable. Before leaving the question of fundamental properties, it should be mentioned that now that such large quantities of high-grade aluminum are being produced for electrical work, the conductivity and tensile strength can be confidently guaranteed. Conductivity and freedom from corrosion are equally dependent on the purity of the metal, and improvements in production have rendered it possible to place upon the market aluminum of well over 99 per cent. purity.

Table I.—Properties of Copper and Aluminum Stranded Overhead Conductors.

	Copper.	Aluminum.
Relative conductivity %	100	60
Specific gravity	8·95	2·71
Relative weights for equal conductance	100	50
Relative cross-section	100	166
Tensile strength, lb. per sq. in......	60,000	30,000
Factor of safety	5	5
Maximum working stress	12,000	6,000
Modulus of elasticity	12,000,000	9,000,000
Specific extension λ	·00000008	·00000011
Coefficient of expansion α.........	·0000093	·0000130
β = α/λ	116	118
Extension in feet for full working stress, 100 ft. span.	·096	·066
Do. 200-ft. span	·192	·132
Do. 400-ft. span	·384	·264

The enormous outlay called for by the line conductors of a transmission scheme renders the economic question a vital one, and before a comparison such as this is justifiable the competing metal must show an advantage over copper in respect of capital invested. In this connection the diagram shown in Fig. 1 gives a graphical means of estimating the difference of cost between the two metals, yielding the result in terms of pounds sterling by which aluminum is cheaper than copper per ton of the latter. The prices considered are the basis ones for wire in each case. A small circle has been inscribed to represent the approximate prices ruling at the time of preparation of this article (January, 1912), the figures being:—

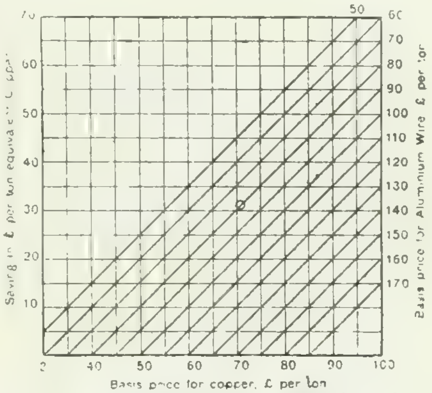


Fig. 1.—Diagram for Estimating the Saving Effected by the Use of Aluminum.

Copper (per ton)	£71 0 0
Aluminum (half ton)	40 0 0
Saving in favor of aluminum........	£31 0 0

The computation, of course, takes into account the fact of aluminum being for a given conductance exactly half the weight of copper. The extra charges for drawing and stranding are a function of the length of the cable, hence on a mileage basis are approximately equal for both metals. The saving as calculated on the above basis is, therefore, unaffected except where multi-stranded cables of small diameter wire are employed.

Turning to the technical problems involved, a starting point is fixed by the Board of Trade recommendations for overhead line construction. Briefly stated, these call for a stress in the conductor not exceeding one-fifth of the ultimate tensile, assuming a temperature of 22 deg. Fahr. and a horizontal wind pressure of 30 lb. per sq. ft. (corresponding to 18 lb. per sq. ft. on the projected surface of the wire). These values together with certain of the physical constants already set forth can by suitable manipulation be substituted in the standard equation for deflection and stress, where—

Deflection at mid-span $\delta = w\, l^2/8\, a\, s$,

and in which w = loading per foot run, lb.; l = span in feet; a = cross-section of conductor, sq. in.; s = maximum working stress, lb. per sq. in. The deduction of this equation from the catenary need not be entered into here.

The loading on the wire (w) is the resultant of its weight w and the wind pressure p—

$$W = \sqrt{w^2 + p^2}$$

and the inclination of the plane in which the conductor will hang is given by—

Angle with vertical $\theta = \tan^{-1} p/w$,

the two forces p and w acting at right angles. In estimating these and other functions it has been found convenient to use a basis as the outside diameter of the cable. A relation between this quantity and the sectional area has been plotted in Fig. 2, and the approximation is very close indeed.

The loading (w) is shown by the curves in Fig. 3, which are plotted from the figures set out in Table II., and in which both of the components and the resultant have been plotted as a function of the cable diameter. The enormous preponderence of wind over weight loading in the smaller sizes will be noted. This, however, only represents abnormal conditions, inasmuch as the specified pressure of 30 lb. per sq. ft. is only realized under extraordinary tempestuous circumstances.

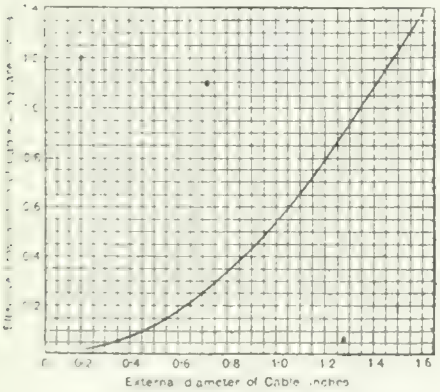


Fig. 2.—Diameter of Stranded Conductors.

As already stated, the formula above given represents the conditions obtaining at minimum temperature, 22 deg. Fahr. With increase of temperature the factor of linear expansion will come into play and the deflection will increase. It is highly important to know the value of the maximum deflection under conditions of high summer temperature, in order that the minimum clearance of the line above ground may be observed and the height of the poles [illegible] in accordance with the same.

Considering, therefore, the effect of a rise of temperature of $t°$ F., if α is the expansion coefficient and l is total length of [illegible], the expansion for a rise of $t° = l \alpha t$ and total length $L_1 = l + l \alpha t$.

Table II.—Particulars of Stranded Overhead Conductors.

Dia. of cable, in.	Effective cross-section sq in.	Weight per ft., lb.	Wind pressure per ft., lb.	Resultant force per ft., lb.
		Copper.		
0.40	0.10	0.40	0.60	0.72
0.60	0.22	0.81	0.90	1.21
0.80	0.38	1.44	1.20	1.80
[illegible]	0.60	2.24	1.50	2.70
1.20	0.84	[illegible]	1.80	[illegible]
1.40	1.15	4.65	2.10	[illegible]
		Aluminum.		
0.40	0.10	0.12	0.60	0.62
[illegible]	[illegible]	0.26	0.90	1.00
0.80	0.38	0.44	1.20	1.30
1.00	0.60	[illegible]	1.50	1.65
[illegible]	0.84	[illegible]	1.80	2.05
1.40	1.15	1.40	2.10	2.50

Now, from the properties of the catenary—

$$L = l + 8\,\delta^2/3\,l \text{ and } L_1 = l + 8\,\delta_1^2/3\,l$$

$$(L_1 - L) = 8\,(\delta_1^2 - \delta^2)/3\,l$$

but $L_1 - L$ = extension for temperature rise $t = l\,\alpha\,t$, hence—

$$l\,\alpha\,t = 8\,(\delta_1^2 - \delta^2)/3\,l \text{ and } t = 8\,(\delta_1^2 - \delta^2)/3\,l^2\,\alpha.$$

It has been thought desirable to manipulate the temperature—deflection equation in the above form in order that a correction for the elastic stretch of the wire may be more readily made. It will readily be seen that as the cable expands with increased temperature the stress is relieved. This reduction of stress, however, gives a diminution of strain, and the conductor will, therefore, extend, due to temperature rise, by an amount which is less than that calculated by the shortening due to reduction of stress. From the other standpoint it will be seen that the temperature rise for a given deflection will be greater than that worked out from the above formula. The correction may, therefore, most conveniently take the form of an increment to the calculated temperature rise. The correction used is a modification of

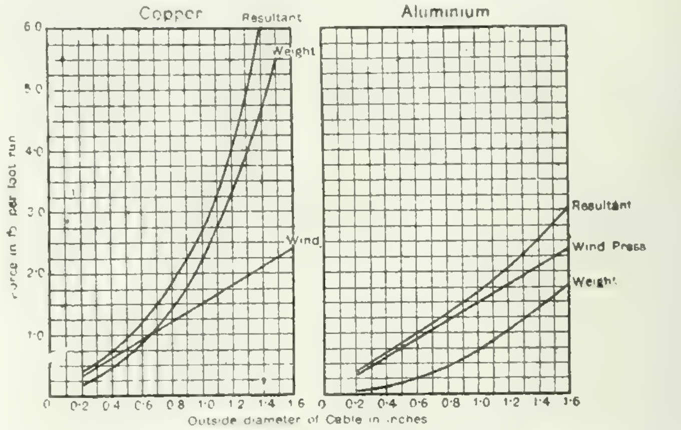


Fig. 3.—Loading Due to Weight and Wind-Pressure on Overhead Conductors.

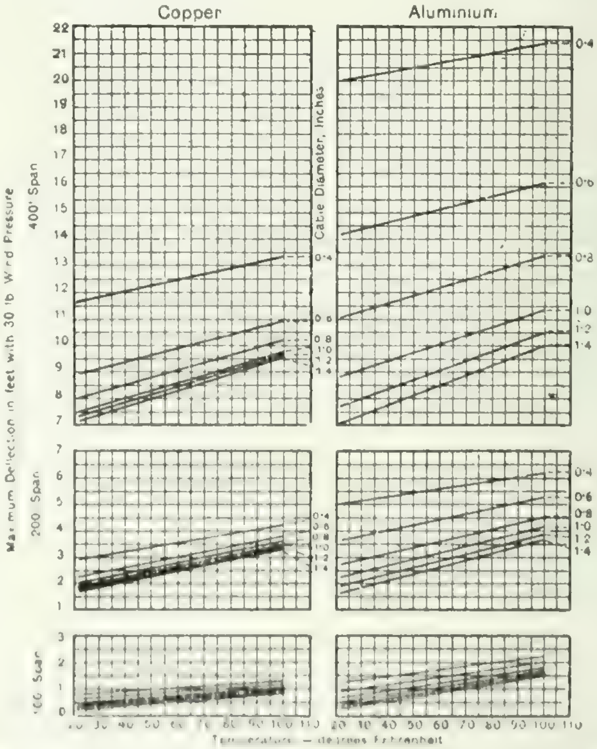


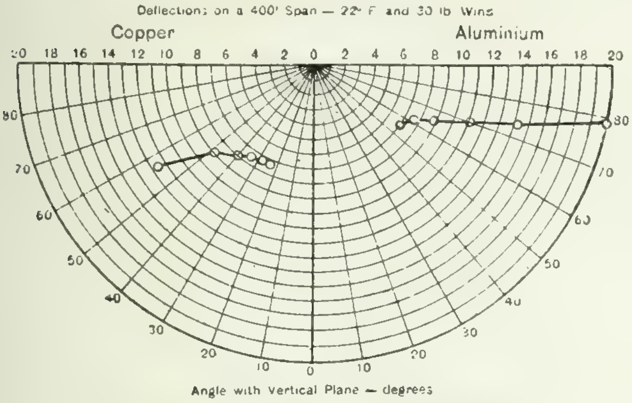
Fig. 4.—Deflections on Overhead Conductors Under Varying Conditions of Temperature.

that suggested by Mr. Shields in the discussion on a paper by Burne on "Overhead Constructions" (Journal I.E.E., Vol. XXXI., p. 432), which was read before this Institution some ten years ago.

This correction may be made as follows:—α = per cent. extension per ° F. λ = per cent. extension per lb. per sq. in. stress. $\beta = \alpha . \lambda$.

Now, for a change in deflection $= \delta_1 - \delta$, there is a change in stress $= S_1 - S$, and $S_1 = S\,\delta/\delta_1$; hence the increment for correcting the above temperature $= (S_1 - S)/\beta$, and this should be added to the right-hand side of the equation.

On this basis the curves in Fig. 4 have been plotted and the results tabulated. It will be noted that maximum wind pressure is assumed throughout, hence the deflection is not only considerably above the normal value, but the conductor will be swung out of the perpendicular by a considerable angle. As already shown, the value of this angle is $\tan^{-1} p/w$. It is, therefore, unaffected by temperature, and only depends upon the wind pressure and the weight of wire.



Diameters of Wire (Copper left to right, Aluminium right to left): 0·4, 0·6. 0·8. 1·0, 1·2, 1·4 inches.

Fig. 5.—Polar Diagram Showing the Angle by Which Conductors are Blown Out of the Vertical.

Fig. 5 shows this feature graphically, the values of deflection for a 400-ft. span, at 22° F., and the maximum wind pressure, being plotted in polars.

From curves in Figs. 4 and 5 will be seen, as might be expected, the relatively greater deflections on aluminum conductors, and the greater effect of a given wind pressure. It should be noted, however, that this is largely due to the abnormal value assumed for the latter quantity. Moreover, as will be seen later, a deflection double that of a copper conductor need only call for a pole 10 per cent. higher. The fact that the greater factor in the loading on aluminum cables is this assumed wind pressure, is an advantage on the side of conductors of this material. Under normal circumstances, with moderate winds, the weight of the cable is the more potent factor of the loading, and this value being 50 per cent. lower for the aluminum cables, it follows that the average stress in such will be lower in value. This is by no means an unimportant point, as the lower the average stress on any section, the less is the liability to fatigue.

In predetermining the forces acting on the conductors at the lower temperature limit of 22 deg. Fahr. it is necessary to take into account the wind pressure. In calculating the maximum deflection due to the highest summer temperature, however, wind pressure must be eliminated. Apart from the physical impossibility of a hurricane blowing at 100 deg. Fahr., it is necessary to calculate the maximum deflection in a vertical direction in order to estimate the necessary height of the pole or other supporting structure; in other words, the deflection in still air is what is required. Some manipulation is necessary to allow for this change in the conditions, and the author has found it convenient to use a graphic method for effecting this.

The conditions obtaining at 22 deg. Fahr., as has been seen, are expressed by—

$$\delta = w\,l^2/8\,a\,S.$$

It will be noticed that all save δ and S are constant; hence— $\delta = K/S$, and $\delta\,S = K$.

If, now, the wind pressure disappears, the state of affairs is given by—

$$\delta_1 = w\,l^2/8\,a\,S_1, \text{ i.e., } \delta_1 = K_1/S_1.$$

Ample information is available for the estimating of K and K_1; the latter being obtained, a locus is fixed for $\delta_1 = K_1/S_1$. This curve plotted for a 200-ft. span in aluminum is shown in Fg. 6, whilst at the top of the diagram is the elastic extension curve plotted downwards to represent a contraction. This is obtained simply by multiplying the stress by the elastic constant and by the length of span. The variation of deflection with extension of the cable is calculated from the equation already given—

$$L = l + 8\,\delta^2/3\,l$$

hence a series of deflection curves can be plotted from the values in the elastic extension curve. The points where these lines intersect the $\delta_1\,S_1$ hyperbola show the positions where the catenary and elastic laws coincide and give the actual deflections which the conductor will take up, with the corresponding stresses.

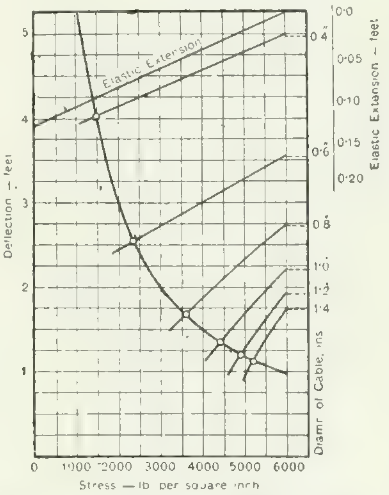


Fig. 6—Graphical Method for Determining the Reduced Deflection, with a Reduction of Stress. Aluminum Cables, 200-ft. Span.

A computation such as this, although somewhat laborious, is the only means of predetermining the actual conditions obtaining when an elastic conductor is used for aerial work. The accuracy of the method depends wholly upon the values chosen for elasticity, and there is room for a considerable amount of experimental work in this connection. Very little reliable information is available respecting the physical properties of stranded cables, and with the broadening of the field of electric power transmission such data must be extended.

The respective deflections on the copper and aluminum cables with and without wind-pressure are shown in Fig. 7. These curves, together with the figures in Table III., summarize all the foregoing calculations, and it will be seen that they are plotted to a base representing equivalent sectional area which, of course, is a function of current-carrying capacity. Thus the two materials are here brought into line on the fairest possible basis for comparison. Analysis of these results is very instructive—it being seen that the maximum amount by which the deflection on an aluminum line exceeds that for copper is about 35 per cent. With smaller sizes of cable than 0.1 sq. in. of course this ratio will increase, but this illustrates the fallacy of the statement frequently made to the effect that aluminum is only suitable for small and unimportant transmission schemes. It is exactly for the large power lay-outs that the advantages are best shown, and the greater the amount of power transmitted the better become both the technical and economic features of aluminum. The only point open to question is, at what section of cable does aluminum become superior to copper? The present investigation is carried down to a section of approximately 1/10 sq. in., or 100 amperes carrying capacity in copper, and it does not seem that any preponderating disadvantage accrues from the replacement of copper by aluminum. If however, the matter were carried further, down to very small cross-sections, then the large deflections necessary owing to allowance for wind pressure would cause trouble in spacing the conductors.

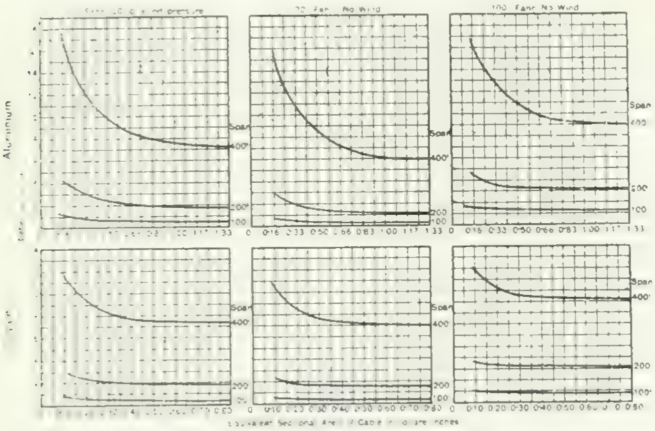


FIG. 7.—DIAGRAMS SHOWING COMPARATIVE DEFLECTIONS ON COPPER AND ALUMINIUM OVERHEAD CONDUCTORS.

In dealing with power transmission at the present day, however, there is a far more valid objection to small-section conductors than the matter of deflection, and that is the phenomenon of corona. It has long been known that high transmission pressures occasion a loss due to brush discharge from the conductors, and more recent investigations have shown that the glow which surrounds the conductor below the limits of the brush discharge is, in itself, a source of considerable loss. The most recent theories on the subject are those of Whitehead ("Losses on Transmission Lines Due to Brush Discharge," Journal I.E.E., Vol. [illegible], No. [illegible]) and Peek ("Law of Corona," Proceedings Am. I.E.E., Vol. XXX., No. 7), both of which are masterly investigations of an extremely involved problem. The feature which has been brought out most strongly is the rapid augmentation of corona loss, with a reduction in the size of the conductor. At working pressures of 80,000 volts and over, this difficulty is a very real one, and the use of tubular conductors has been proposed in order to increase the radius and diminish the liability to discharge. Although such high working pressures are by no means imminent for British transmission schemes, it should be remembered that in our climate corona will form at an appreciably lower voltage than in the drier atmospheric conditions obtaining on the American Continent. There is thus every reason for believing that, other things being equal, the larger diameter conductor will carry a given pressure with a lower corona loss. This is the main reason which dictated the exclusive use of aluminum on the transmission system of the Ontario Commission, which operates at 110,000 volts. The 30 per cent. greater diameter of the aluminum conductor over the equivalent copper is a powerful advantage for high-pressure systems.

TABLE III.—DEFLECTIONS UNDER EXTREME CONDITIONS.

Section, sq. in.		100-ft. span.		200-ft. span.		400-ft. span.	
Copper.	Alum'in.	Copper	Alum'm.	Copper.	Alum'in.	Copper.	Alum'm.
(1) Temperature 22° F. 30 lb. wind pressure. Deflections in feet.							
0·10	0·16	0·73	1·08	2·92	4·30	11·68	17·20
0·20	0·33	0·59	0·76	2·36	3·04	9·45	12·20
0·30	0·50	0·52	0·62	2·07	2·48	8·30	9·90
0·40	0·66	0·49	0·54	1·95	2·16	7·80	8·65
0·50	0·83	0·48	0·51	1·90	2·04	7·60	8·16
0·60	1·00	0·47	0·48	1·89	1·92	7·51	7·70
0·70	1·17	0·47	0·46	1·88	1·84	7·50	7·36
0·80	1·33	0·46	0·45	1·88	1·80	7·50	7·20
(2) Temperature 22° F. No wind.							
0·10	0·16	0·45	0·48	2·17	3·10	10·50	15·30
0·20	0·33	0·41	0·40	1·85	1·85	8·40	10·90
0·30	0·50	0·405	0·35	1·80	1·45	7·70	8·50
0·40	0·66	0·40	0·30	1·75	1·35	7·30	7·30
0·50	0·83	0·40	0·28	1·70	1·25	7·10	6·65
0·60	1·00	0·40	0·27	1·65	1·20	7·00	6·20
0·70	1·17	0·39	0·26	1·60	1·15	7·00	6·00
0·80	1·33	0·39	0·26	1·59	1·10	6·90	6·00
(3) Temperature 100° F. No wind.							
0·10	0·16	0·96	1·45	3·50	4·70	12·10	16·50
0·20	0·33	0·90	1·40	3·40	3·65	10·20	12·70
0·30	0·50	0·90	1·35	3·35	3·30	9·60	11·00
0·40	0·66	0·89	1·32	3·29	3·25	9·40	9·80
0·50	0·83	0·89	1·30	3·38	3·20	9·30	9·40
0·60	1·00	0·89	1·25	3·25	3·15	9·25	9·15
0·70	1·17	0·88	1·20	3·22	3·12	9·22	9·00
0·80	1·33	0·88	1·20	3·20	3·10	9·20	8·90

The matter of supporting structures for the conducting line has next to be considered, and on this point considerable diversity of opinion prevails. The single wooden pole has been almost totally displaced in America by the built-up lattice steel tower, mainly on the score of mechanical stability. Whilst this is justifiable in the very large transmission schemes common on the American Continent, it is doubtful whether the advantages of steel towers would be as great in this country. Not only would the cost of such structural steelwork be greater on account of the necessarily lower aggregate weight required, but wooden poles can be obtained in England far superior in durability and scientific design to those hitherto used abroad. For span lengths, such as have been considered in this investigation—viz., up to 400 ft.—the **A** type of pole amply takes care of the stresses due to a double three-phase network, except with abnormally large sections of cable, or with extremely high voltages. Neither of these latter conditions need be anticipated in the immediate future of British transmission schemes, and it would seem that this type of pole is amply sufficient for such projects. In estimating the cost per mile in line, therefore, **A**-type poles have been assumed of appropriate strength and of sufficient height to maintain a minimum distance of 22 ft. between the ground and the lowest point of the wire. The approximate cost of such poles is shown in the curves of Fig. 8, and values have been chosen from these curves for plotting in the "cost per mile" diagrams (Fig. 9). The latter represent the cost per mile of material for a high-pressure double-circuit three phase line, comprising the costs of metal, poles and insulators. Analysis of these curves will show that in no case does the extra cost for the poles on the aluminum lines approach the value of the saving effected on the line conductors.

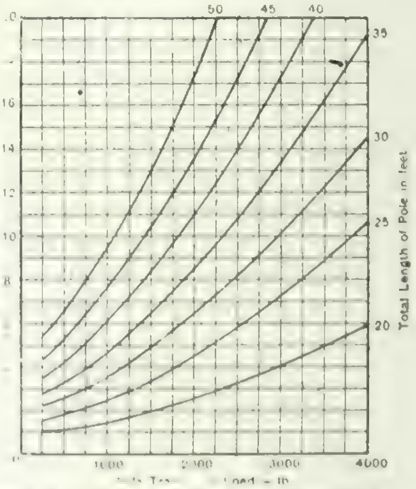


Fig. 8.—Diagram Showing Cost of A-Type Wooden Poles.

This is the most important result, as it refutes the statement often made, that a saving on the cost of line conductors does not imply a saving on the whole expenditure. For very small amounts of power, of course, the cost of poles and insulators will be of relatively greater magnitude, but in such cases the nearest stock size of pole would be requisitioned, and would be pressed into service regardless of the line conducting material.

If it be granted that the poles along the run of the line need to be somewhat stronger and more expensive for aluminum than for copper, the reverse in the case with strain poles, and all structures which have to take the longitudinal stress of the line. The stresses in the aluminum conductors being some 20 per cent. lower than the equivalent in copper, there is much less liability of the poles coming down due to a breakage of one or more conductors. Where, however, steel towers are used they will be designed especially for a copper or an aluminum line. In the former case, the towers will have a greater strength in the direction of the line than the latter, whilst the transverse strength will be in the reverse proportion. Hence, it is reasonable to believe that steel towers for an aluminum transmission line need not cost much more than those for a copper line.

Problems connected with erection are for the most part common to both conducting materials, and for this reason scarcely need treatment in this article. The jointing problem has been solved in both cases by the adoption of the torsion joint, in which the conductor ends are run into a figure 8 or oval section sleeve and twisted up. In straining up the conductors the dynamometer should always be used with reference to a table of stresses. Adjustment by gauging the deflection is unsatisfactory, whatever be the method employed. It should be remembered that the cable should be stressed up to its elastic limit and then let down again, for the reason that if this be not done it will take up a permanent set in the first gale of wind and deflect considerably more than the calculated amount. Neglect of this precaution has been largely responsible for the abnormal deflections reported on certain aluminum lines. This operation, of course, calls for the use of a dynamometer, and can in no wise be accomplished by merely sighting from pole to pole. In this paper deflection instead of stress curves have been plotted, but from the former a table of stresses can be readily prepared and should always be employed on erection work.

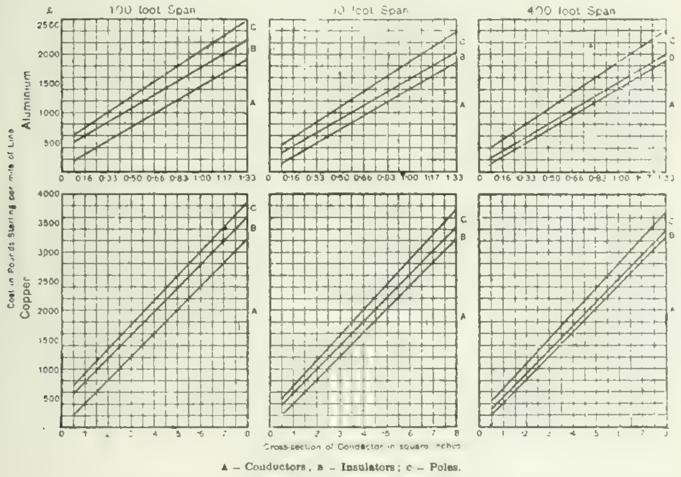


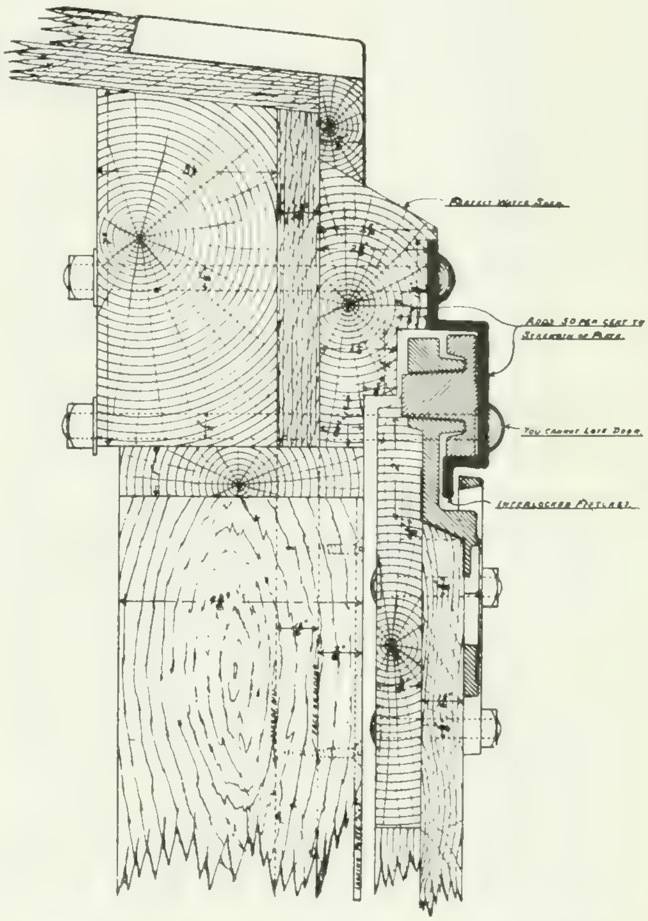
Fig. 9.—Approximate Figures for Cost of Material Per Mile.

In conclusion, the author would say that this short thesis was intended to be by no means an exhaustive treatise on the subject of the title, but merely an example in the use of some simple rules to facilitate comparison between copper and aluminum line conductors. Much of the information relative to the use of the latter metal is here published for the first time, and the author's best thanks are due to Mr. Arthur Jacob, of the British Aluminum Co., Ltd., for permission to use the same.

◆

A NEW TYPE OF BOX CAR DOOR.

There has always been a great deal of trouble with box car doors. When doors are made tight they offer considerable difficulty in opening, and when they are made loose they are liable to be lost. With the necessity of making the doors wider the car is liable to be weakened very much structurally. For the above reasons the Chicago Car Door Company, Monadnock Block, Chicago, has recently placed on the market a new type of box car door. The illustrations shown herewith give a fair idea of the design.



Section of Chicago Car Door Showing Interlocking Principle and Watershed.

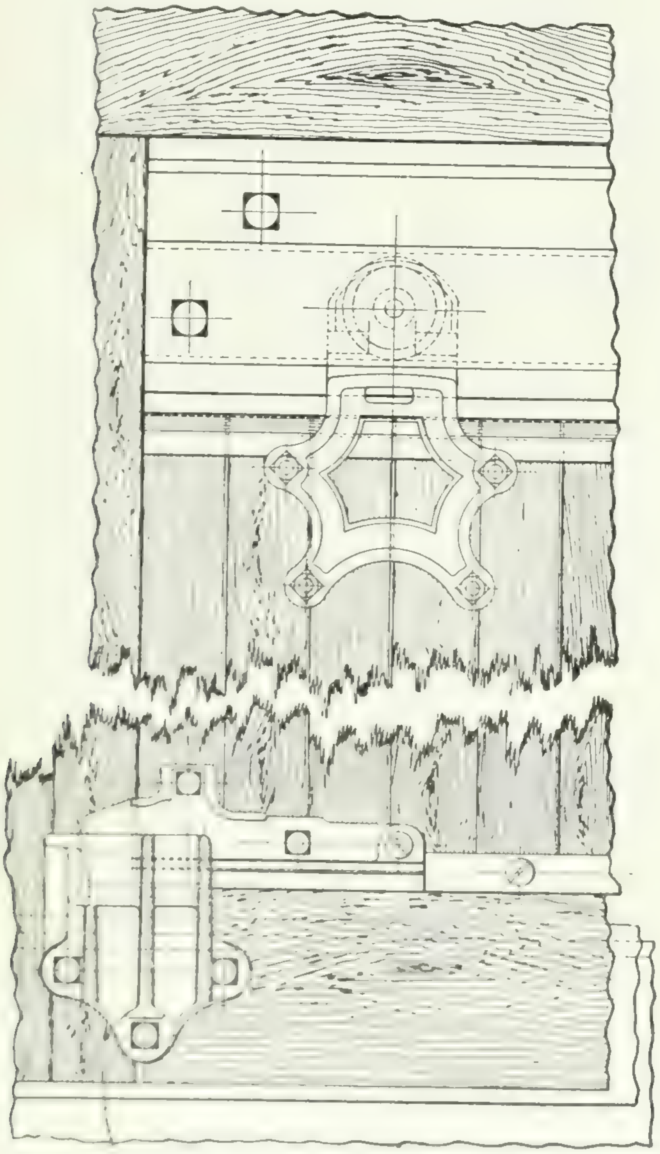
The track is a rolled steel section about five inches wide, and together with the block by which it is attached to the car, it more than doubles the strength of the plate at the doorway.

As the rolls operate on the inside face of the track they are thoroughly protected from snow and ice and are so arranged that either one of them will travel on the inside top of the track if the door is tilted, either in opening or closing, making it impossible to cramp the door, both rolls always being in contact with the track.

The track also forms an indestructible hood and is a perfect water protection at the top of the door. It projects down on the outside face of the door for a distance unusually great. At the same time it is to be interlocked with the hangers that, if the track is hanging loose on the side of the car, the door cannot be removed without taking out the bolt at the end of the track. This makes it impossible to lose the door off the car without wrecking the latter, a feature which is of interest to every railway official.

On the back edge of the door a spark strip is arranged to interlock with a plate on the face of the door post, similar to others in use, and forms a protection against either sparks or water entering the car at this point.

The bottom of the door is protected by burglar-proof brackets, thousands of which have been in service for several years. These brackets form the guides for the bottom of [illegible] by which they are attached to the sill, are taken out, as the [illegible]



Sketch of Car Door Showing Lock Brackets.

[illegible] door are securely attached, and are intended to take the full [illegible]

PROGRESS OF TRANSCONTINENTALS

Some time during 1914, the Grand Trunk Pacific and the Canadian Northern will be completed across the continent. With three transcontinental railroads, Canada should experience another impetus to further development. At the same time, freight congestion should be relieved and there may also be some adjustment in Western freight rates.

President E. J. Chamberlin, of the Grand Trunk, stated at Winnipeg, that the Grand Trunk Pacific's end of the National Transcontinental will be finished before the end of 1914, and sooner if labor troubles do not interfere. There will be no increased passenger service for the head of the lakes until rights-of-way have been fixed up. The company is getting ready to handle a lot of this year's crop, and to this end elevators and yard facilities are being augmented.

Western advices state that men are working continuously on the big 70-ton steam shovel on the route of the Grand Trunk Pacific from Tofield to Calgary—by the light of the sun in the day time and under the glare of two powerful searchlights at night. It is estimated that the Grand Trunk Pacific will have reached the city limits of Calgary by the end of August, and that steel will be to the waters of the Bow River less than 30 days later.

The bridge over the Skeena, near Hazelton, which has caused delay in laying the rails east of the Skeena crossing, will, it is hoped, be completed by the end of this month. This has been a difficult bridge to construct, the foundations having had to be sunk 25 feet below the bed of the river.

Work has commenced on the large terminals of the Canadian Northern Railway at Montreal, including the tunnel under Mount Royal, and it is officially announced that the Montreal terminal will be completed in 1914. The terminal works are under way at the Pacific coast terminal, Port Mann.

Plans have been completed for the harbor and terminal improvements at Port Mann and work is to be started next month on the first installation of the terminal shops and yards there, the initial cost to be $500,000. The International Milling Company has secured a site on the water front at Port Mann and will begin construction of terminal elevators and a large flour mill on the water front to cost $1,000,000. Mackenzie & Mann have under consideration an application from an English concern for the construction of a dry dock and shipbuilding yards there.

The Canadian Northern's western line is being rapidly extended into the Rocky Mountains this year, and next year will witness the completion of the work in the Yellowhead Pass. Work is proceeding rapidly at all the other points on the system, so as to insure the linking up of the whole road by 1914.

This year 1,053 miles of new road are to be constructed, including several new branches, as follows:—

	Miles.
Montreal to Hawkesbury	58
Ottawa to Ottawa River	32
West from Ruel, Ontario	100
East from Port Arthur	108
Branch lines and extensions in Alberta and Saskatchewan	400
British Columbia	75
Sydenham, Ont., to Ottawa	80
Relaying track on main line west	200

Two thousand men are employed in the construction work, and the approximate amount paid in wages is $1,800,000 a month. In addition to this, 62,000 tons of new steel will be used in laying tracks this year. The probable cost of the tunnel and terminals at Montreal is put at not less than $25,-[illegible] while $[illegible] is being spent for new equipment.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."
Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.
Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.
London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, JULY 18, 1912. No. 3

CONTENTS OF THIS ISSUE.

Editorial: PAGE

Highway Bridges 187
Chicago's Illusive Sewage Disposal Methods.. 187

Leading Articles:

An Electrical Sewage Disposal Plant........ 167
The Construction of Distribution Systems for Outlying Systems and Smaller Plants..... 169
Cantilever Forms for Concrete Retaining Walls 174
Passenger, Terminal and Office Facilities, C.P.R., Vancouver, B.C. 175
The Buying of Coal 176
Precise Leveling in Canada 177
The Characteristics of Copper and Aluminum Overhead Line Conductors 181
The Panama Canal 189
Irrigation Projects of the C.P.R. Co. in Alberta 192
Originality in Bridge Design 197
Canada's New Industry 198
Personals 199
Coming Meetings 200
Engineering Societies 200
Market Conditions 24-26
Construction News 67
Railway Orders 74

HIGHWAY BRIDGES.

The highway bridge question throughout the country is one to which far too little attention is given. A casual inspection of the greater number of bridges now in existence shows that many of them are in exceedingly bad condition through lack of repairs and maintenance. While it is true that a great number of steel highway bridges have been erected during the past few years, particularly in the more thickly populated parts of the country, we feel satisfied that there has been little improvement in the general safety of the bridges. Probably one of the prime reasons for this is the fact that the responsibility of county councils appears to end when they have installed a new steel bridge. Several reasons may be cited to account for this feeling. County councils do not appreciate the necessity for regular and frequent painting of steel structures. They are misled often from the fact of their misunderstanding of the term "permanent," and perhaps here, too, the bridge companies are partly to blame in allowing the misunderstanding to exist. The fact remains that great numbers of highway bridges erected in the last few years are unsafe because no care or maintenance has been put on them. Far too often the design and construction has been contracted for by agents (responsible or otherwise) of the bridge companies, with the result that poor design and extremely light metal has been used. Thus very often the bridge in its initial state has been none too safe.

The remedy for the above condition of affairs appears to be the institution of a rigid system of continuous inspection throughout the country, and this inspection preferably in the hands of the provincial authorities. This inspection should place in the hands of the provincial authorities the power to enforce repairs and regular painting of the structures. Such a system of inspection would repay itself from the start. Under present conditions the life of a highway bridge of light metal without maintenance may be a matter of twelve years or less; with adequate inspection this could be doubled or trebled.

◆

CHICAGO'S ILLUSIVE SEWAGE DISPOSAL METHOD.

It has always been understood that municipalities have prior rights to water for the necessary purposes of domestic water supply and sewerage. It has never been understood that municipalities have any rights to so divert water in such a manner that it is not returned into the watershed or watersheds from which it is taken.

In 1892 the Sanitary District of Chicago commenced a system of sewage disposal by dilution, but not the ordinary method of dilution practised by simply discharging raw sewage into a large body of water. In this particular case a canal or open sewer was constructed, running south from Chicago and discharging into the watershed of the Mississippi. The water used for domestic purposes and pumped from Lake Michigan was thus not returned to its original source, but was diverted. In order to dilute the sewage and produce a less objectionable character than the raw material it was decided that this open sewer required a quantity of new water added from Lake Michigan. Chicago is divided from the watersheds of the Great Lakes and the watersheds of the Mississippi by a comparatively short and low neck of land, consequently it was an engineering possibility to connect the two watersheds and cause Lake Michigan water to flow to the Mississippi.

This open sewer, or canal, as it is now called, was completed in January, 1900, and the Sanitary District of Chicago have continued to use with a permit from the United States Secretary of War to divert 4,167 cubic feet of water per second from Lake Michigan.

Canada and the shipping interests of both continents have watched this peculiar, extraordinary and isolated method of sewage disposal with no little alarm. The principle that the waters of the Great Lakes may be used not only for sanitary purposes in the usual way, but may also be diverted from the Great Lakes and the Gulf of Mexico, is one which causes every interest on the Great Lakes waterways to hesitate and enquire into the stability of the nature of things in general.

The permit of the United States Secretary of War to allow 4,167 cubic feet diversion was alarming to the degree that an extraordinary precedent and principle was admitted, but when the Sanitary District of Chicago recently followed up this permit with a request to the Secretary of War for 10,000 cubic feet, then it appeared that the various interests interested in maintaining a flow of water to the St. Lawrence Gulf had better make some practical enquiries and know best where they stood.

We have before us a bound copy of papers relating to the application of the Sanitary District of Chicago for permission to divert 10,000 cubic feet of water from Lake Michigan to the Gulf of Mexico, published by the Canadian Department of Marine and Fisheries. The papers deal principally with arguments contained in a brief by Mr. Daniel Mullin, K.C., and others who were nominated by the Canadian Government to oppose the application before the United States War Secretary. The chief argument used is the obvious and practical one that any diversion of water will affect the level of the lakes to the extent of the current of diversion, and that not only will the level of the lakes be affected, but, of more importance to navigation, the levels of all the connecting channels, canals and harbors will also be affected. Measurements and computations have shown that a diversion at Chicago of 10,000 cubic feet will lower the levels at various points as follows:—

	Inches.
Lakes Michigan and Huron	7.4
Erie	6.1
Ontario	4.5
Rapide Plat	6.8
Cornwall Canal	5.0
Coteau	5.4
Montreal	10.25
Sorel	6.0

The United States Secretary of War has also his attention drawn to the fact that Canada by treaty has some interest and right in maintaining the levels of the Great Lakes and waterways. The interests connected with navigation and power development are enormous, and we would refer our readers to the published evidence and arguments. It is sufficient to say here that the Chief of Engineers of the United States War Department in a recent communication to the President of the United States, states that the lowering of Lake Erie by one foot would do $[illegible] damage to existing conditions.

This is the most serious and far-reaching question in connection with the International Waterways that Canada has been asked to face. The question of mere dilution of sewage on the part of Chicago is no longer the primary one, but only the secondary.

Mr. Isham Randolph, C.E., of Chicago, in the final [illegible] by any means an engineering appeal, but a crude, impassioned, and essentially egotistical argument (so called) presented to the Secretary of War, states: "Now, I would not leave a doubt in your mind as to what Illinois wants. The question has been raised, For how long a time is the water wanted? As long as water runs down hill or floats a boat, Illinois wants this water. She wants it for the health and life of her people; she wants it for her own water borne commerce and for that of her sister States; she wants it for the power that it will yield; she wants it for the fish that it will produce to feed all the people; she wants it now, henceforth, and forever."

The cat is out of the bag. It is not just a simple little question of the disposal of raw sewage, but a question of a ship canal from Lake Michigan to the Gulf of Mexico, a question of power development by water which is equally the property of both the States and Canada, and also a question of providing sewage-fed fish for all the people.

Well! We are induced to think that Illinois will continue to want, if we are allowed to form any conclusion from the weird nonsense and childish bathos which Mr. Randolph presents as an engineering argument to the Secretary of War. On page 4 of the printed argument we find a paragraph which, as a prime example of egotistical inflation, we quote in full:—

"I am a part of the history of the Sanitary District; for fourteen years and two months I was its chief engineer, the executive head of its construction, and I am, and have been for nearly five years, its consulting engineer, and I know whereof I am speaking!"

Here is another example of the sort of stuff which Mr. Randolph as an engineer presents to the Secretary of War, page 11. Some printed arguments: "Mr. Secretary, you are looking for the truth in regard to this controversy. You must found your ruling upon the bedrock of truth, or else that ruling will be like the house founded upon the sand; when the rain of criticism descends, and the winds of opposition blow, and the flood of indignation come, the decision will fall, and great will be the fall of it."

We cannot but feel that the Church has lost a shining light in the way of a good advertising preacher, and that Mr. Randolph has missed his vocation. He certainly has no pretensions for the legal profession, as he states on page 14: "My knowledge of law is only that absorbed by thirty odd years contaminating association with learned lawyers." We sympathize sincerely with the lawyers of the United States.

We would not quarrel with the extreme egotism and silly verbiage of this would-be engineering brief, if it only contained the truth on which the author desires that the Secretary of War act. But when we find that the principal argument of the brief is to prove that the abstraction of 10,000 cubic feet will in no way affect the waterways and harbors of the Great Lakes, and that the whole of the evidence is based upon the well-known fact that the levels of the lakes fluctuate from time to time, then we must really ask is Mr. Randolph himself sincere, or is he merely perpetrating what is termed a "huge bluff." Four thousand one hundred and sixty-seven cubic feet, the amount of water now allowed, is more than sufficient to form a decent sized river, and there is no practical reason why Chicago should not partly purify its sewage so as to discharge it in a non-putrescible state into such a river.

The statement that 10,000 cubic feet is necessary to the health of Chicago is absolute bluff. The statement that the diversion of 10,000 cubic feet will not affect the lake levels and damage the shipping interests is also bluff. The statement of sewage-fed fish for all the people is also bluff. The statement that power can be developed is not bluff. The idea of the diversion of Lake Michigan waters for purposes of a ship canal to the Gulf of Mexico is not bluff.

THE PANAMA CANAL.

The following statement gives information relative to the Panama Canal on points about which inquiries are being constantly received from many sources.

Type of Canal.—The canal will have a summit elevation of 85 feet above the sea, to be reached by a flight of three locks located at Gatun, on the Atlantic side, and by one lock at Pedro Miguel and a flight of two at Miraflores, on the Pacific side; all these locks to be in duplicate, that is, to have two chambers, side by side. Each lock will have a usable length of 1,000 ft. and a width of 110 ft. The summit level, extending from Gatun to Pedro Miguel, a distance of about 31.5 miles, is to be regulated between 82 and 87 feet above sea level by means of the spillway in the dam at Gatun. The Gatun Lake, which will have an area of 164.23 square miles, will be maintained by earth dams at Gatun and Pedro Miguel. The Chagres River and other streams will empty into this lake. A small lake, about two square miles in area, with a surface elevation of 55 feet, will be formed between Pedro Miguel and Miraflores, the valley of the Rio Grande being closed by an earth dam on the west side and a concrete dam with spillway on the east side at Miraflores.

The approaches from deep water to the Gatun locks on the Atlantic side, and form deep water on the locks at Miraflores on the Pacific side, will be sea level channels, about 7 and 8 miles in length, respectively, and each 500 feet wide.

Length, Width and Depth of Canal.—The canal is to be about 50 miles in length from deep water in the Caribbean Sea to deep water in the Pacific Ocean. The distance from deep water to the shore line in Limon Bay is about 4½ miles, and from the Pacific shore line to deep water is about four miles; hence, the length of the canal from shore to shore will be approximately 41½ miles.

The channel from mile 0 in the Caribbean to mile 6.70 at the north end of Gatun locks will be 500 feet wide; from the south end of Gatun locks to mile 23.50 not less than 1,000 feet wide; from mile 23.50 to mile 26.50, 800 feet wide; from mile 26.50 to mile 27.00, 700 feet wide; from mile 27.00 to mile 31.25, 500 feet wide; mile 31.25 to Pedro Miguel lock (mile 39.36), 300 feet wide, and from Pedro Miguel lock to Miraflores locks, and from Miraflores locks to deep water in Panama Bay, 500 feet wide.

The average width of the channel in this project is 649 feet, and the minimum width 300 feet. The canal will have a minimum depth of 41 feet.

Gatun Dam.—The Gatun dam along the crest will be about 8,000 feet long, including the spillway, or about 1½ miles, and 2,100 feet wide at its greatest width.

The crest of the dam will be at an elevation of 115 feet above sea level, or 30 feet above the normal level of Gatun Lake, and 100 feet wide. The width of the dam at the normal water level of the lake, i.e., 85 feet above sea level, will be about 388 feet.

The central part of the dam will be filled by hydraulic process, protected by rock toes on both sides of the dam. The upper slope on the lake side of the dam will be further protected by 10 ft. thickness of rock. The other parts of the dam will be filled with available material from canal excavation.

In entering the canal from the Atlantic side, a ship will proceed from deep water in Limon Bay to Gatun locks, a distance of 6.9 miles, through a channel 500 feet wide; passing into the locks, 0.78 of a mile in length, the ship will be carried up to an elevation of 85 feet above sea level in three lifts to the level of the water in Gatun Lake; thence for a distance of 16 miles the channel will be 1,000 feet or more in width to mile 23.7; from this point to mile 26.9 the channel will be 800 feet wide; from this point to mile 27.45 the channel will be 700 feet wide; from this point to mile 31.5, near Bas Obispo, the channel will be 500 feet wide; from Bas Obispo to Pedro Miguel lock, through the Culebra Cut, to mile 39.68 the channel will be 300 feet wide. Going through Pedro Miguel lock, 0.37 of a mile in length, the vessel will be lowered to the level of Miraflores Lake, 55 feet above mean tide through which there will be a channel 500 feet wide to Miraflores locks at mile 41.72, thence through the two Miraflores locks, 0.58 of a mile in length, the vessel will be lowered to tide level and proceed through a channel 500 feet wide to deep water in the Pacific at mile 50.0. It is estimated that the time required for the passage of a ship of medium size through the entire length of the canal will be from 9½ to 10 hours, and for larger vessels from 10½ to 11 hours.

Excavation by the French.—The amount of material taken out by the old and new Panama Canal companies was 78,146,960 cubic yards, of which it is estimated 29,908,000 cubic yards will be utilized in the adopted plan of canal.

Total Amount of Excavation.—The following is the estimated excavation required May 4, 1904, based on the present plans for the lock canal:

	Prism	Diversions, etc.	Locks	Dams	Total
Atlantic Division	40,355,636	1,732 882	5,139,304	.	47 227,822
Central Division	100,551,296	1,250,000			101 801,296
Pacific Division.....	41,034,069	....	5,015,459	244,733	46,294,261
	181,941,001	2,982 982	10,154 763	244 733	195 323,379

Comparison Between Lock and Sea Level Projects.—For the purpose of comparison, it may be stated that an estimate has been made from the latest available data, which shows that the excavation required in the canal prism for a sea level canal as of May 4, 1904, would be 319,146,000 cubic yards.

This estimate is for a sea level canal from the —41-ft. contour in Limon Bay to the —45-ft. contour in the Bay of Panama; the channel in Colon Harbor from the seaward end to Boca Mindi to be 500 ft. wide on the bottom, and 41 ft. deep; from Boca Mindi to near the Sosa tide lock, 150 ft. wide on the bottom and 40 ft. deep in earth and 200 ft. wide on the bottom and 40 ft. deep in rock; approach to the tide lock to be 350 ft. wide and the channel from the tide lock to the —45-ft. contour in Panama Bay, 300 ft. wide. This plan includes a concrete dam at Gamboa and a twin tide lock at Sosa with chambers 110 ft. by 1,000 ft. The average width of channel in this project would be 218 ft. and the minimum width 150 ft.

Estimated Cost of Lock Canal Under Construction.—The cost estimated by the present commission for completing the canal is $325,201,000, which includes $20,053,000 for sanitation, and $7,382,000 for civil administration.

These figures do not include the $50,000,000 paid to the new French Canal Company and to the Republic of Panama for property and franchises. Hence, it is estimated that the total cost of the canal to the United States will approximate $375,000,000.

Time of Completion.—While the official date of opening of the Panama Canal has been set for January 1, 1915, it is the intention to allow vessels to utilize the canal just as soon as practicable. Present indications seem to bear out the opinion previously expressed by the chairman and chief engineer of the Isthmian Canal Commission that this can be accomplished during the latter half of 1913, although it is too far in advance at this time to fix any definite date. Shipping interests will, however, be advised as soon as the commission feels assured that vessels can be passed without unnecessary delay.

Material Excavated by the United States.—The amount of material excavated since the Americans took control on May 4, 1904, is as follows:

	Cubic yards.	Monthly average.
May 4 to December 31, 1904	243,472	30,434
January 1 to December 31, 1905....	1,799,227	149,936
January 1 to December 31, 1906....	4,948,497	412,375
January 1 to December 31, 1907...	15,765,290	1,313,774
January 1 to December 31, 1908....	37,116,735	3,093,061
January 1 to December 31, 1909....	35,096,166	2,924,680
January 1 to December 31, 1910....	31,437,677	2,619,806
January 1 to December 31, 1911....	31,603,899	2,633,658

Year or Month	Atlantic Division		Central Division x	Pacific Division		Total
	Steam Shovels	Dredges	Steam Shovels	Steam Shovels	Dredges	
	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.
Total to Dec. 31, 1911	8,549,205	27,472,627	85,426,915	4,368,559	32,193,667	158,010,963
1912						
January	34,495	520,228	1,444,392	168,984	412,118	2,580,217
February	24,445	581,399	1,415,714	136,552	432,796	2,590,906
March	254	428,626	1,712,225	149,079	404,939	2,695,123
April		403,616	1,626,947	195,117	383,985	2,609,675
May	27,134	430,156	1,418,284	179,277	388,310	2,443,161
Grand Total	8,635,533	29,836,652	93,044,477	5,197,568	34,215,815	170,930,045

x Includes Culebra Cut—188,239 cubic yards were removed by dredging.

Note.—Of the above total of 170,930,045 cubic yards excavated up to June 1, 1912, [illegible] cubic yards were excavated in the last twelve months.

	Cubic yards.
Estimated French excavation usable in present canal	29,908,000
Estimated amount of excavation required May 4, 1904, as shown on page 4..................	195,323,379
Total excavation required to complete canal under present plans	225,231,379

	Cubic yards.	
Amount taken out by French prior to 1904	[illegible]	
Amount taken out by Americans to June 1, 1912	170,930,045	
		[illegible]
Amount remaining to be excavated June 1, 1912,		54,301,334

Progress of Work on Locks and Dams.—It is estimated that [illegible] cubic yards of concrete will be placed in Gatun locks and [illegible] in the Gatun spillway. For the construction of the Pedro Miguel lock about [illegible] cubic yards of concrete will be required; about [illegible] cubic yards of concrete will be placed in the Miraflores locks, dam and spillway.

Concrete in Locks, Dams and Spillway.

	Gatun Locks	Pedro Miguel Locks	Miraflores Locks	Gatun Spillway	Miraflores Dam
	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Fill Placed in Dams.

	GATUN		Pedro Miguel Dry Fill	Miraflores x Dry Fill
	Hydraulic Fill	Dry Fill		
	Cu. yds.	Cu. yds.	Cu yds.	Cu. yds.
In place April 30th, 1912	10,158,826	9,641,673	545,355	1,172,634
Work in May, 1912.	194,733	227,017	21,782	31,220
Total to June 1st, 1912.	10,353,559	9,868,690	567,137	1,203,854

x 660,598 cubic yards of wet fill were placed in Miraflores dam up to June 1, 1912.

The.figures given in the above table of fill in Gatum dam are in excess of the amount in place, determined from cross-section surveys, due principally to consolidation of material. Up to February, 1912, the surveys showed a difference of 757,068 cubic yards, and this amount should be deducted to obtain the net amount of material in place. An allowance of about 200,000 cubic yards should be made for future consolidation.

It is estimated that the net amount of material in the completed dam will be 22,100,000 cubic yards.

The construction of Gatun dam is being carried on by first building two lines of rock, composed of spoil from the canal and lock excavation, about 1,200 feet apart and parallel to the centre line of the dam. The south of upstream pile or "toe" as it is called, has a height of about 60 feet and the downstream toe about 30 feet. These rock toes confine the body of the dam between them, which is to be mainly of impervious material pumped in by pipeline dredges. At the bottom this impermeable core will have a width of about 860 feet outside of which the body of the dam will consist of spoil, which can be placed with the least expense. Outside of the toes are the waste piles for the spoil of neighboring excavation. These piles will slope down gradually and extend indefinitely, so far as material is available.

Unit Cost of Canal Work (Including Plant Arbitrary Charges).—The average cost of dry excavation in the central division (including the Culebra Cut) for the fiscal year ending June 30, 1911, was 58.80 cents for direct charges, and 4.57 cents for administrative and general expenses of the and general expenses of the Isthmian Canal Commission, making the total average cost 24.33 cents per cubic yard.

The average cost for dredging in the Atlantic end of the canal for the fiscal year ending June 30, 1911, was 22.15 cents for direct charges, and 2.18 cents for administrative and general expenses of the Isthmian Canal Commission, making the total average cost 24.33 cents per cubic yard.

The average cost of dredging in the Pacific end of the canal for the fiscal year ending June 30, 1911, was 25.19 cents for direct charges, and 2.45 cents for administrative and general expenses of the Isthmian Canal Commission, making the total average cost 27.64 cents per cubic yard.

Steam Shovel and Dredge Equipment.—There are now on the Isthmus 100 steam shovels of different capacities, and 18 dredges, the latter being classified as 7 ladder, 3 dipper, 6 pipe-line suction, and 2 sea-going suction dredges.

Force Employed.—In the month of March, 1912, there were approximately 45,000 employees on the Isthmus on the rolls of the commission and of the Panama Railroad Company, about 5,000 of whom were Americans. There were actually at work on April 24, 1912, 36,136 men, 29,354 for the commission, and 6,782 for the Panama Railroad Company. Of the 29,354 men working for the commission, 4,276 were on the gold roll, which comprises those paid in United States currency, and 25,078 were on the silver roll, which comprises those paid on the basis of Panama currency or its equivalent. Those on the gold roll include mechanics, skilled artisans of all classes, clerks and higher officials, most of whom are Americans; those on the silver roll include principally the common laborers, who are practically all foreigners. Of the 6,782 Panama Railroad employees, 831 were on the gold roll.

Finances of the Canal. Appropriations and Expenditures Down to April 30, 1912.

Receipts.

Appropriations by Congress—		
Purchase of canal rights, June 28, 1912		$ 40,000,000.00
Purchase of canal zone rights, Apr. 28, 1904		10,000,000.00
Construction of canal, June 28, 1902		10,000,000.00
Construction of canal, Dec. 21, 1905		11,000,000.00
Construction of canal, Feb. 27, 1905		5,990,786.00
Construction of canal, June 30, 1906		25,456,415.08
Construction of canal, March 4, 1907		27,161,367.50
Construction of canal, Feb. 15, 1908		12,178,900.00
Construction of canal, May 27, 1908		29,178,000.00
Construction of canal, March 4, 1909—		
Construction engineering and administration		5,458,000.00
Construction of canal, March 4, 1909		33,638,000.00
Construction of canal, Feb. 25, 1910—		
Civil administration		76,000.00
Construction of canal, June 25, 1910		37,855,000.00
Construction of canal, March 4, 1911		45,560,000.00
Expenses in the United States	$ 180,000.00	
Construction, engineering and administration	43,100,000.00	
Civil administration	680,000.00	
Sanitation and hospitals	1,600,000.00	
		$293,561,468.58
Armament and fortifications, March 4, 1911		3,000,000.00
Private acts for relief of individuals		5,460.18
Total credited by U.S. Treasury to April 30, 1912		$296,566,928.76
Miscellaneous—		
Water rentals, Panama and Colon		751,331.18
Value of French material used in construction or sold		1,198,725.70
Collections account sale of government property, etc.		5,586,426.77
Miscellaneous collections and collections account individuals and companies		335,938.69
Total receipts		$304,709,351.10

Disbursements.

Classified expenditures			$ 254,818,475.17
Department of Civil Administration		$ 5,577,318.30	
Department of Sanitation		14,547,085.02	
Department of Construction and Engineering		146,899,666.09	
Atlantic Div.	$ 42,382,833.95		
Central Div.	75,355,690.21		
Pacific Div.	29,161,141.93		
Fortifications		766,333.22	
General items		87,028,072.54	
Paid into U.S. Treasury account sale of government property, etc.			5,856,426.77
Services rendered and material sold to individuals and companies			4,167,762.42
Bills collectible, outstanding			485,506.88
Unclassified expenditures, including material and supplies			6,491,629.27
Total			$ 271,819,800.51
Less amounts included in above but unpaid on April 30, 1912			1,635,389.74
Net disbursements			$ 270,184,410.77
Balance available April 30, 1912			34,524,940.33
Congressional appropriations		34,524,940.33	
Total			$ 304,709,351.10

RAILROAD EARNINGS.

The gross earnings of the Canadian Pacific Railway for the past three fiscal years are as follows:—

July 1, 1911, to July 1, 1912	$122,856,000
July 1, 1910, to July 1, 1911	103,525,000
July 1, 1909, to July 1, 1910	94,490,000

The Grand Trunk May statement shows net profit, as follows: Grand Trunk proper, increase £500 sterlin Atlantic, net profit decreased £3,250; Grand Trunk western, net profit increased £23,950; Grand Haven, net profit increased £1,650. The total net profit for the whole system increased £22,850.

The gross earnings of the Canadian Northern Railway for the twelve months ending June 30, 1912, were $19,538,600, as compared with $15,199,200 in the previous twelve months, a gain of $4,339,400.

The gross earnings of Toronto Railway for June were $444,598.91, as compared with $401,185.88 in the corresponding month last year, an increase last month of $43,413.03. In the past five years the street car receipts for the month of June have increased by $153,141.41, and the percentages paid to the city for June have increased by $45,201.17.

Traffic is increasing steadily on the Timiskaming and Northern Ontario Railway, although heavier operating charges keep net earnings from gaining much on last year's figures. The gross earnings for April amounted to $142,525, compared with $118,181 in May, 1911. Operating charges increased from $78,000 to $107,000, leaving a net revenue of $50,869. In April, 1911, the net for the month was $40,467. From the beginning of the financial year on November 1st to the end of April, net earnings amounted to $278,000, compared with $272,000 for the corresponding period last year. A considerable portion of the road's earning revenue this year is represented by ore royalties, the total being $71,900, compared with only $12,391 for the corresponding period of 1910-1911.

The following are the railroad earnings for the week ended June 30th:—

	1911.	1912.	Increase or decrease.
C.P.R.	$2,807,000	$3,293,000	+ $486,000
G.T.R.	1,629,178	1,552,647	— 76,531
C.N.R.	469,700	579,700	+ 110,000
T. & N.O.R.	32,048	33,423	+ 1,375
Halifax Electric	6,311	6,871	+ 560

IRRIGATION PROJECTS OF THE CANADIAN PACIFIC RAILWAY COMPANY IN ALBERTA.

By A. S. Dawson.*

Supplying moisture to desert and semi-arid lands by artificial means is no new thing in the enterprises of civilization, and has been practiced on one portion or another of the globe since the dawn of history.

It was practiced by the Egyptians, Arabians and Assyrians many centuries past; and history records that the flood waters of the Nile were used to irrigate its valleys many hundreds of years ago. The Romans operated vast systems, which are in use at the present time; and the Chinese are credited with having put water on their rice lands by artificial means several centuries before the Christian era.

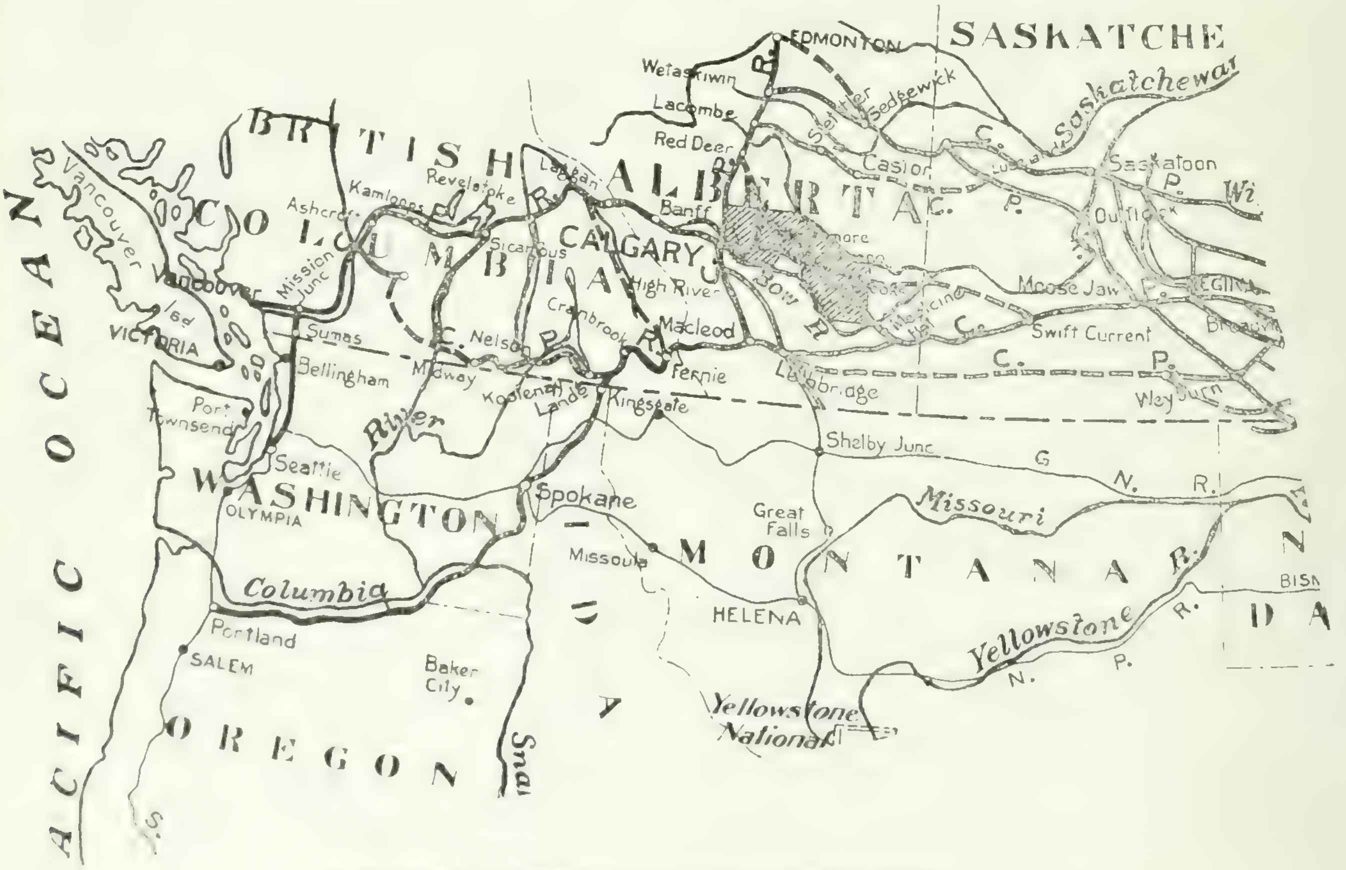
This ancient art had its origin in America in prehistoric times with the Pueblo Indians, who inhabited what are now portions of New Mexico and Arizona.

Mormons settling on the shores of Great Salt Lake were [illegible] ap- [illegible] Western America; and this was shortly followed by the use of ditches in California, originally constructed for placer mining. The results obtained therefrom soon induced settlers in the states [illegible] and Wyoming to resort to [illegible] This was followed by large private enterprises; and the passing in [illegible] of the United States. This vast enterprise, under the direction of the Sec- [illegible] or under construction projects involving an expenditure of over $60,000,000; and has undertaken to complete 35 projects, to serve 3,200,000 acres of land, at an estimated cost of $145,000,000.

The extent to which irrigation is practiced to-day is ofttimes overlooked; amounting as it does to 53 million acres in the Indian Empire, 8 million acres in Egypt, 5 million in Italy, 3 million in Spain, 15 million in the United States, with smaller areas in China, Japan, Australia, France, South America, and elsewhere.

The works providing for the irrigation of these vast areas represent an investment of over one billion dollars; and produce annually crops valued at over that amount.

Irrigation in Southern Alberta may be said to date from 1892, when a series of dry years turned the attention of the settlers to the possibility of aiding the growth of their crops by the artificial application of water. The question subsequently assumed such importance as to warrant its being taken up by the government; with the result that well-considered and comprehensive laws relating to the use of water for irrigation were passed; a system of general surveys undertaken to determine the source and value of available supplies; and the location of the areas where such water could be used to best advantage.



Map Showing Location of the C.P.R. Irrigation Block. Area is Shown in Cross Hatching.

These surveys showed that three extensive areas offered special advantages for irrigation; one containing some 250,000 acres, situated in the Lethbridge district, which could be supplied from the St. Mary's river; a second containing about 350,000 acres lying near the Junction of the Bow and Belly rivers, in townships 11 to 13 inclusive, ranges 11 to [illegible] inclusive; and a third, a much larger one, situated along the main line of the Canadian Pacific Railway, and extending about 150 miles east of the city of Calgary. It is interesting to note that the works to serve all of these tracts have either been built, or are now under construction.

---

*Chief Engineer, Department of Natural Resources, Canadian Pacific Railway Co.

It is the last mentioned project that this paper deals with specifically.

This tract of land eventually passed into the hands of the Canadian Pacific Railway Company, and is now known as the Bow Valley Irrigation Block. It was conceded that its development and colonization along proper lines would add materially to the selling prices of the land; would do away with the uncertainty of getting sufficient moisture for certain crops in certain years; would admit of intensive farming on smaller areas; and would result in settlers being attracted in greater numbers than could otherwise be expected; all of which are the basis of the revenue-producing value of any agriculture country as far as traffic receipts are concerned.

The Bow River heads, as you are aware, in the Bow Lakes on the eastern slope of the Rocky Mountains; and with its tributaries has a drainage area of about 3,800 square miles at Calgary, and about 5,100 square miles at Bassano. It generally reaches its highest stages between June 15th and August 15th of each year, and its lowest stages during January and February. Its maximum flood discharge at Calgary has probably been close to 100,000 second feet, although the hydrographic records for both extreme high and low water are rather meagre.

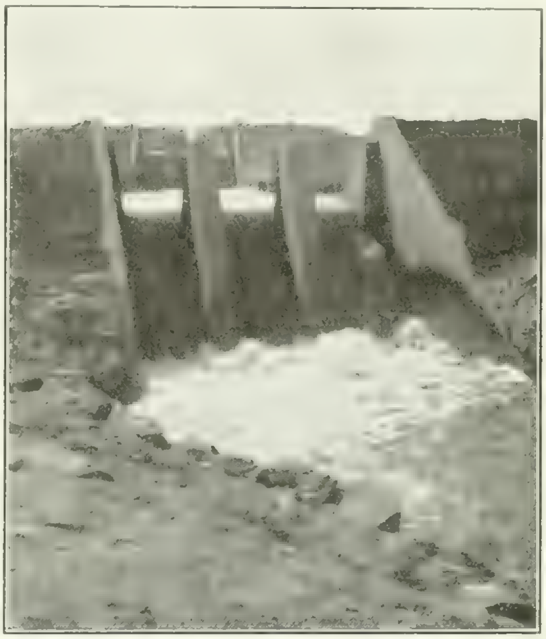
The Block is an open prairie plateau with a general elevation of about 3,350 ft. above sea level at its westerly limits, sloping gradually until a general elevation of about 2,300 is reached at its easterly boundary. Its topography is rolling, particularly in the western portion; whereas large areas of almost level plains are found in its easterly limits. The soil is good, consisting of a heavy black loam and clay subsoil in the westerly portions; and a lighter sandy loam of great depth overlying clay and hard pan in its easterly limits.

It is bounded on the west by the Fifth Meridian; on the south by the Bow River; on the east by the line between ranges 10 and 11, west of the Fourth Meridian; and on the north by the Red Deer River and the north boundary of township 28. Its length east and west is about 140 miles, and it has an average width north and south of about 40 miles. It is intersected by the main line of the railway company, and numerous other railway facilities are being provided in various directions. It contains an area of 4,840 square miles, or 3,097,580 acres.

The precipitation varies considerably from year to year, and decreases easterly as the altitude becomes lower. Meteorological records only exist subsequent to 1886, and are only applicable to the westerly portion of the Block. The average annual precipitation at Calgary between 1886 and 1910 was 15.15 inches; the minimum for the same period being 5.90 inches in 1889, and the maximum for that period 31.90 inches in 1902. The average for the irrigation period of five months, from May 1st to October 1st, covering the same years, was about 11 inches.

Combined Headgates and Drop. Secondary Canal System, Western Section.

· This moisteure, however, is not always available when most needed; and it is a recognized fact that without irrigation certain crops cannot be raised to advantage; and that in any year the certainty of crop production with large yield can only be assured by artificial means.



String of 17 Concrete Drops. Secondary Canal System, Western Section.

Surveys in connection with the project were commenced by the railway company in 1903, and have been gradually extended in detail since that date. As you may understand, this represented a vast amount of work; as an irrigation project demands surveys and examinations far more complete than those for a railway line. Elevation is the controlling feature; and lateral extent or width of country is as important as length; and width, length and height have all to be considered.

Accurate topographical surveys have been carried on by plane-table methods over practically the whole Block at an average cost of about ten cents per acre, on which the complete system has been projected.

On the completion of the preliminary surveys it became evident that the Block naturally divided itself into three sections, which were designated as the western, eastern and central, of about one million acres each; and the work is being carried on along the lines of development in the order named. The western and eastern sections are complete units in themselves, whereas the central section, owing to its general elevation, could only be served by an enlargement of a portion of the trunk lines in the western section.

Western Section.—The western section comprises an area of 1,039,620 acres, of which about 370,000 acres have been brought under ditch. Construction was commenced in 1903 and completed in 1910, and water was first used in 1907. Water for this section is diverted from the Bow River at a point near the present easterly limits of the city of Calgary. The head works are of timber, and are well protected by a pile and timber wall along the river bank, extending 350 feet above and 1,400 feet below the structure. Their sill elevation is 3,353, and they consist of 20 openings, three feet wide and ten feet high, subject to side and top contractions. The gates are of wood, of the straight lift type, and are operated by rack and pinion through a triple reduction gear with a power ratio of 100 to 1, arranged on a movable winch mounted on a travelling truck. It is the intention to replace this structure in the near future with permanent works; and at the same time to build a collapsible dam in the river which will admit of obtaining the full head of about ten feet required, during all stages of the river.

Main canal "A" heads at this structure, its capacity being 2,000 cubic feet per second at full supply of ten feet. Its section varies to suit conditions, its maximum section being 60 feet bed width, 120 feet at the water level, with 3 to 1 slopes, and a grade of .01 per cent. Throughout the greater portion of its length its dimensions are 44 feet bed width, 84 feet on the water line, with 2 to 1 slopes, and a grade of .02 per cent.; which, with an assumed value of n = .025 gives a calculated discharge of 2,050 cubic feet per second. At a point about 2½ miles below the headgates, this canal was crowded close to the river banks by heavy excavation, and at this point a set of escape or regulating gates was provided, with sill elevation one foot below canal grade. This structure is of timber, and consists of four openings 6 ft. by 11 ft. each controlled by wooden gates. These are known as balanced pressure gates, and are so designed that they will rise of their own accord when the head against them is about 5 feet. Each consists of a rectangular barrier working freely between parallel walls without guides. Each gate is hinged to four long arms arranged in pairs, the location of the hinges being so chosen that the weight of the gate is balanced by any required pressure. They are made practically watertight by rubber flashings, and are lifted by an ordinary chain windlass provided with pawl and brake.

At a point about 15 miles below the headgates, the main canal makes a vertical drop of ten feet, where an important timber structure was built. The excessive velocity resulting from this drop was taken care of by the contraction of the opening above to 25 feet, and by a water cushion 5 feet deep below, with an enlargement of the opening to 43 feet terminating in wings. Piling was extensively used in this and all [illegible] structures built on the earth [illegible] of the project.

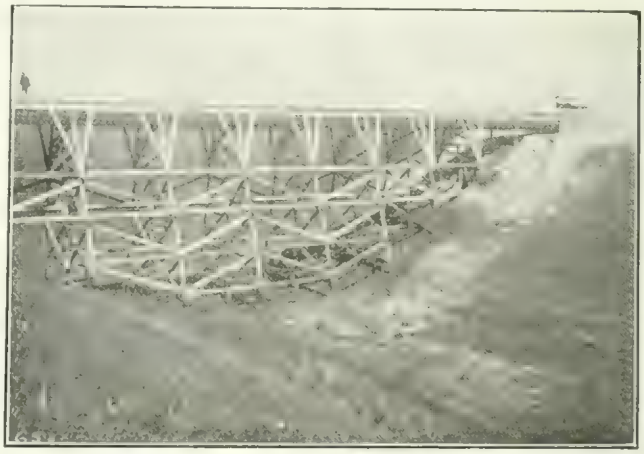
Spillway, East Branch Secondary Canal "C," Western Section.

About two miles beyond this point, or 17 miles from the headgates, the main canal terminates in reservoir No. 1, which, [illegible]

From this reservoir the water is taken out in three secondary canals, known as "A," "B" and "C," having a combined length of about 250 miles. These are each controlled by timber headgates with sill elevation of 3,321.50, and are of a type similar to those described in connection with the main canal spillway.

Numerous large structures are located on all of the secondary canals, including headgates, drops, flumes and bridges.

Secondary canal "A" heads out from the south end of reservoir No. 1, and secondary canal "B" and "C" together are taken out at the north end. Secondary canal "A" at its outlet is 18 feet bed width, carrying 8 feet of water, with 2 to 1 slopes, on a grade of .03 per cent.

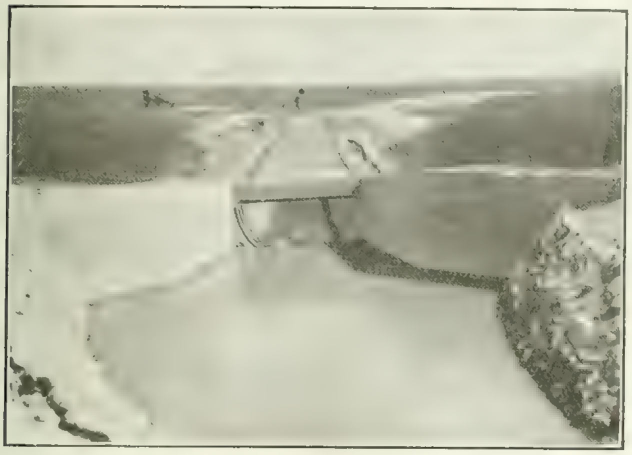


Metal Flume, 7 ft. dia. Secondary Canal System, Western Section.

It drops twice to cross the railway line; and about 15 miles from its head again drops about 30 feet and expands into what is known as reservoir No. 2; at which point its section was changed on account of grade to 22 feet bed width, carrying 6 feet of water, with 2 to 1 slopes, on a grade of .035 per cent. About 30 miles beyond, near Strathmore, it again drops and crosses the railway line, splitting into a north and south branch. North "A" is 10 feet bed width, carrying 3.2 feet of water, with 1 to 1 slopes, on a grade of .06 per cent. South "A" is 18 feet bed width, carrying 4½ feet of water, with 2 to 1 slopes, on a grade of .04 per cent. Both continue easterly to the vicinity of Gleichen, covering lands to the Crowfoot Creek at an elevation of about 2,970.

Secondary canals "B" and "C" together utilize a natural channel for three miles from the north end of reservoir No. 1, and there divide, "B" turning easterly and "C" northerly. "B" is 28 feet bed width, carrying 6 feet of water, with 2 to 1 slopes, on a grade of .025 per cent., continuing for four miles to split gates dividing it into a north and south branch. "C" is 40 feet bed width, carrying 6.4 feet of water, with 1½ to 1 slopes, on a grade of .03 per cent., and serves all the land lying between the Rosebud River and the Serviceberry Creek. At a point about eight miles from its upper end it splits into an east branch, which is 37 feet bed width, carrying 8 feet of water, with 1½ to 1 slopes, on a grade of .035 per cent., and a west branch, which is 12½ feet bed width, carrying [illegible] feet of water, with 1½ to 1 slopes, on a grade of .04 per cent. The east branch utilizes about ten miles of natural channel, in which 175 feet of grade is disposed of. The west branch crosses the valley of the Crowfoot Creek by a wood stave pipe siphon of 53 inches internal diameter and 1,600 feet long, working under a maximum head of [illegible] feet, in which 8 feet of grade is used up

Exclusive of the main canal, secondary canal "B" north branch is the most important waterway in the western section, as it is intended ultimately to be used for the main supply channel to the central section of the Block. After leaving the junction of its north and south branches, it follows a natural channel for about 16 miles, this channel being straightened in places by artificial cut offs. In this distance it falls about 250 feet, the elevation of the split gates being 3,284 and of the headgates at the lower end of the natural channel, known as Weed Creek, being 3,031. At the dam on this channel the canal heads out 18 feet bed width, carrying 4½ feet of water, with 2 to 1 slopes, on a grade of .045 per cent., and extends a distance of 14 miles to a summit with an elevation of 2,998. Before crossing this summit one branch is taken off to serve lands in the vicinity of the south branch of the Crowfoot Creek. After crossing the summit it again splits; the main branch continuing on the north side of an elevated ridge until Summit Lake is reached, which is the controlling point for the central section of the Block, and where a broad low valley of about elevation 2,884 will be crossed by a siphon.



Metal Flume, 7 ft. dia. Secondary Canal System, Western Section.

From the secondary canals the water is again taken out, and distributed through a comprehensive system of distributing ditches, which bring it to each parcel of land to be served.

In the western section of the Block the following mileage of canals has been constructed:—

	Miles.
Main canal	17
Secondary canals	254
Distributing ditches	1,329
Total	1,600

and in addition to the above there are several hundred miles of small ditches constructed by the farmers.

The structures, consisting of headgates, spillways, drops, flumes, bridges, etc., are numbered in thousands; and in their construction 10 million feet board measure of timber, and over four thousand cubic yards of reinforced concrete were used.

In constructing the system in the western section over 10 million cubic yards of material was excavated. Practically all the work was carried out under contract at prices ranging from 12½ cents to 43 cents per cubic yard; the latter price including overhaul on the heavy work. The average price was about 17½ cents per yard. The cost of timber work in place has been slightly over $55 per thousand feet; and of reinforced concrete about $23 per cubic yard; both figures including all material used as well as excavation, trenching, and backfilling.

Central Section.—This section contains 901,740 acres, and it was at first contemplated to irrigate about one quarter of this area. Detailed surveys, however, showed that the cost of serving such an area would be excessive, and at present it is not contemplated to serve more than about 75,000 acres of this section, with an elevation at its westerly boundary of about 2,940.

As previously intimated, this section could only be reached through an enlargement of a portion of the trunk system already constructed to serve the western section of the Block; and due consideration has been given this matter wherever possible by spreading double banks far enough apart to admit of carrying the additional amount of water which will be required.

Up to date the construction of this portion of the system has not been started.

Eastern Section.—The eastern section of the Block contains 1,156,220 acres, of which 440,000 acres are to be rendered irrigable. Most of the land is of a gently rolling character and susceptible to good drainage. The soil for the most part is a rich sandy loam overlying hard pan and shale at various depths.

The idea of the peculiar topographical conditions existing in this section is necessary before the scheme as worked out can be understood. The main watershed of the country between the Bow and the Red Deer River starts, as far as this section of the Block is concerned, at a point on the Bow river locally known as the Horseshoe Bend, about three miles south-west of Bassano, a station on the main line of the Canadian Pacific Railway 83 miles east from Calgary. It parallels the river for a few miles to near the south-east corner of township 18, range 17, west Fourth Meridian, from which point it runs almost due east to a point three miles south-east of Brooks station, thence north-easterly to Tide Lake in township 19, range 11. At the Horseshoe Bend the ridge is cut across by a wide valley, which apparently is

Wood Stave Pipe Syphon, 53 in. dia., 1,800 feet long. Western Section.

an old river channel, the summit of which is only 95 feet above the river bed and about 600 feet from the same. A stream known as the Mat-zi-win Creek has its source in the valley above referred to; and this is the natural boundary between the lands served by the two main branches of the system.

This project as outlined from the surveys takes advantage of a low pass in the watershed referred to, to take water from the Bow River by an intake located at the Horseshoe Bend. A dam is being built across the river at this point, which performs two functions. First, it will raise the water level at the intake, thus enabling the system to command a much larger area of land than it otherwise would have done; and secondly, it reduces the quantity of material to be removed from the main canal heading at the dam. At this point the ordinary low water level elevation is 2,515. The elevation of the canal headgates will be 2,549.6, and normal depth of water in the pool will be 11 feet higher, or 2,560.6. The dam is to be a composite structure, consisting of a long and high earthen embankment on the west bank of the river, and a reinforced concrete spillway in the existing river channel, connected at its easterly end with the canal headgates. Just above the site of the dam the river makes a long bend in the shape of a horseshoe, which gives the locality its name, the dam being located at its toe. At this point the river is approximately 600 feet wide, its north or left bank having a narrow bench immediately at the water's edge and only a few feet above it, beyond which is a cut bank rising over one hundred feet above the bed of the stream. The west or right bank has a gravel beach rising gradually until it forms a tongue between the two legs of the horseshoe. This tongue has a broad flat top several hundred feet in width and rising gradually to the general prairie level, its general elevation near the river being about 25 feet above the bed of the stream.

On this tongue an earth dam is now under construction, to which the spillway structure will be joined. This embankment will have a maximum height of about 45 feet, a total length of about 7,000 feet, and at its highest point is 310 feet in width at the base. Its wetted slope is 4 to 1, and dry slope 3 to 1, the top width being 32 feet, with a free board of 9 feet above normal water level. Provision has been [illegible] filled with bould- [illegible] upper slope [illegible] about one million cubic yards, which material is being transported from the excavation from the main canal across the river over [illegible] The [illegible] of this dam [illegible] gravel and boulders, which in turn overlie dense blue clay.

The spillway referred to is designed to pass over its [illegible]

[illegible]

to be at 15 centres, with every second buttress carried up in the form of a bridge pier. Emergency gates will also be provided in case of necessary repairs having to be made to the main gates.

The spillway proper is a reinforced concrete structure of the so-called "Ambursen" type, consisting of a heavy floor built upon the bed of the stream, and upon this floor are erected parallel buttresses of substantially triangular outline, having a slope on the upstream edge of about 45 degrees. Upon brackets or haunches projecting from the faces of the buttresses and parallel to the upstream edges, is built a concrete slab forming a deck, terminating at the top of the buttresses in a curved crest, and passing down over the downstream edge of the buttresses in the form of an apron suitably curved to correspond as nearly as possible to the path of the overfall flood waters. In front of the dam the floor is being carried downstream a distance of about 75 feet, forming a tumbling hearth. In general, the cross section of the spillway is what is known as the Ogee section, and consists of constructing the downstream face of the dam between the crest and the floor in the form of a reverse curve; the lower edge of this curve being tangential to the floor of the structure, so that the overfalling nappe shall be let down the face of the dam and turned into a horizontal direction parallel to the river bed with the least possible disturbance.

The spillway is founded on a deposit of sand, gravel and boulders, overlying a thick stratum of stiff blue clay.

At the upper and downstream edges of the structure heavy cut-off walls are carried well down into the clay and bonded to the body of the carpet. A concrete apron extends about 12 feet above the upper cut-off wall, and boulder concrete will be placed in the river bed for some distance below the tumbling hearth.

The structure is to be 720 feet in length between abutments, with a maximum height of 40 feet to the overflow crest, above which 11 feet of water will be retained by the gates above referred to. It will contain about 40,000 cubic yards of concrete, and 2½ million pounds of reinforcing steel.

(To be continued.)

BONUS FOR THE PRODUCTION OF QUICKSILVER.

The Mines Department of New Zealand has recently sent out a notice regarding a bonus for the production of quicksilver. We are indebted to Mr. Egerton R. Case, patent attorney, Temple Building, Toronto, for furnishing us with a copy.

Notice is given that a bonus of fourpence (8 cents) per pound will be paid on the production of the first one hundred thousand pounds weight (100,000 lb.) of good marketable retorted quicksilver, free from all impurities, from any mine in New Zealand, on the following conditions:—

That at least one-third of the quantity is produced on or before the 31st March, 1914, and the remaining two-thirds [illegible]

[illegible] hundred thousand pounds (100,000 lb.) of quicksilver has been produced as stipulated to the satisfaction of an officer to be appointed by the Minister of Mines, and on whose certificate alone the bonus will be paid.

[illegible] quired quantities of quicksilver before the dates named, inquiry will be made by the officer above referred to, when, if [illegible]

ORIGINALITY IN BRIDGE DESIGN.

H. G. Tyrrell, Evanston, Ill.

While writing my latest book, entitled "Artistic Bridge Design," which is now in press, my attention has been called to the general lack of originality in the designs prepared by American engineers. In our haste we seem as a nation of engineers to have followed a few accepted types, favored by the various bridge building companies, as the most easily made and usually the cheapest. While it is a fact that America has many of the world's finest bridges, a greater amount of originality can often be found in foreign works, such as the Sukkur and Connel Ferry cantilevers, the Blaauw Krantz, Assopos and Nami-Ti Gorge arches, and many works (Fig. 2) of the earlier engineers such as George and Robert Stephenson. Even in concrete bridges, we find that as early as 1840 European engineers were experimenting with surface treatment when one with a span of nearly 40 feet was built in France by the eminent engineer LeBrun.

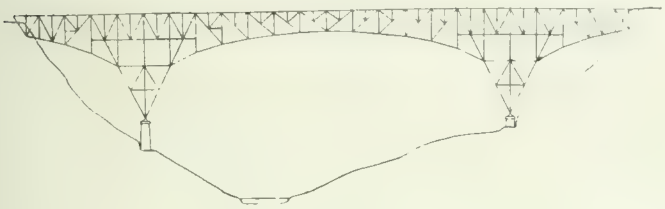


Fig. 1.

It is, therefore, a pleasure on new American works to see the old stereotyped forms laid aside, and plans made with their parts evidently arranged to fulfil their purpose and duties, and not simply copies of some former ones. For this reason the new arch bridge over St. Croix River on the Minneapolis, St. Paul and Sault Ste. Marie Railway (Eng. News, Dec. 28, 1912) is to be commended, not that it is necessarily the cheapest or most appropriate type for the place, but that the designer had the courage to depart from accepted practice by building a series of arches with large rise, instead of a trestle or deck lattice bridge on high piers. In lower outline the bridge is somewhat similar to the central span of a cantilever with an opening of 750 feet, and deck 370 feet above water (Fig. 1) which was designed by the writer in 1906. In these designs, instead of supporting the framing in the usual way on high piers, the chords are curved down to deliver their reactions on comparatively low blocks of masonry. It is gratifying to find that there are many other evidences of improved bridge design in America, where parts are proportioned not only to perform their duties in the most logical manner, but at the same time, to be artistically worthy of preserving and in keeping with other public works of a great nation. Progress in this direction is due chiefly to the leadership of such prominent engineers as Gustav Lindenthal, Chas. C. Schneider, A. P. Boller, Theodore Cooper, and others, and to the eminent architects who have been associated with them in their work, such as Thomas Hastings, Whitney Warren, Palmer & Hornbostle, and Paul Pelz.

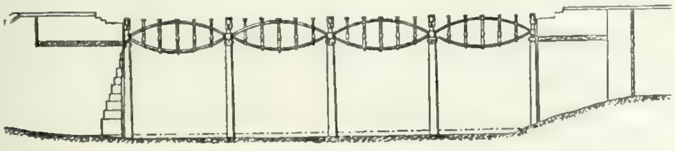


Fig. 2.

OUTLOOK FOR BRITISH COLUMBIA'S MINES

The British manufacturers in their visit to the coast have seen for themselves the possibilities for commercial and industrial enterprises there.

Apart from the interest thus awakened in Great Britain, from where much money comes for development purposes in Canada, the attention of business men in other countries will be attracted. Capital has come to the West from France, Germany and Belgium, and when it is seen that Britain is alive, these other countries will be alert to opportunities. Present trade conditions are in favor of greater commercial relations with western Europe, with the round-the-world steamship lines that have been established in recent years, and in the expansion of commerce that is confidently looked for within the next few years many countries will participate. It was gratifying to note the strong feeling of imperialism in the speeches at the banquet here, indicating that in fututre trade Britain will have the preference. These manufacturers have come, after trips that have been made by several special representatives, press and otherwise, who reported on conditions, and now the principals themselves will be able to judge first hand just what is in Canada and what the possibilities of the future are.

In this letter a couple of weeks ago, mention was made of the prosperous condition of the lumber industry. Note may be made also of the activity in mining. News from the interior is encouraging, and the outlook is better for the operation of metalliferous properties. Prices of silver and lead are very favorable, one of the reasons being the trouble in Mexico, which has interfered with the supply from that country. Higher prices mean better conditions for the low grade properties in the interior of British Columbia, in the Slocan and Boundary, mine owners are very sanguine. Lead has gone up so that the bounty granted by the Dominion has been withdrawn for the time being, and operations are more extensive in the southeastern part of the province.

The Lucky Jim Company has been re-organized and this mine will be shipping as soon as the Canadian Pacific Railway branch line has been extended to the property. Mr. T. G. Proctor, of Nelson, has been successful in interesting capital in the Lucky Jim and the directors now include Premier Roblin, of Manitoba; Hon. G. R. Coldwell, minister of education; Hon. J. H. Armstrong, attorney-general; Hon. Hugh Armstrong, minister of finance, all of Winnipeg; Mr. Joseph Morris, Edmonton; Mr. S. Montgomery, St. Paul, and Col. G. Weaver Loper, Spokane. Mr. A. G. Larson, Vancouver, has been appointed consulting engineer for the company. This is the only one of the fine properties in the Slocan, another being the Standard, which is being developed by Spokane people, and is a money maker.

The British Columbia Copper Company is again among the dividend payers, the latest dividend of three per cent. being an increase of one half per cent. over the dividend of June, 1911. This company is operating full capacity, production running over a million pounds per month, with estimated earnings of about $60,000 per month. The British Columbia Copper Company has an option on the Voight property, comprising several claims near Princeton. Developments there have been highly satisfactory, in the vicinity of Princeton, are many properties and development on a large scale in that district will do much in attracting capital.

The Nickel Plate owners have bonded an adjoining group for $150,000, and an American company, controlled by Mr. C. H. Brooks, has taken over the Kingston group. It has been the wonder of those who know the mineral resources of the Similkameen, why some of the properties with excellent showings have not been taken up by men with capital. The Nickel Plate is in the midst of a number of fine claims, and its earnings show what money is to be made. The Nickel Plate is now paying dividends of twenty-five per cent. per annum, and another quarterly dividend of five per cent. has just been declared. Their plan is to declare three quarterly dividends of five per cent. and a fourth of ten per cent. This company now has an output of about 6,000 tons a month of gold ore, which runs about $12 to the ton.

Reports such as these indicate activity in mining that will result in considerable progress. Metalliferous mining will be the great backbone of prosperity in British Columbia, and while it is coming to the front perhaps only gradually its advancement is substantial.

◆

CANADA'S NEW INDUSTRY.

A substantial addition to the industrial life of Canada has just been consummated by the entrance into the field of the Standard Underground Cable Company of Canada, Limited. The large new plant of this company at Hamilton, Ont., has begun operating several of its various departments and others, we understand, will be started as rapidly as possible.

It will be of interest to our readers to know something of the history of this newcomer into Canadian industrial life. It is not strictly correct to speak of this company as a "newcomer" because its associate American Company has been selling to the Canadian trade for many years, its wires, cables and cable accessories, being well represented on many important electrical installations in the Dominion. Tracing back the new company's lineage through its associated company, we find the latter to have been the pioneer on this continent in making electric cables for underground service. Being the pathfinder, it has always blazed its own trail and has the enviable reputation of having hewn its marks high so that those who follow in its footsteps had to look up, as well as ahead, in their efforts to maintain the progressive pace.

The parent company began the manufacture of lead covered cables and transmission of electricity about 1882 in Pittsburg, Pa. It originated and developed many of the types of cables and manufacturing processes in use to-day and was for years the only manufacturer of such materials in the United States. From the small plant in Pittsburg the company widened the scope of its business and increased its lines of products until now, in addition to the plant at Pittsburg, enlarged from time to time, it has a large aggregate of plants at Perth Amboy, N.J., and Oakland, Cal., a total floor space of over 12 acres. The products that come from these various plants include electric wires and cables of all kinds, for street railway, light and power, signal, telephone, telegraph, fire alarm, and any other service involving transmission of electric current by underground, aerial or submarine circuits. These products also include cable accessories such as terminals and junction boxes, insulating materials, cable splicing tubes, hangers, etc.

It will be seen that while the company's name carries [illegible] chiefly with the manufacture of "underground cable" yet, as a matter of fact, its products include almost every kind of conductor known to the electrical industry. Indeed, in range of products and in [illegible] of great business, this company exceed any exclusively electric wire and cable manufacturer on the American continent and probably in the world.

[illegible] who have built up the [illegible] were instrumental in [illegible] Canadian [illegible] of great interest, as they include many of the most noted American financiers and business men, connected, unless otherwise stated, with the following Pittsburg institutions:

President J. W. Marsh is also president of the Exchange National Bank, one of the oldest financial institutions of Pittsburg. His keen unerring business judgment was signally recognized when he was made chairman of Merchandise Creditors' Committee and that some years ago cooperated most effectively in reorganizing the Westinghouse Electric and Manufacturing Co., of which company, as also of the Colonial Steel Co., he is now a director and Executive Committee member. William Conner, vice-president and manufacturer, also vice-president of the Perth Amboy Trust Co., Perth Amboy, N.J.; Frank A. Rinehart, secretary and treasurer; Albert H. Childs, capitalist and director of the Exchange National Bank; L. W. Dalzell, capitalist and director of the Exchange National Bank; Joseph Wood, first vice-president of the Pennsylvania Lines west of Pittsburg; B. F. Jones, Jr., president of the Jones & Laughlin Steel Co.; J. N. Davidson, president of the Second National Bank of Allegheny; John Moorehead, Jr., of Moorehead Bros. & Co., Inc., of Pittsburg, Pa., and vice-president and director of the Exchange National Bank.

These men saw the wonderful possibilities of the Canadian field and realized that their company's increasing Canadian business could only be adequately fostered by building a plant in the Dominion that would have every modern facility possessed by the United States plants for turning out high quality products and in sufficient volume to keep pace for many years with the increasing demand resulting from the rapid electrical development of Canada. Naturally the choice of location fell upon Hamilton, Ont., the "Electrical City," and there the new plant was erected on a tract of land fronting 400 feet on Sherman Avenue and extending 600 feet along the T. H. & B. Railroad, a location which has every advantage in the way of manufacturing and shipping.

The buildings erected so far include: One three-story brick and structural iron building, 64 x 335 feet; one one-story saw tooth building, 60 x 224 feet; one one-story saw tooth building, 60 x 250 feet; one one-story building, 64 x 90 feet; one one-story building, 30 x 70 feet; also an office building and other small buildings.

The buildings are the very latest type of factory construction, and represent, with their equipment, an investment of $500,000. The plant is electrically operated throughout by power from the Dominion Power and Transmission Co.'s lines. The electric motors are of three-phase, 220-volt induction type. The three testing laboratories are equipped with the most modern and up-to-date appliances for thoroughly testing all products before shipment. These appliances consist of regulating transformers giving voltages as high as 60,000 volts, Wheatstone bridges, D'Arsonval galvanometers, Fisher testing sets, etc., for determining insulation resistances, capacity, conductivity, locating grounds, leaks, crosses or other faults in cables.

True to their policy of employing, so far as practicable, Canadian skill in this Canadian venture, the company employed, in the main, Canadian contractors to erect the new buildings and the Hamilton Bridge Works Co., Limited, supplied the structural iron. The sub-contractors and workmen were all Canadians. The architects were Prack & Berrine, factory experts of Pittsburg and Hamilton.

The officers of the Standard Underground Cable Co., of Canada, Limited, are: President, J. W. Marsh; vice-president and manufacturer, W. A. Conner; vice-president and general sales manager, P. H. W. Smith; secretary and sales manager, W. H. Marsh; treasurer, F. A. Rinehart; assistant to sales manager, H. G. Burd.

BIG BRITISH ENGINEERING ENTERPRISE IN CANADA.

Further details of the Canadian British Engineering Company, Limited, are available. The company's share capital is £205,000 divided into 200,000 7 per cent. preferred ordinary shares of £1 each and 100,000 deferred ordinary shares of one shilling each. The company have made a public flotation of 100,000 of the preferred ordinary shares. Every subscriber when applying for preferred ordinary shares is entitled to subscribe for at par and be allotted one deferred ordinary share for every five preferred ordinary shares allotted to him. The deferred ordinary shares are payable in full on application.

This company has been formed to carry on the business of an engineering supplies and construction company in Canada. It will establish branches in the principal centres in the Dominion, where stocks of standard appliances, spare parts, etc., will be carried. The company will carry out contracts for the supply and erection of all clases of machinery, purchasing the plant required as far as possible from the leading makers of such appliances in the United Kingdom. In cases, where the nature of the work is such that it can be more advantageously carried out by the manufacturers themselves, the company will act for such manufacturers as agents on a commission basis.

The company's capital will be utilized principally in carrying stocks of standard machinery and engineering appliances and in executing contracts for the construction and equipment of engineering works. The directors anticipate that the profits on this portion of the business will be sufficient to provide for a substantial dividend on the whole of the subscribed capital, in which case all profits accruing from the various agency or commision agreements, for which little or no capital is required, will be applicable for surplus dividends on both classes of shares.

The company will have a London office or buying house, through which all communications and negotiations with manufacturers will pass. The London staff will purchase all machinery and appliances required by the company for the fulfilment of its contracts, will inspect plant in course of construction, and generally take the necessary steps to ensure that all such orders receive proper attention.

Sole agency agreements have been obtained by the company from the following firms:—Sir W. G. Armstrong Whitworth and Company, Limited, hydraulic and electric cranes and conveyors, dock and harbor equipments, etc.; Ashmore, Benson, Pease and Company, Limited, gas works plant, etc.; Cammell Laird and Company, Limited, high grade steels, railway and tramway tires and axles, springs, etc.; Dorman Long and Company, Limited, steel beams, angles and channels, etc.; Galloways Limited, pumping plant, mill engines, blowing engines, rolling mill engines, large gas engines and boilers; Power Gas Corporation Limited, Mond gas producers for power and furnace heating and by-product recovery plants; Ransomes, Sims and Jefferies, Limited, agricultural machinery; Sandycroft Foundry Company, Limited, mining plant equipments; and Willans and Robinson, Limited, steam turbines Diesel oil engines and condensing plant.

The directors of the company are as follows:—C. Leonard Agnew, Northwich; W. H. Patchell, M. Inst. C.E., M.I. Mech. E., M.I.E.E., London; Leonard Andrews, M. Inst.C.E., M.I.E.E., London, managing director in Great Britain; William A. Martin, Toronto, managing director in Canada; local board in Canada: William A. Martin, Toronto; Ernest M. Sellon, M.I.E.E., Montreal; Charles Ruttan, Winnipeg; Nicol Thompson, Vancouver.

PULPWOOD CONSUMPTION IN CANADA.

The quantity of pulpwood manufactured in Canada in 1911 showed an increase of 73,801 cords (or 12.3 per cent.) over 1910. In 1911, 672,288 cords were manufactured, as compared with 598,487 cords in the previous year. The value of the wood also increased, with the result that the 1911 product brought to its vendors $4,338,024, as compared with $3,585,154 for 1910, an increase of $752,870. The value of the wood ($6.45 per cord) was greater than it had been for years.

Of the total amount, Quebec consumed in its 28 mills 58 per cent. Ontario used nearly one-third of the total consumption; this province has the highest consumption per mill of any, viz., 12,450 cords. New Brunswick mills were hampered by low water during the year. The consumption of pulpwood in these four mills was 45,824—over twice as much as in the depression of the previous year. Nova Scotia, where only mechanical process of pulp-making is used, in its seven mills consumed 22,221 cords of pulpwood. In British Columbia pulpwood manufacture was still in the experimental stage.

Quebec used four species of wood for pulp, namely, spruce, balsam fir (or balsam), hemlock and poplar. Ontario and Nova Scotia employed spruce, balsam fir and poplar, while New Brunswick used spruce and balsam fir only.

◆

PERSONAL.

MR. MALCOLM R. BOW, of Regina, has resigned his position as assistant bacteriologist for the province of Saskatchewan.

MR. F. A. GOBY, B.A.Sc., has been appointed chief engineer of the Ontario Hydro-electric Power Commission to succeed Mr. P. W. Sothmann, who has just resigned.

MR. J. CHISHOLM has been appointed master of bridges and buildings on the Ottawa division of the Grand Trunk Railway, in place of Mr. J. H. Johnston, promoted.

MR. ALAN FRASER, B.A.Sc., has been appointed to fill the vacancy on the staff of Mr. R. A. Baldwin, district engineer, Mackenzie and Mann, 23 Victoria Street, Toronto.

MAJOR J. E. HUTCHESON, superintendent of the Ottawa Electric Railway since its construction, nearly 21 years ago, has accepted the general managership of the Montreal Tramways Company.

MR. CHARLES WILLIAM DILL, formerly of Toronto, and a member of the firm of contractors, Chambers, Dill and Russell, has been appointed a member of the Board of Highway Commissioners of Saskatchewan.

MR. P. W. SOTHMANN, for six years chief engineer of the Hydro-electric Commission, has resigned and will sever his connection with the Commission on September 1st. Mr. Sothmann is going into private practice. He will organize a firm of consulting engineers under his own name and establish headquarters in Toronto.

MR. JOHN T. DICKERSON, Associate Member American Society of Civil Engineers, has been appointed sales engineer of the Strauss Bascule Bridge Company, in charge of the eastern territory, with headquarters in New York city, succeeding Mr. G. C. Bartram, who has resigned. Mr. Dickerson has been associated with the Scherzer Rolling Lift Bridge Company in their engineering and sales department for the past seven years, prior to which time he was engaged in engineering work for the Burlington, Rock Island and other railroads. Mr. Dickerson is a graduate of the Rose Polytechnic Institute.

OBITUARY.

MR. FRANK T. CONLON, son of Mr. Thomas Conlon, of St. Catharines, Ontario, passed away on July 10th, after a long illness. Mr. Conlon was a graduate of the Faculty of Applied Science and Engineering of the University of Toronto in the class of 1902. For some time he had been employed on the engineering staff of the Welland Canal.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memorial Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read [illegible] Wednesdays [illegible] winter months, on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairgé; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-[illegible] each month, October to April, in [illegible].

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, R[illegible].

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; Secy-Treasurer, [illegible], Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible]; Secy-Treasurer, W. F. Heal, Moose Jaw, Sask.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, [illegible], Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phoenix Block, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close — Noted in issue of
7-20—Concrete Arch, Stratford, Ont. ....(P. & S.) 7-4
7-20—Concrete work on bridge and dam at Georgetown, Ont. .... (P. & S.) 7-11
8-5—Electric Generating Machinery, Canora, Sask (S.) 7-18

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Arnold's Cove, N.S., dredging	July 17.	July 11.	68
Boisedale, N.S., wharf	July 24.	July 11.	68
Calgary, Alta., three bridges	July 31.	July 11.	67
Edmonton, Alta., gas holder and tank	Aug. 9.	July 4.	67
Edmonton, Alta., steel pipes and specials	July 31.	July 4.	67
Guelph, Ont., bridge and dam	July 20.	July 11.	78
Hamilton, Ont., motors, etc.	July 24.	July 11.	78
Kindersley, Sask., waterworks and electric light	July 22.	June 27.	80
Kingston, Ont., model and gun shed	July 29.	July 11.	68
Lasalle, Que., aqueduct	July 17.	July 11.	68
Moose Jaw, Sask., steam-electric machinery	Aug. 1.	July 4.	80
North Toronto, Ont., pavements	July 30.	June 27.	80
Norway House, Man., school and hospital	Aug. 19.	July 11.	68
Orillia, Ont., wharf and approach	July 29.	July 11.	68
Ottawa, Ont., Hudson Bay Rly.	Aug. 1.	June 20.	80
Ottawa Ont., designs for monument	**Oct. 1.**	**Apr. 18.**	**60**
Pas Reserve, Sask., school building	Aug. 19.	July 11.	68
Point Grey, B.C., plans for university	July 31.	Feb. 7.	**60**
Point Tupper, N.S., engine house and annex, etc.	July 19.	July 4.	68
Reeds' Point, N.B., breakwater	July 24.	July 4.	68
Regina, Sask., addition to Regina Institute	July 20.	July 4.	68
Seaforth, N.S., breakwater	July 24.	July 11.	68
Ste. Felicite, Que., landing pier	July 31.	July 11.	68
Stratford, Ont., concrete arch	July 20.	July 4.	78
Toronto, Ont., opera chairs	July 22.	June 20.	68
Toronto, Ont., pavements and storm sewers	July 30.	July 4.	78
Watrous, Sask., pump house, machinery and well	July 31.	June 27	68
Windsor, N.S., sea wall	July 18.	July 4.	68
Winnipeg, Man., high pressure plant, etc.	July 17.	July 4.	68
Winnipeg, Man., water meters	July 18.	July 11.	68
Yorkton, Sask., court house building	July 20.	July 11.	68

TENDERS.

Canora, Sask.—Tenders for one crude oil engine and auxiliary and for one electric generator and equipment will be received by H. M. Sutherland, sec.-treas., Canora, Sask., until August 5th, 1912. Specifications may be obtained from the sec-treasurer or from the engineers, or may be seen at the office of Norman A. Hill, 43 Victoria Street, Toronto, and at the offices of The Canadian Engineer, Toronto and Montreal. Bowring and Logan, Engineers, 322 Donald Street, Winnipeg. (See advt. in The Canadian Engineer.)

Clive, Alta.—Tenders for the erection of a school building to be built of brick, will be received until July 20th, 1912. Plans and specifications at the office of F. S. Fulthorp, Secretary-Treasurer.

Edmonton, Alta.—Tenders for gas plant will be received by the City Commissionerss until August 23rd, 1912. Specifications, etc., at the office of the City Gas Engineer, 143 Elizabeth Street, Edmonton.

Islington, Ont.—Tenders for the construction of a 24-inch storm sewer, near the village of Islington, Ont., will be received up to noon of July 23, 1912. Plans and specifications at the office of J. A. L. Macpherson, Engineer, Islington. (See advt. in The Canadian Engineer.)

Kenora, Ont.—Tenders for the erection of a high school building in the town of Kenora, will be received up to noon of Monday, July 22nd, 1912. Plans, etc., may be obtained from E. A. Hudson, H. S. Building Inspector, Kenora. M Seegmiller, Secretary-Treasurer.

Kingston, Ont.—Tenders will be received until July 23, 1912, by City Engineer R. J. McClelland, for one tandem steam roller and one asphalt heating kettle. (See advertisement in The Canadian Engineer.)

Kirkfield Park P.O., Man.—Tenders for the erection of an incinerator will be received until August 8, 1912, by Frank Ness, Secretary-Treasurer, Kirkfield Park P.O., Man. (See advt. in The Canadian Engineer.)

Kirkfield Park P.O., Man.—Tenders for the construction of a reinforced concrete bridge across Sturgeon Creek, will be received until July 19, 1912, by Frank Ness, Secretary-Treasurer, Kirkfield Park, Man. Plans and specifications at the Municipal Hall, St. Charles.

Miniota, Man.—Tenders for the construction of a cement concrete bridge over the Ten Mile Creek in the Municipality of Miniota will be received until July 24th, 1912. Plans, etc., can be seen at the office of the Department of Public Works, Winnipeg, and also at the office of Wm. Howard, sec.-treasurer, Miniota.

North Bay, Ont.—Tenders will be received by Mr. T. N. Colgan, Commissioner of Works, until July 20th, for 30,350 ft. of wire wooden stave pipe, 10 in., 12 in. and 14 in.

Orillia, Ont.—Tenders for the construction of approximately 120,000 sq. ft. of concrete sidewalks will be received until July 29, 1912. Specifications at the office of the Town Engineer, Orillia. W. K. Greenwood, town engineer; E. Long, chairman of committee. (See advertisement in The Canadian Engineer.)

Ottawa, Ont.—The Department of Public Works will receive tenders until July 30, for dredging required at River Bourgeois, N.S. Combined specification and form of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders for dredging required at Marble Cove, St. John Co., N.B., will be received at the office of the Secretary, Department of Public Works, Ottawa, until July 23, 1912. Specifications, etc., at the office of the Secretary.

Ottawa, Ont.—The Department of Railways and Canals, Ottawa, will receive tenders until July 18, for the construction of a brick and stone passenger station at Ste. Flavie, P.Q. Plans, etc., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa; office of the Chief Engineer of the Intercolonial Railway at Moncton, N.B.; and offices of the agents of railway at St. John, Fredericton, Levis and Montreal.

Regina, Sask.—Tenders for the erection of an eight-story steel frame office building for Messrs, McCallum, Hill and Company, will be received by Messrs. Storey and Van Egmond, Architects, Credit Foncier Building, Regina, Sask., up to noon of July 27, 1912.

Regina, Sask.—Tenders for the construction of a reservoir in the village of Cupar, Sask., will be received up to noon of July 20, 1912. Plans, etc., may be obtained from H. S. Carpenter, Acting Deputy Minister of Public Works, Regina, Sask.

Sault Ste. Marie, Ont.—Tenders for the construction of street pavements will be received by C. J. Pim, city clerk, until July 29th. Specifications and plans may be seen and all information obtained at the office of the city engineer. (See advt. in Canadian Engineer.)

St. Thomas, Ont.—The time for receiving tenders for the construction of sewers is extended from July 3rd to July 17th. Plans, etc., at the office of M. H. Baker, City Engineer, St. Thomas.

Sudbury, Ont.—Tenders will be received by the town clerk, until July 29th, for the construction of sewage disposal works, the contractor to furnish all materials and labor. Plans and specifications may be seen at the office of the Engineers, Toronto and Sudbury. Chipman and Powers, engineers; Geo. Elliott, Esq., town clerk.

Vancouver, B.C.—Tenders will be received until July 22, for a school building on the Dawson School Grounds. C. W. Murray, Secretary, School Board.

Vancouver, B.C.—Tenders for the building of the Lumley-Kelowna section of the Okanagan Valley branch of the Canadian Northern Railway will be called for shortly.

The Canadian Northern is about to ask for tenders for the construction of ten railway stations in the Fraser River Valley between Port Mann and Hope.

Victoria, B.C.—Tenders for the following installation will be received until July 22:

(a) Supply and install arc lighting cables on Government Street.

(b) Install arc lighting system on Dallas Road.

Plans, etc., for same can be seen at the office of the City Electric Lighting Station. M. Hutchison, City Engineer.

* * *

CONTRACTS AWARDED.

Fernie, B.C.—The contract for the construction of the new mine rescue station at Fernie, for use in connection with the Draeger system, has been let to W. Grenier, who [illegible]

Fredericton, N.B.—Messrs. Charles and Robert Forbes, of Nashwaak Village, N.B., have received the contract for [illegible]

Guelph, Ont.—The contract for the erection of the new factory of the Dominion Linen Mills has been awarded to Messrs. P. H. Secord and Sons. Messrs. Secord and Sons [illegible]

North Vancouver, B.C.—The city council has accepted [illegible]

Orillia, Ont. [illegible]

[illegible]

Owen Sound, Ont. [illegible]

St. John, N.B.—Tenders have been called for paving King Street and Charlotte Street and awards have been made to Messrs. B. Mooney and Sons and The Caritte-Patterson Mfg. Co., Ltd., as follows: Construction of sheet asphalt pavement on Charlotte Street, from Union Street to south side of King Square—vit. block pavement, $4.44 per square yard; new curb stones, $1.25 per lin. foot; old curb stones, reset, etc., 60c. per lin. foot; reconstruction of one catch basin, $95; repair and regulation of old catch basins, $65 per basin; sheet asphalt pavement, $2.90 per square yard.

Construction of granite block pavement on track allowance King Street, from Charlotte Street to Prince William Street—granite blk. pavement, $4.25 per square yard; new curb stones, $1.25 per lin. foot; old catch basins redressed, 60c. per lin. foot; construction of three new catch basins, $95 each; repair and regulation of old catch basins, $65 each; bituminous macadam pavement, $1.85 per square yard.

Toronto, Ont.—The Advisory Industrial Committee of the Board of Education has appointed the Canadian Domestic Engineering Co., of Toronto and Montreal, sanitary engineers in connection with the erection of the new Central Technical School.

Toronto, Ont.—The tender of The Toronto Type Foundry, of $1,157.25, for a printing plant, was accepted.

Vancouver, B.C.—The Northern Construction Company has been awarded a contract for grading the proposed railway yards of the Canadian Northern at Port Mann. The cost will be about $150,000. W. G. Swan, divisional engineer, will supervise the carrying out of the railway improvements.

Victoria, B.C.—A contract has been let to Messrs. Williams, Trerise and Williams for the erection of a temporary office structure for the Provincial Government while new additions to the Parliament buildings are being completed. Cost, $8,500.

Weston, Ont.—At a meeting held on the 10th day of July, 1912, to consider tenders for the construction of a storm and sanitary trunk sewer, the contract was awarded to Messrs. Campbell, Lattimore and McAllister, of Toronto, for $74,481.75. The other tenders were:

Mr. Connolly	$100,804.00
James Bogul	100,902.10
J. M. Scott	85,209.30
Fry and Thorold	77,274.00
Proctor and Fullerton	95,573.25
J. Rowland McLaren	80,424.05

* * *

RAILWAYS—STEAM AND ELECTRIC.

Port Arthur, Ont.—The city council is considering a route for the belt line for the street railway. The line will be about six miles long.

Victoria, B.C.—The Great Northern Railway will shortly start construction of a large wharf at Sidney, Vancouver Island, B.C.

Brantford, Ont.—The ratepayers voted in favor of assisting in a financial manner the directors of the Erie and Northern Railway.

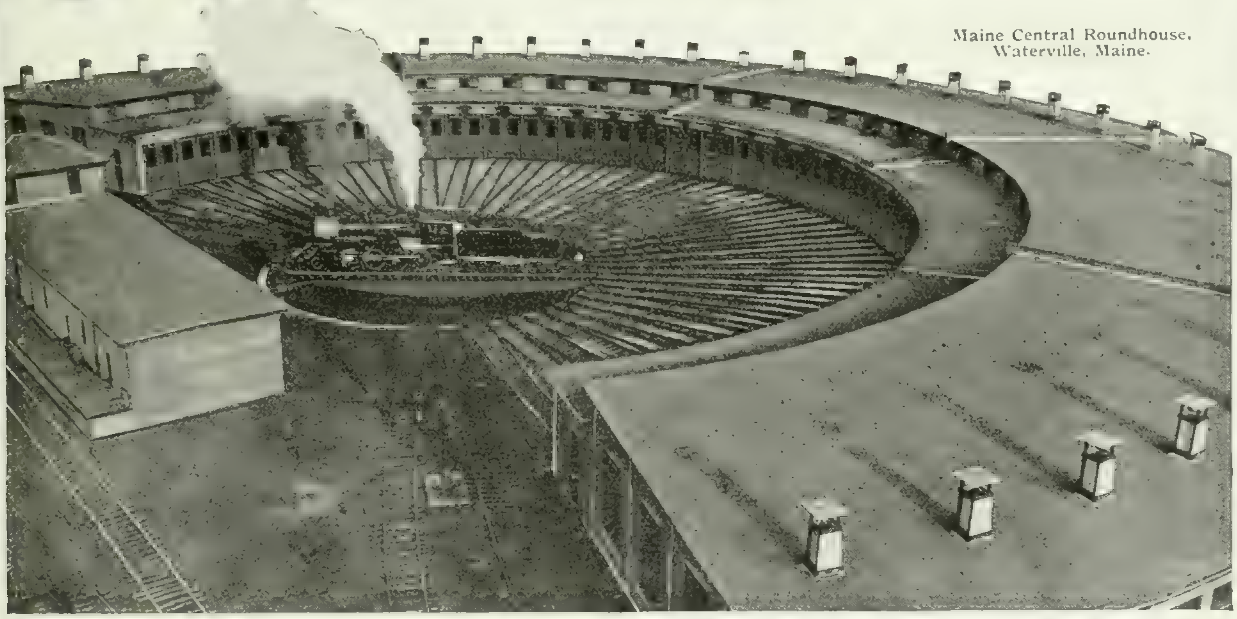
Southern British Columbia.—The Canadian North Eastern Railway Company (the Portland Canal Short Line), has secured the approval of the provincial Minister of Railways for its location plan of the main line from a point 13.5 miles from the town of Stewart to the confluence of Naas and Blackwater Rivers, a distance of about 91.5 miles.

* * *

COPY OF CANADIAN ENGINEER WANTED.

Copies of the Canadian Engineer of April 25th, 1912, are wanted. Parties sending in copies will have the usual extension of one month added to their subscription.

Barrett Specification Roofs



Maine Central Roundhouse,
Waterville, Maine.

THE RAILROAD TEST.

THE hardest kind of a building to roof successfully and economically is a railroad roundhouse.

Such a building is exposed to heat inside, condensed vapor from above and below, as well as acid fumes of coal smoke and the constant dropping of cinders and sparks on the surface. All this, in addition to the ordinary wear and tear of the weather.

Only one type of roofing can stand up under such conditions successfully and that is a Barrett Specification Roof.

Its low cost makes it attractive to begin with and the fact that there is no maintenance expense such as painting or coating, makes the net cost per year of service far below that shown by any other roof covering.

The reasons which make Barrett Specification Roofs particularly desirable for roundhouses make them even more desirable and economical when used on manufacturing plants, warehouses, apartments, in fact, on all flat-roofed commercial structures.

Every architect, engineer and owner should have a copy of The Barrett Specification with tracings for use in future building plans and we are pleased to mail same free on request to our nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

LIGHT, HEAT AND POWER.

Kingston, Ont.—The city council have decided to spend $50,000 on extensions of the steam plant to develop electric power and to extend the city's lines to Portsmouth village.

Kingston, Ont.—The Civic Utilities Commission of this city propose installing a new electric generator. This will necessitate increased steam capacity, including auxiliary, at an approximate expense of $50,000. Mr. C. C. Folger is the general manager of the Civic Utilities Department.

Montreal, Que.—The E. B. Eddy Company has decided to erect a hydro-electric power plant which, when completed, will be one of the largest self-owned industrial power plants in the world. Excavation has already been made, and the concrete retaining walls built for the generating station. The new plant will obviate the necessity of purchasing power from outside sources, and will centralize the entire water power system of the company. The consulting engineer for the project is Mr. Wm. Kennedy, jr., of Montreal, with Prof. L. A. Herdt, of McGill University, acting in an advisory capacity. Mr. Bradley is superintending the excavating and concrete work for the E. B. Eddy Company, and Mr. W. C. Baldwin is the electrical superintendent.

Quebec, Que.—Fire caused by lightning completely destroyed the power plant of the Quebec and Jacques Cartier Electric Company at St. Gabriel de Brandon. This plant, which could develop 2,000 horsepower, gave light to a part of the city of Quebec. The loss is estimated at about $50,000.

Toronto, Ont.—The Toronto Power Company have placed survey parties in the field to locate the towers on the duplicate transmission lines between Niagara Falls and Toronto. Mr. R. J. Fleming is general manager.

Welland, Ont.—Welland town will on August 6 vote for the Hydro-Electric by-law to expend $45,000 on a new lighting system in the town. Thirty-year debentures will be issued to pay the costs of same.

◆

GARBAGE, SEWAGE AND WATER.

Calgary, Alta. — Commissioner Graves is preparing plans for an alternative scheme to the gravity system for pumping water for the city from the Bow River, the cost of [illegible] about $[illegible].

Fergus, Ont.—The municipal council have engaged the services of Mr. Peter Gowan, of Galt, to install a water works in that town.

Ottawa, Ont.—The plans, specifications and estimates for the new civic waterworks purification plant will be ready very shortly for submission to the city council.

Ottawa, Ont.—City Engineer Ker has been authorized to have the necessary surveys made and plans and estimates [illegible] two new units to the city's pumping plant, each of which would have a capacity of at least 8,000,000 gallons per 24 hours.

Ottawa, Ont.—A sanitary survey of the river above Ottawa is being made by men acting under instructions from Dr. Shirreff, medical health officer. He is of the opinion that [illegible] of the city's water supply is due to the unsanitary methods of people living along the river banks, [illegible].

Parkhill, Ont. [illegible]

Port Mann, B.C. Negotiations are being conducted between [illegible]

Toronto, Ont. The Municipal Works Committee are [illegible]

Toronto, Ont. [illegible]

BUILDINGS AND INDUSTRIAL WORKS.

Amherst, N.S.—The management of the Amherst Malleable Iron Company, a sub. company of the Canada Car and Foundry Company, will erect a new building 250 feet by 100 feet.

Berlin, Ont.—D. Lorne McGibbon, president of the Canadian Consolidated Rubber Company, Montreal, announces that his concern has accepted the $25,000 bonus offered by the Town Council to erect a $1,000,000 auto tire plant here.

Brockville, Ont.—It is reported that the management of the Richelieu and Ontario Navigation Company will make extensive alterations to the Frontenac Hotel.

Camrose, Alta.—Rev. T. T. Carlson, as president of the Alberta Norweigan Lutheran College Association, announces that building operations will be commenced in the near future.

Fort William, Ont.—Four by-laws were submitted on July 10th, and all were endorsed. They are as follows:—The Canadian Car and Foundry Co. is to build a plant at a cost of $1,000,000. The A. M. Nanton starch and glue factory is to be erected at a cost of $400,000. The H. D. McKellar Building Co. is to build a plant at a cost of $150,000. The Great West Wire Fence Co. plant is to cost $100,000.

Fort William, Ont.—Mr. J. A. Kilpatrick, general manager of the Canadian Iron Corporation stated that plans which have been prepared for an enlargement of the plant will necessitate an expenditure of about $250,000.

Hamilton, Ont.—Report states that the Bank of Toronto has secured a site on James Street, for the purpose of erecting a bank building. The amount involved in the transaction is $70,000.

Moose Jaw, Sask. — A report states that the Canadian Pacific Railway are making preparations for the erection of a $750,000 depot in this city during the early part of 1913.

New Westminster, B.C.—The management of the British Columbia Electric Railway have purchased a plot of ground and propose erecting a new car shop. The present plant is to be used entirely for the repair of cars.

North Vancouver, B.C.—With the opening up of a means of communication to the large zinc deposits of the Western Dominion Land and Investment Co. at the head of Lynn Creek, there is a possibility that a smelter will be established in North Vancouver for the smelting of the ore and the manufacture of zinc products. It is thought that a plant to cost between $120,000 and $150,000 will be established.

Ottawa, Ont.—Messrs. Grant-Holden-Graham, Limited, a wholesale manufacturing firm of this city, intend to commence soon the erection of a two-story addition to their building. They also contemplate the erection of a new building at a cost of approximately $150,000.

Ottawa, Ont.—The proposal of the Federal Government regarding the erection of additional buildings. The scheme is a very large one as it is intended to erect about six at a cost of $20,000,000. A report states that the Canadian Prime Minister will engage an expert in Great Britain for this work.

Port Arthur, Ont.—Engineers for the Ontario and Western Car Co. are laying out the grounds for the construction of 15 large buildings which will be a part of the equipment for construction of cars.

Port Arthur, Ont.—St. Paul's Presbyterian Church have begun excavation for basement of the new church. Hood and Scott are architects.

Port Arthur, Ont.—The federal government are making preparations for the erection of a grain elevator adjoining the structure of the Canadian Northern Railway.

Port Colborne, Ont.—The Dominion Government propose to increase the capacity of the grain elevator at this point.

Toronto, Ont.—The Government has drawn up plans for the new asylum at Whitby, which will cost approximately $[illegible]. It was [illegible] that buildings will be constructed of [illegible] taken from the provincial prison farm at Guelph.

Toronto, Ont.—Construction work has been commenced on a new dry dock for the Polson Iron Works. Mr. David [illegible] has undertaken the contract of erecting this structure.

48 in. CONTINUOUS STAVE LINE.

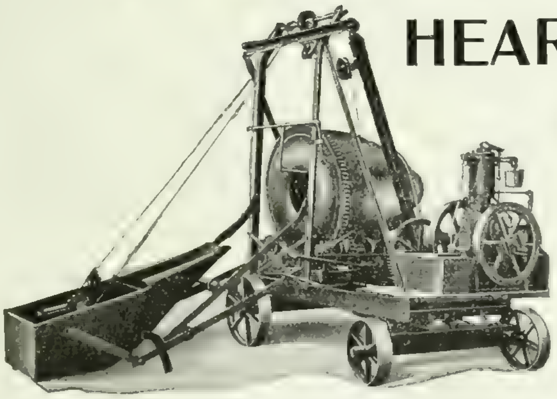
Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

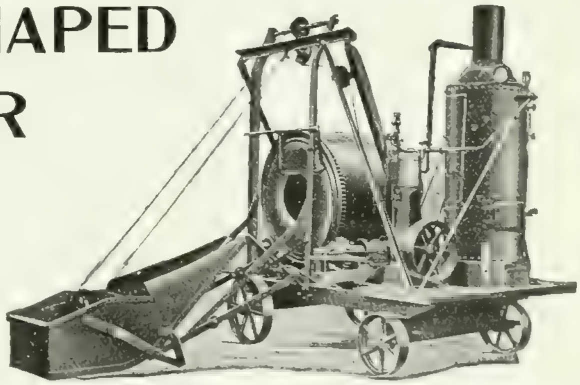
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER
HEART-SHAPED
MIXER



Write for
1912
Catalogues.



A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT
MITCHELL, ONT.
DETROIT, MICH.
BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

Victoria, B.C.—By-laws for the raising of $500,000 for the erection of a new city hall and $715,000 for necessary expenditures for school purposes are under consideration.

Victoria, B.C.—Construction work has started at Granby Bay on the 2,000 ton custom smelter to be erected by the Granby Consolidated Mining and Smelting Co. It is estimated the new plant will cost $1,700,000.

Winnipeg, Man.—The Exhibition authorities have taken definite steps in the matter of additions and extensions to the buildings of the fair grounds for next season. The work includes an extension to Main Street, $30,000; improvements in the Arts and Museum section to cost $12,000; and remodelling the train sheds at a cost of $20,000.

◆

BRIDGES, ROADS AND PAVEMENTS.

County of Wentworth, Ont.—Road Superintendent Taylor, following a trip through Wayne County, Michigan, U.S.A., has advocated the use of concrete roads for this portion of the country. He will seek permission to put down a demonstration road near Stoney Creek at a cost of $1,000 to show the merits of concrete construction.

Toronto, Ont.—The Municipal Works Committee have decided in favor of steel in place of concrete for the proposed Bloor Street Viaduct.

York County, Ont.—The members of the York County Highways Commission made an inspection of the roads coming under the jurisdiction of that body.

The concrete roadway extending along the Lake Shore Road from the city limits to Mimico Creek has been finished. The work on the other thirteen roadways was found to be well advanced.

◆

FIRES.

Chatham, Ont.—A fire at Tilbury destroyed a livery stable, grist mill and the town pumping plant, with a loss of nearly $22,000.

Pictou, N.S.—The plant of the Atlantic Milling Company was destroyed by fire with a loss of $28,000.

◆

CURRENT NEWS.

Berlin, Ont.—The management of the Canadian Consolidated Rubber Company have accepted the $25,000 bonus offered by the town council, and will proceed with the erection of a $1,000,000 plant. D. Lorne McGibbon is president of this company.

Fort William, Ont.—The ratepayers voted on the several by-laws, as follows:

By-law.	For.	Agst.
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
McKellar Bedding Co.	1,495	454
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Water Works Improvements	[illegible]	[illegible]

Guelph, Ont.—The municipal ratepayers voted against a [illegible]

Ottawa, Ont. [illegible]

Toronto, Ont. [illegible]

Toronto, Ont. [illegible]

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending July 2nd, 1912:

An English firm are in the market for supplies of aluminium in flat sheets about 29g, frosted on one side, and would like to hear from Canadian manufacturers.

A London firm of roller-bearing manufacturers wish to get into touch with a first-class firm at St. John, N.B., to represent them there; they are also desirous of being represented at Fort William, Ontario.

From the branch for city trade inquiries, 73 Basinghall Street, London, E.C.:

A London company manufacturing billiard tables would be glad to get into correspondence with Canadian importers.

◆

NEW TECHNICAL PERIODICAL WANTS AUTHORS.

"Steam Machinery," a monthly magazine of men, machinery and methods, intended especially for the lumberman, the contractor, the railroad-builder and the excavator will commence publication before the end of this year.

The magazine will contain departments devoted exclusively to each of the above, and will publish therein articles of interest to those engaged in these various lines.

Contributions of a technical or amusing nature are invited on anything pertaining to the above. All articles submitted must be in typescript, and accompanied by a stamped addressed envelope for return in case of non-acceptance. All articles submitted will be accepted or rejected within a month from the date of receipt.

Accepted articles will be paid for immediately after publication, not at a word rate, but at a rate determined by their interest and value and by the originality of the thought contained in them. The magazine will be edited for the Clyde Iron Works of Duluth, Minnesota, by Charles H. Mackintosh, to whom all articles should be submitted.

◆

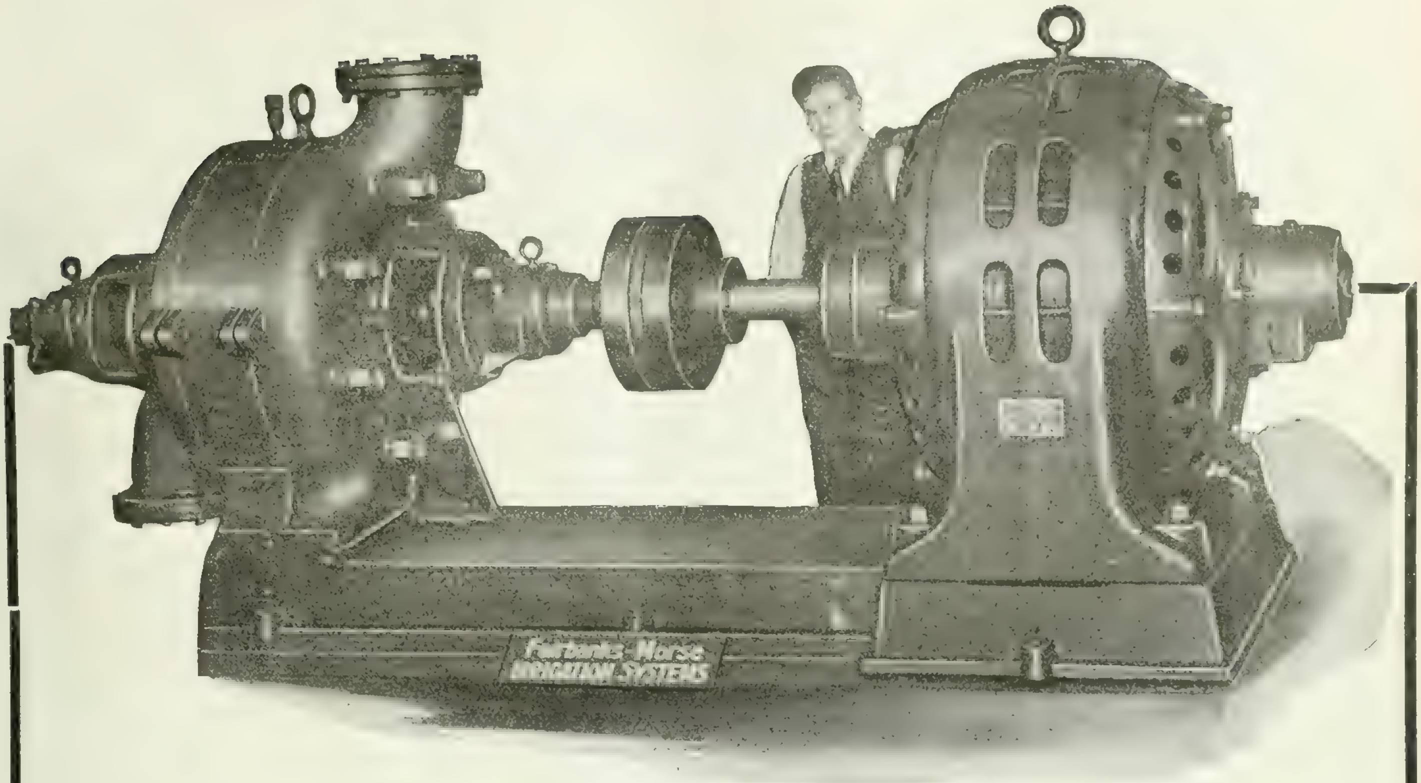
NEW TIMBER MARKS IN WESTERN CANADA.

The timber department of the Provincial Government of British Columbia have issued an entirely new system of private marks for lumbermen, cancelling the old marks as fast as the new marks are given out. In order to put the new system into practice, and to see that it is properly enforced, the department despatched Inspector Wm. Black on the government launch R. J. Skinner for Knight's and Bute Inlets, with instructions to visit all the lumber camps in the north. Capt. Nye was also despatched on a similar errand on the department's launch Kiora, with instructions to visit the camps at Jarvis Inlet, Texada Island, Hornby, Denman's and other islands in the vicinity.

The new system is designed to render less difficult the task of distinguishing the logs cut on licenses, leases, crown grants, etc., and to show which logs are eligible for export and which are not. At present the larger lumber companies are cutting on all manner of grants, leases and licenses, and mark all their logs with the same mark, no matter from which source the logs may come. This causes great confusion, as the royalties and privileges vary with the various terms of leases and licenses, and the department have to largely depend on the word of the companies' employees given on affidavit as to the origin of the various classes of logs.

◆

The municipal council of the city of Winnipeg made an interesting exhibit at the Canadian Industrial Exhibition which proved to be one of the most attractive and instructive exhibits in the fair. There was in operation a complete model of the power plant at Point du Bois, on the Winnipeg River. The water was shown flowing down and operating the turbo generator that keeps the majority of Winnipeg homes supplied with light and other electrical conveniences. Alongside of this demonstration, a large booth has been equipped with all the electrical appliances known to lighten [illegible]



The Largest Direct Connected Centrifugal Pumping Unit in British Columbia.

The Vancouver Power Company have recently installed at their works at Coquitlam Dam, B.C., the largest direct connected centrifugal pumping unit in British Columbia. This outfit is to operate in parallel with a number of other pumps that are to furnish water under pressure for sluicing into place the material for their new dam.

This pump is a 10-inch, class "F," two-stage centrifugal, with bronze inpellers and renewable bronze diffusion vanes. It has a normal capacity of 1833 imperial gallons per minute when operating at 1160 r.p.m. against a total head of 355 feet or an equivalent pressure of 154 lbs. per square inch. It is mounted on a common sub-base with a 300 h.p. type "B," Fairbanks-Morse squirrel cage, induction motor, 2200 volts, 60-cycle, 3-phase, 1160 r.p.m. at full load, being direct connected thereto by means of a flexible leather link coupling

The motor possesses a feature in rotor construction that is unique. The end rings are welded on to the rotor bars by a new process, making a perfect joint, free from the troubles common to the purely mechanical or riveted joint, such as oxidation, working loose, and solder-throwing. This improvement marks a long step forward in the elimination of rotor trouble.

Our Vancouver Branch supplied and assembled this complete pumping unit. We are in a position to quote on the necessary equipment for any pumping requirements on receipt of specifications.

The Canadian Fairbanks-Morse Co., Limited

Fairbanks Standard Scales, Fairbanks-Morse Gas Engines
Pumps Safes Vaults

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

A NEW MANUFACTURING COMPANY.

A new company, Forter and Kilpatrick, Limited, has been formed for the purpose of taking over for the Province of Ontario, the patent rights and the sole right to manufacture sewer pipe with the Thomas Glazed Cement Sewer Pipe Machine. The company has also the sole rights to manufacture and deal in "Trojan" partitions and ceilings, stonewood plastic flooring, "Sorce" asphalt and waterproofing. It is understood that a number of large contracts have already been secured throughout Canada. The headquarters of the company at present are with the Prudential Trust Company, Ltd., Home Bank Building, 8 King Street West, Toronto.

◆

DIMINISHING RAILWAY RETURNS.

Confidence in the ability of a railway company properly to continue its operations and adequately to maintain and extend its facilities depends in greatest measure upon its net operating revenue. This is what is left of the receipts from traffic constituting the total operating revenue, after the operating expenses have been met. As the mileage of the railways tends to increase year by year, an accurate measure is obtained of the operating revenues, operating expenses, and net operating revenue by ascertaining what they have amounted to for each mile. It may be, for example, as was the case in March, that while in the aggregate net operating revenue has increased, it has decreased when measured per mile of line.

Monthly summaries of the revenues and expenses of the steam railways of the United States have been compiled by the Bureau of Railway Economics from the reports filed month by month by the railways with the Interstate Commerce Commission, for the twenty-two months from July, 1910, to April, 1912, the latest month for which returns are available. Net operating revenue per mile of line for the railways as a whole in comparison with the corresponding months of the previous year decreased in eighteen of these months, and increased in but four. The decrease per mile of line per month was as great in amount as $53, and as great in ratio as 15 per cent. The greatest increase for any one of the four months showing increases was $31, or 14.1 per cent. This was in February, 1912, and was exceptional as this month contained one more day than February, 1911. The highest average net operating revenue per mile of line for any one month of this period was $409, the lowest $203.

Seven of the ten months from July, 1911, to April, 1912, show decreases in net operating revenue per mile of line as compared with the corresponding months of the fiscal year ending June 30, 1911; and eleven of the months of the fiscal year which ended June 30, 1911, showed decreases in comparison with the respective corresponding months of the fiscal year ending June 30, 1911. It it therefore evident that the trend of railway net revenue has been downward for the [illegible].

The summary for April, 1912, shows that net operating [illegible] 945, averaged $8.57 for each mile of line for each day in [illegible] year. This is the gross income per mile of line per day before anything has been taken out for taxes, rentals, interest on bonds, appropriations for betterments or dividends. Taxes for April [illegible] per cent.

◆

[illegible] minion.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

16921—June 27—Authorizing G.B. & S. Ry. (C.P.R.) and G.T.R. to operate trains over crossing at mileage 50.5 from Victoria Harbor, account interlocker completed; and G.B. & S. Ry. (C.P.R.) and James Bay Ry. (C.N.R.) at Brechin, Ont., account interlocker completed.

16922—June 28—Temporarily approving G.T.P., C.R.C. No. 10, Standard Freight Mileage Tariff to supersede C.R.C. No. 7.

16923—July 2—Authorizing Algoma Central and H.B. Ry. to open for carriage of traffic its line between mileage 85 and mileage 93, north of Sault Ste. Marie.

16924—July 2—Authorizing Canadian Copper Co. and Algoma Eastern Ry. to open trains over crossing in Twp. of McKim, account half-interlocker completed.

16925—July 2—Authorizing C.N.P. Ry. and C.P.R. to operate trains over crossing on C.P.R. Mission Branch, account interlocker completed, B.C.

16926—July 2—Approving location of C.N.R. through Twps. 24-22, Rge. 1, west 5 M., and Rge. 29, west 4 M., Alta., M. 0.0 to 13.21.

16927—June 29—Authorizing C.L.O. & W. Ry. (C.P.R.) to cross 4 highways, and to divert highways between mileage 165.46 and 165.96, Ontario.

16928—July 2—Authorizing C.P.R. to construct additional track across Queen Street, Port Moody, British Columbia.

16929—July 2—Authorizing C.P.R. to construct its Moose Jaw Southwesterly Branch across highway at mileage 29.75.

16930—June 29—Authorizing G.T.P. Ry. to construct spur to Union Stock Yards, St. Boniface, Man. Crossing of C.N.R. to be protected by interlocker.

16931—July 5—Extending until Aug. 1, 1912, time for putting into effect Order 16479, May 10, 1912.

16932—July 4—Authorizing C.P.R. to open for carriage of traffic its Moose Jaw South Westerly Branch from mileage 27.4 to 35; speed limit of 15 miles.

16933-34-35—June 29—Authorizing Edmonton, Dunvegan and B.C. Ry. to cross 5 highways in Alberta; and approving its revised location through Twp. 55, Range 25, W. 4 M., and to cross highway between Secs. 33 and 34, Twp. 55, Range 26, W. 4 M.

16936—June 28—Directing G.T.R. to construct improved type of electric bell at two crossings in village of Corinth, Ont., 20 per cent. from Rly. Grade Crossing Fund.

16937—June 29—Approving location Kettle Valley Ry. from Penticton to Coldwater, B.C. (Section A).

16938—July 6—Approving location Alberta Interurban Ry. through Sec. 13, Twp. 24, R. 1, west 5 M., mileage 1.25 to 2.28, in city of Calgary, Alta.

16939—July 4—Directing that Vancouver, Fraser Valley & Southern Ry. be subject to penalty of $25 a day after 10th July, 1912, it shall be in default of requirements of Order 16225, April 3rd, 1912, re filing tariffs.

16940—June 29—16941—July 2—Authorizing C.N.O. Ry. to cross two public roads in Twp. of Westmeath, County of Renfrew, Ontario.

16942—June 29—Amending Order [illegible], May 31, 1912, by adding words "and maintain" after word "construct," in 2nd line of operative part of the Order.

16943—June 27—Approving changes in G.T.R. bridges in Township of Tay, to carry railway across public road.

16944-45—July [illegible]—Authorizing G.T.R. to construct spurs to serve Meaford Brick Co., Con. 1, Twp. of St. Vincent, County Grey, Ont., and Alabastine Hardmortar Co., Ltd., Toronto.

16946-47—July [illegible]—Approving G.T.R. plans for bridges 183 and 77, on its Northern and Ottawa Divisions, and [illegible] bridges on its 12th and 15th Districts.

[illegible]—June 29—Authorizing Campbellford, Lake Ont., & Western Ry. to [illegible] railway in the village of Newcastle, and Twp. of Hope, County of Durham, Ont.

[illegible]—July [illegible]—Authorizing C.P.R. to reconstruct two bridges on its Windsor and Ontario S. Divisions, and construct two bridges on its Campbellford, Lake Ont., & Western Subdivision, mileage 180.57 and 0.91, Ont.

[illegible]—Extending until 31st day of July, 1912, time for completion of electric bells by C.P.R. as required by [illegible] C.P.R., [illegible] at Wolverton, Ont., and extending [illegible] time for completion by C.P.R. of [illegible]

[illegible]—May [illegible]—Relieving C.P.R. from erecting and maintaining fences [illegible]

[illegible]—July [illegible]—Authorizing C.P.R. to construct spur for Canada Cement Co., Ltd., under [illegible] Calgary, [illegible], Alta.; [illegible] County of L'Assomption, Que., [illegible] Flour Mills Co., [illegible] Montreal, Que.

[illegible]—July [illegible]—Authorizing C.P.R. to expropriate land for Windsor [illegible]

[illegible]—July [illegible]—Directing G.T.R. to [illegible] at Windsor, Ont., [illegible] County of Essex, Ontario.

[illegible]—June [illegible]—Relieving G.T.R. from [illegible] protecting crossing [illegible] Man.

[illegible]—July [illegible]—Extending [illegible] time for completion of [illegible]

[illegible]—July [illegible]—Relieving C.P.R. from further protecting crossing [illegible]

Volume 23 Toronto, July 25, 1912 Contents of this issue on page 221

The Canadian Engineer

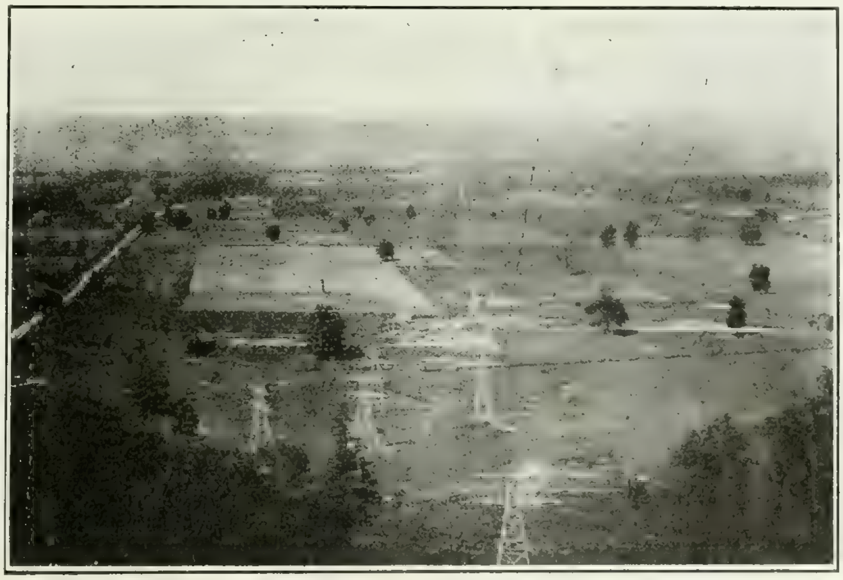
An Engineering Weekly

THE HIGH TENSION TRANSMISSION SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

Description of the System.

The high-tension steel tower transmission system described herein is, perhaps, the most prominent example of high-tension transmission in the world. The system operates at a potential of 110,000 volts, and was designed and constructed by the Hydro-Electric Power Commission of Ontario, a government corporation appointed by the Provincial Legislature to provide for the development, generation and distribution of hydro-electric energy at cost to the various municipalities of the province.

Ultimately, the commission plans to extend its system over the entire province; particular attention being given the central and northern districts, where the available water powers have an aggregate horse-power of more than twice that of the Niagara district, although the latter district is the only one that has been developed to date by the commission.



General View of High Tension Transmission lines in Dundas Valley.

System.—There are 281 miles of steel tower line sectionalized as shown in Table I., and twelve transforming stations. The general map shows the extent of the system.

It will be noticed that while two circuits have been erected in Sections A and B, only one circuit has been erected throughout the rest of the system. The reason for this is apparent upon examination of the accompanying map. All the stations beyond Dundas, with the exception of Toronto and St. Thomas, are on a loop circuit and as a result may be served from Dundas in either direction around the loop. Under normal operating conditions, the direction of current flow is from Dundas to London on the south side and from Dundas to St. Marys on the north side of the loop, the line between St. Marys and London being held in reserve.

The main step-up transformer station of the system is located at Niagara Falls, Ontario, where the energy, purchased from the Ontario Power Company and supplied at 12,000 volts, 25 cycles through a 2,200-foot conduit line, is stepped-up to 110,000 volts for delivery to the three-phase high-tension lines. The present installed transformer capacity at this station is 27,000 kw.

The transmission voltage is later stepped-down to 13,200 and 6,600 volts for local and low-tension distribution at the following sub-stations, the installed transformer capacity being as follows: Dundas, 2,250 kw.; Toronto, 7,500 kw.; London, 3,750 kw.; Guelph, 2,250 kw.; Preston, 2,250 kw.; Berlin, 2,250 kw.; Stratford, 2,250 kw.; St. Marys, 2,250 kw.; Woodstock, 2,250 kw.; St. Thomas, 2,250 kw.; Port Credit, 3,750 kw.

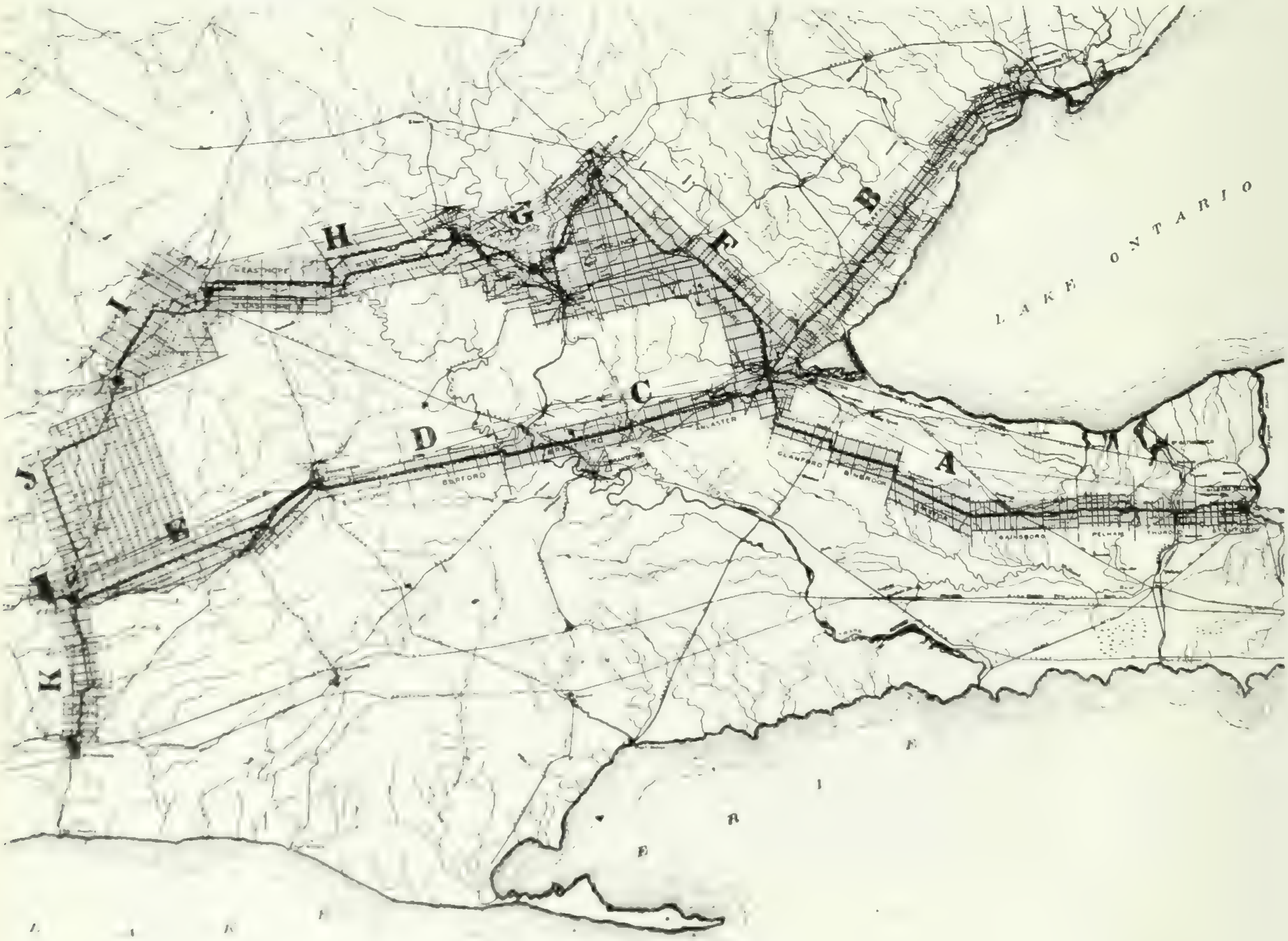
Construction of Line.

Surveys.—The territory embraced by the high-tension transmission system was first covered by reconnaissance to determine the most feasible route for the line. The preliminary examination was performed with the primary intention, wherever possible, of adopting a route parallel to travelled roads, in order to reduce the transportation, maintenance and patrol costs to a minimum. In selecting the route care was also taken to avoid any sections of country subject to electric storms, and some projected and otherwise favorable routes were abandoned as a result of information supplied by telephone and telegraph companies already operating in these vicinities.

After the route has been selected an instrument survey was made. No profiles were, however, necessary; for the towers were located and staked in the field, and the locations

Table I.—High-Tension System of Ontario.

Nomenclature of Sections.	Miles.	Towers.	Circuits at present erected.
Section A, Niagara Falls-Dundas	51.4	Double-circuit	2
Section B, Dundas-Toronto	39.1	Double-circuit	2
Section C, Dundas-Paris	22.6	Double-circuit	1
Section D, Paris-Woodstock	21.8	Double-circuit	1
Section E, Woodstock-London	25.4	Double-circuit	1
Section F, Dundas-Guelph	25.3	Double-circuit	1
Section G, Guelph-Berlin	19.1	Double-circuit	1
Section H, Berlin-Stratford	25.1	Double-circuit	1
Section I, Stratford-St. Marys	13.5	Single-circuit	1
Section J, St. Marys-London	23.6	Single-circuit	1
Section K, London-St. Thomas	13.4	Double-circuit	1



Map of Transmission System.

thus established were plotted on the plans. These plans were employed by the commission while purchasing right-of-way and later by the contractor to locate the towers. The tower locations were staked by small transit parties sent out the line ahead of the construction gangs. They first set a hub marking the centre of the tower base and then two other hubs along the tower tangent marking the centre of two opposite sides of the square tower base. A reference stake was then driven upon which was marked the number, type and location of the tower.

Right-of-Way.—The transmission line right-of-way was acquired through easements, which give the commission the privilege to enter upon property and to construct, maintain, operate, repair and patrol their transmission line for a period of thirty years. Every property owner along the route signed an agreement whereby, for an amount mentioned therein, these rights and privileges were conferred upon the commission. The remuneration included compensation for all trees, houses, barns or other obstructions which were permanently removed from the right-of-way. Patrol rights were purchased only on cross-country sections, since they were not needed where the line parallels the highways. The patrol paths are four feet wide and are provided with light steel gates at intersecting fences.

The commission has the right to renew these agreements at their expiration for an amount equivalent to the original compensation or one settled by mutual agreement or arbitration. This method of acquiring right-of-way dispensed with the necessity for fencing the land beneath the line and also permits of its cultivation.

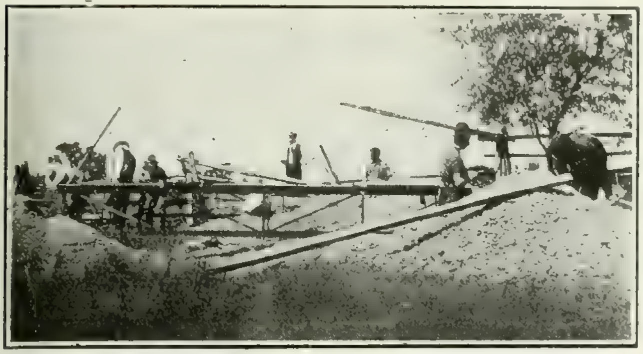


Fig. 1.—Setting of Tower Footing, Showing Templet.

Footings.—The standard tower footings consist of rivetted-steel grillages 28 inches square, embedded in the soil at a depth of about seven feet and horizontally bolted to an eight-foot leg angle protruding from 12 to 15 inches above the natural surface of the ground. Similar footings are employed for long span and corner towers, but the steel is heavier and the grillages are 42 inches square.

The grillages are shop-rivetted and the leg angles bolted to them in the field. The footing steel was not galvanized, receiving instead two coats of special protective paint. Approximately 1,000 tons of footing steel were utilized in the construction of the line.

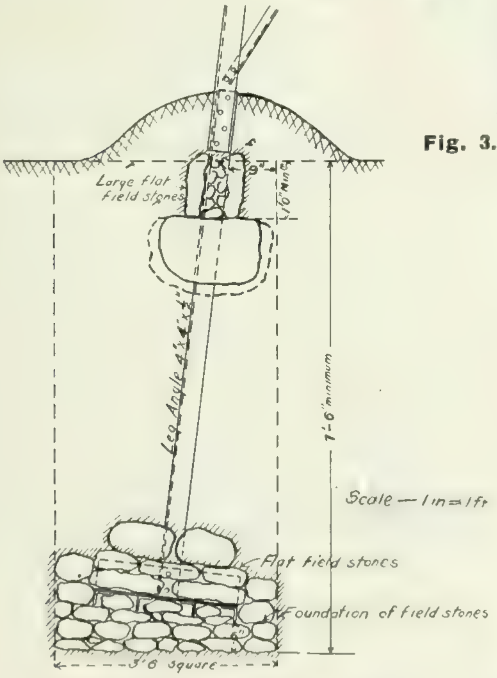


Fig. 2.—Setting of Standard Tower Footing in Earth.

The four footing pits for each tower were blocked out by two men with a light wooden templet from the three hubs previously located by the transit party and a gang of laborers excavated the pits to a minimum depth of 7 feet 6 inches.

Closely following came a gang of twelve men and a foreman. They carried a steel templet with corner posts having the same slope as the leg angles of the towers. This gang placed the footings in the pits, bolted the leg angles securely to the corner posts of the templet, (Fig. 1) lined the templet in with the three hubs set by the locating party, levelled the four sides with a spirit-level, placed the field stones, back-filled and watered the pits and thoroughly tamped the replaced earth with iron tamping bars, as shown in Fig. 2. This gang, under favorable working conditions, could prepare an average of five sets of footings a day. The labor cost on the standard footings in moist or dry soil ranged from $15 to $25 a set. This included the cost of excavation, setting and back-filling.

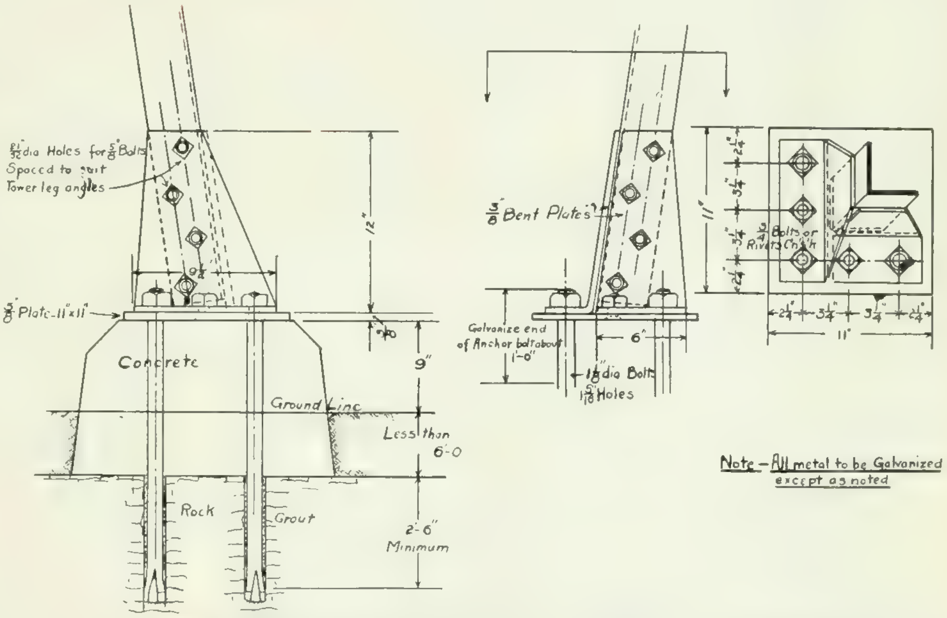

21/32" dia Holes for 5/8" Bolts Spaced to suit Tower leg angles
12"
9 1/2"
5/8" Plate-11"x11"
Concrete
9"
Ground Line
Less than 6'-0
Rock
Grout
2'-6" Minimum
3/8" Bent Plates
Galvanize end of Anchor bolt about 1'-0"
6"
1 1/8" dia Bolts
1 5/16" Holes
11"
2 1/4"
3 1/4"
3/4" Bolts or Rivets Ch'k
Note – All metal to be Galvanized except as noted

Fig. 3.—Tower Footing Where Rock Occurs Less Than 6 Ft. Below Earth Line.

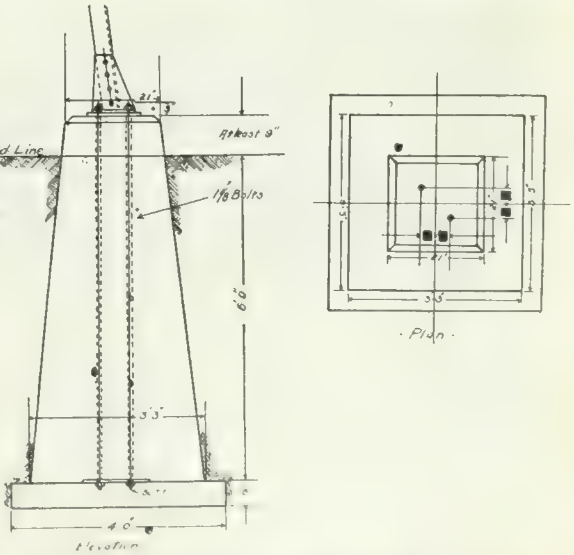


Fig. 4—Concrete Footings for Heavy Anchor Tower.

In locations where quicksand, rock or very wet soil was encountered special construction was necessary and another gang was employed for this purpose. In swamp, where good bottom was within reach, the pits were shored and the soft material removed. The shoring was left in place and the pits refilled to the proper depth with good material. The footing was then set in the usual way. In permanently wet clay or clay loam auxiliary grillages were placed above and below the ordinary steel grillages to further distribute the bearing pressure and increase the upheaval resistance. This auxiliary grillage consisted of two cross-laid spiked layers of four-inch planks five feet in length placed below, and four cross-laid spiked layers of three-inch planks placed above the steel grillages. Where rock was encountered less than six feet from the surface a fox-tailed anchor bolt with pier construction was used (illustrated in Fig. 3). Connections between the lower legs and the anchor bolts were made by means of heavy steel shoes. Where corner towers were placed on long spans, large angles or in poor locations the concrete footings shown in Fig. 4 were used. The cost of this footing, including material and labor on excavation and forms was from $50 to $190, the higher cost occurring in [illegible] [illegible] [illegible] [illegible] [illegible]. The standard steel grillage and leg angles weighed [illegible] pounds per tower, while the [illegible] [illegible] footings weighed [illegible] pounds.

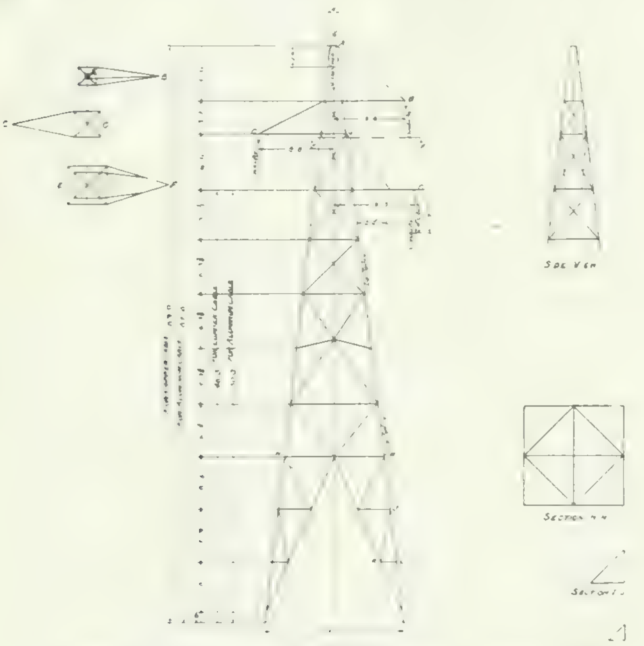


Fig. 5 A.—Standard Single-Circuit Towers.

Fig. 6.—Erecting Tower With Gin Poles.

Towers.—The towers are constructed of open-hearth [illegible] steel and were built from designs prepared by the engineers of the Hydro-Electric Power Commission in competition with designs submitted by the contractors. Sample towers were built from both designs, and [illegible] tests to the [illegible] of [illegible] [illegible] proved that the tower built from the Commission's design was the strongest tower of the two (Fig. 8). This tower withstood, without appreciable injury, a horizontal stress of 20,000 pounds at the centre of the lower cross-arm, and finally failed at 20,950 pounds.

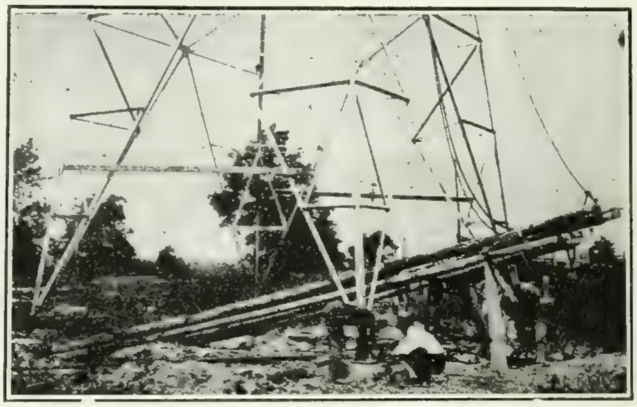


Fig. 7.—Erecting Tower With Shear Legs.

The average cable span length on tangents for level country is 550 feet. This is varied elsewhere to suit topographical conditions. Approach spans to angles in the centre line vary from 400 feet on angles up to 8 degrees, to 100 feet on angles of 45 degrees, the maximum angle turned on one tower. The towers were delivered "knocked down"

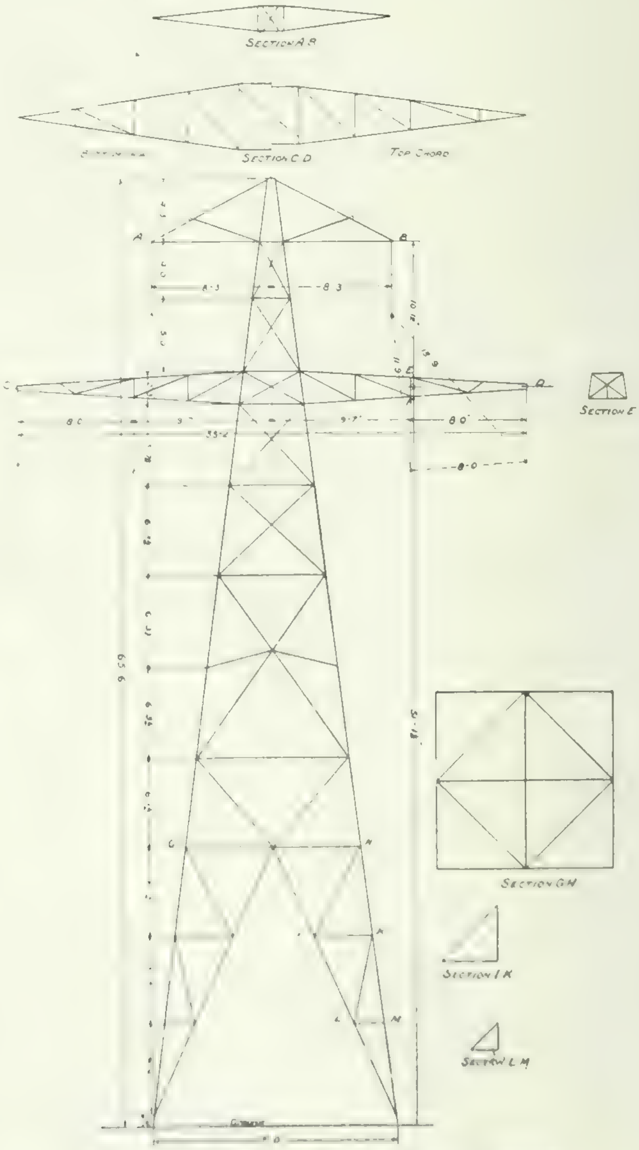


Fig. 5 B.—Standard Double-Circuit Towers.

in bundles to various railway sidings and transported by team to the line. All connections were made by means of galvanized bolts, the required number being delivered with each tower.

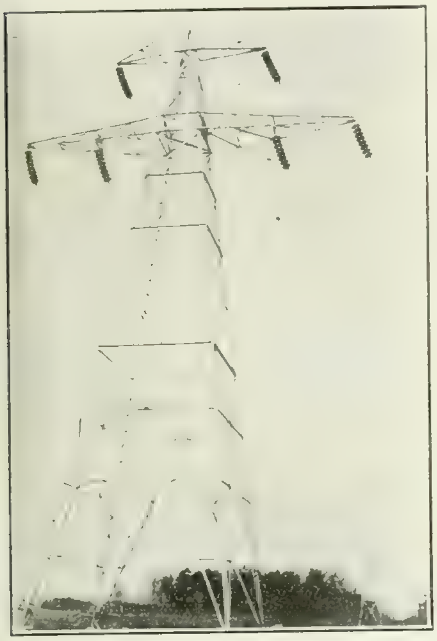


Fig. 8.—Standard Double-Circuit Line Tower.

An assembling gang, usually consisting of eighteen men including a foreman and sub-foreman, followed the footing gang. Two men from this assembling gang went ahead to break out the bundles and lay out the towers on the ground. The main gang assembled the body of the tower, while the cross-arms were assembled by a gang which followed consisting of three men and a sub-foreman. All bolts were drawn tight and the projecting threads burred with a hammer or centre-punch. This assembling gang working winter and summer could assemble an average of three and one-half towers a working day. Under favorable summer conditions from five to six towers a day were assembled. The average winter and summer labor cost for assembling a double-circuit tower was $10; the maximum cost in winter with heavy snow was $24, and in summer with good weather conditions $6.25 a tower. The single-circuit towers were assembled in summer at an average cost of $7.35 a tower.

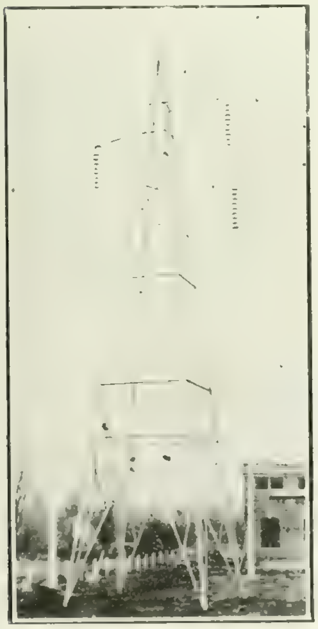


Fig. 9.—Standard Single-Circuit Tower.

The erection gang, consisting of five or six men with a foreman and team, followed the assembling gang. Gin-poles, A-frames and shear-legs were variously employed for the erection of the towers, the shear-leg method, however, was found to be the most satisfactory. (Figs. 6 and 7). The method of erection was as follows: Temporary stiffening struts were bolted to the tower legs; the shear-legs were placed in a vertical position about the centre of the tower base and the toes securely snubbed; a heavy line leading from a set of double blocks was then carried over the shear-legs and attached to the tower just below the lower arm; the blocks were snubbed to "dead-men" and the tower drawn into a vertical position by a team, after which stiffening struts were removed and the tower legs bolted to the footing angles. The average rate of erection under various conditions was about four towers a working day. During the summer and in good country eight towers a day could be erected in straight runs by the erection gang. The average labor cost for erecting double-circuit towers was $4.75 a tower, the minimum cost $2.45. Single-circuit towers were erected at an average cost of $3.50 a tower. All work on single-circuit towers was done in the summer and early autumn.

Fig. 10.—Special Tower, Toronto Entrance.

The double-circuit towers, of the general design shown in Fig. 8, are classified as "standard towers," "line anchor towers," and "corner and long-span towers." General specifications are given in Table II.

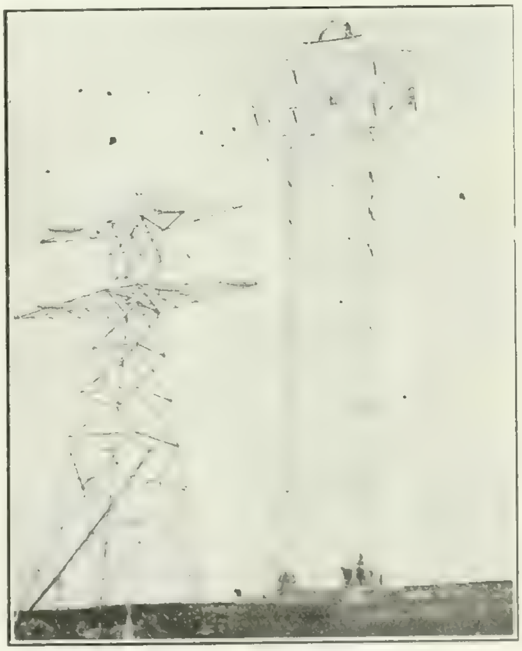


Fig. 11.—Special Tower at Welland Crossing.

In addition to the standards mentioned on the following page, other special towers required were: Twenty-eight double-circuit towers designed to support the lower conductors 50 feet, 55 feet and 70 feet above ground, and employed for crossing high-tension transmission lines; forty double-circuit towers (Fig. 10) designed to give 70 feet conductor clearance above ground, employed within the corporate limits of Toronto; two double-circuit towers giving 150 feet navigable clearance over the Welland Canal, and thirty-six horn-gap towers 19 feet in height at station entrances

The towers used in crossing the Welland Canal (Fig. 11) weighed 25 tons each and were erected on specially designed reinforced concrete footings. The complete system required in all 3,040 towers, and the total weight of galvanized material ordered was 6,200 tons.

Table II.—Specifications for Double-Circuit Towers.

	Standard towers.	Line anchor towers.	Corner and long-span towers.
Average assembled weight, galvanized without footing	3995 lb.	4560 lb.	5020 lb.
Total over-all height	[illegible]	61′ 4″	61′ 4″
Total spread of upper-arm	1[illegible]′ 10″	17′ 6″	17′ 6″
Total spread of lower-arm	35′ 2″	39′ 6″	39′ 6″
Dimensions of base	17′ sq.	18′ sq.	18′ sq.
Height of lower cable suspension from ground	45′	45′	45′
Spacing and insulator con-[illegible]	9′	10′	10′
Minimum distance of cable from tower leg: maximum swing	3′ 6″	5′ 10″	5′ 10″
Total number of towers required	2205	105	176

The single-circuit towers, of the general design shown in Fig. 9 are classified as "standard towers" and "anchor towers." General specifications are given in Table III.

Table III.—Specifications for Single-Circuit Towers.

	Standard towers.	Anchor towers.
Average assembled weight, galvanized, without footing	3200 lb.	3450 lb.
Total over-all height	64′ 6″	67′
Total spread of arms	18′ 3″	18′ 3″
Dimensions of base	16′ sq.	16′ sq.
Height of lower cable suspension from ground	45′	45′
Minimum distance of cable from tower leg	6′	6′
Total number of towers required	[illegible]5	62

◆

LOCK GATES ON THE PANAMA CANAL.

The [illegible] Gatun Locks which are all [illegible] the water [illegible] Gatun Lake [illegible] levels, are being coated with a final layer of heavy lead gray paint. The material for the gates was painted with a priming coat [illegible] it was covered with a coat of red lead, Navy standard; and the third and [illegible] Com-[illegible] the composition of the most satisfactory covering be ascer-[illegible]

SOME NOTES ON BAND CONVEYORS.

By F. Tissington.

(SECOND ARTICLE.)

The following eleven diagrams show different arrangements for these band conveyors.

Fig. 1 indicates a plain horizontal conveyor having the tension end (screw type) arranged at the loading end of the conveyor and the driving gear at the other.

Fig. 2 is a similar arrangement but with two methods indicated for a weighted tension.

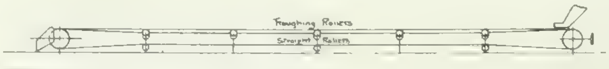


Fig 1

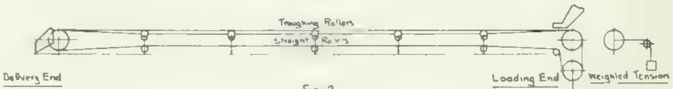


Fig 2

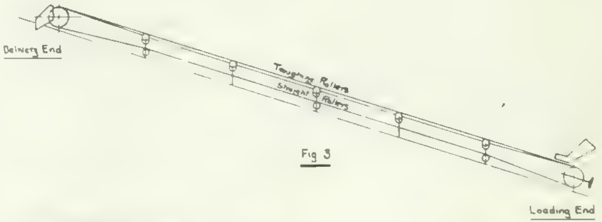


Fig 3

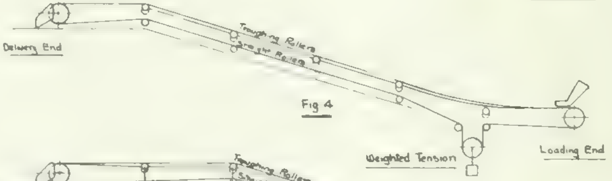


Fig 4

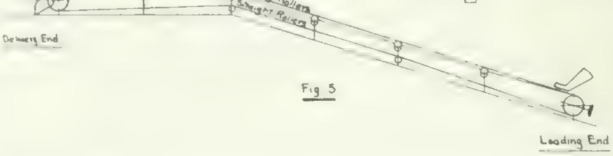


Fig 5

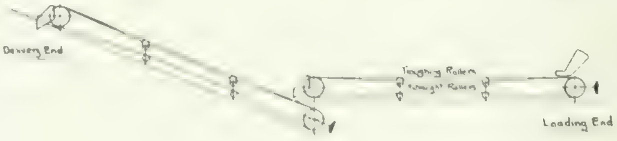


Fig 6

Fig. 3 is an inclined conveyor with driving and tension ends similar to Fig. 1.

Fig. 4 is another type of a combined horizontal and inclined conveyor with one or more loading points and this shows a weighted tension arranged at an intermediate point between the two ends. The pulley at the loading end being mounted in fixed bearings.

Fig. 5 is type of a partly inclined and part horizontal conveyor with a screw tension.

Fig. 6 shows two conveyors, one horizontal and delivering on to the second, which is inclined.

Fig. 7 indicates how the driving gear may be arranged if required to be placed other than at the two ends.

Fig. 8.—This arrangement is a modification of Fig. 6, and, if required, may be driven from one of the pulleys in the centre of the belt.

Fig. 9. This shows an ordinary horizontal conveyor fitted with a throw-off carriage or tripper. The latter may be either stationary or arranged to travel along the length of the belt.

Fig. 10. This is a similar arrangement to the previous one, but indicates that two trippers may be used on the same belt, and if this is done one of them usually has a special spout to return material carried to the band when required.

Fig. 11 shows a reversing conveyor which may be loaded from each end alternately and by means of the tripper the material may be delivered at any point along its length. Other combinations may be arranged to suit any particular scheme, and these diagrams are simply given to indicate a few of the various arrangements that may be made.

Driving Gear.—Usually the first set of gear is supplied with the conveyor, including countershaft and bearings, and the latter, together with the bearings for the drum shaft, are mounted on a combined sole plate, either of cast iron or a short length of I-beam. The terminal pulleys should all be about one inch wider than the width of the band for widths up to about eighteen inches. Above this the extra width should be at least two inches more. This is done in order to prevent the edge of the belt being cut through or getting ragged at the edges, which would probably happen if the belt overlapped the pulley due to the tendency all belts have to travel sideways slightly.

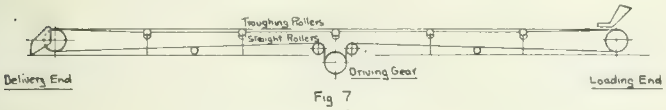


Fig 7

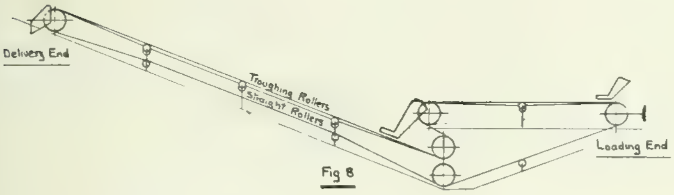


Fig 8

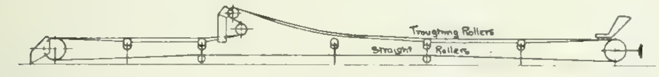


Fig 9

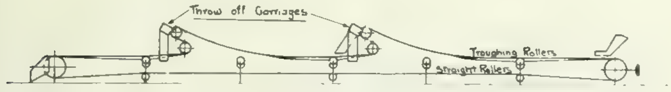


Fig 10

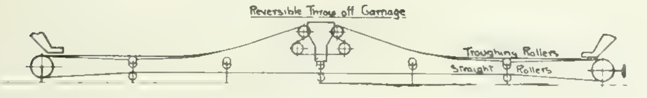


Fig 11

The pulleys may be made of either cast, wrought iron, steel or wood. Cast iron pulleys are very seldom used now on account of their weight and greater liability to damage. The wrought iron or steel rim pulley, with wrought iron round spokes rivetted to the rim, and with a cast iron boss, either solid or split, is the general practice. These give very good results, are cheap, and there is very little danger of breakage, also the weight is comparatively small. For the wider belts it is necessary to introduce double arm pulleys or otherwise put two or three single arm pulleys side by side on the same shaft to make up the width. If, however, this latter is done the pulleys should be faced up in the lathe mounted on the shaft in position in order to produce a true and even surface without ridges.

All wood pulleys are now made in large quantities, are very serviceable, and, further, have the advantage of an increased coefficient of friction, which gives them a slight advantage, but in the writer's opinion this is more than counteracted by the shorter life they possess, especially if used in a damp situation or a moist climate.

Sometimes the pulleys are covered with a rubber face, in order to gain an increase in the coefficient of friction and thereby add to the driving power, and, roughly, it may be said that this gives something like an increase of about 7 per cent. to 10 per cent. over and above the power obtained by the use of a plain-faced pulley.

Like the use of the wood pulley, this practice also has an objection, namely, that if any gritty material is being carried it is likely to get on the underside of the belt, and, sticking in the rubber facing of the pulley, cause rapid wear to take place.

The bearings for the drum shaft can be of cast iron fitted with adjustable gun metal bearings, and provided with large-sized grease lubricator.

Some engineers specify self-oiling bearings of the ring type, but this seems quite a needless expense, for the drum shaft at any rate. These self-oiling bearings are, however, very desirable when the revolutions of the shaft are rather high, which may be the case with the countershaft very often.

Tension Gear.—If this is of the adjustable screw type it is preferable to arrange the screws in tension if possible, and perhaps the best type is the one with the screw fixed in relation to the frame, but free to revolve in bearings and having a nut mounted on the screw, which is located in the pedestals, or filbows carrying the drum shaft. Then the screw is fitted with a small hand-wheel which, on being turned, traverses the bearings along the screw either backward or forward. Occasionally the two tension gears are coupled together with gearing, so that there is no likelihood of one side traveling in advance of the other and so causing the belt to run out of true. This, however, is purely a requirement for which there should be little necessity if the attendant is at all careful.

It was stated in the previous article that there was certainly a great danger of overstressing the fabric with this type of tension gear, and that the weighted tension was likely to give better results. On account of the extra cost, however, these seem to be avoided in most cases, particularly for the narrower and shorter belts.

This other type of tension gear consists of two fixed pulleys (one of which may be the end drum) and one other pulley mounted on a shaft free to travel up and down in guides and loaded with sufficient weight to produce the necessary tension in the belt for driving.

A modification of this can be arranged with one of the drum shafts free to move horizontally to which is attached a wire rope which passes over a pulley and to the other end of the rope are attached weights of sufficient capacity as before. The diameter of the terminal pulleys should not be less than the following:

3-ply belts from 18 to 24 diam., according to width of belt
4 " " 24 to 32 " " " "
5 " " 30 to 36 " " " "
6 " " 36 to 42 " " " "
7 8 " " 42 to 48 " " " "

TABLE I.

CAPACITIES OF TROUGHED BELT CONVEYORS

Material Weighing 125 Pounds per Cubic Foot

Width of Conveyor Belt Inches	Speed, 200 Feet Per Minute.		Speed, 400 Feet per Minute		Speed, 600 Feet per Minute	
	Largest Size of Cube that can be carried. Inches.	Number of Tons Per Hour.	Largest size of Cube that can be carried. Inches.	Number of Tons per Hour.	Largest size of Cube that can be carried. Inches.	Number of Tons per Hour.
10	1½	10	½	25	¼	35
12	2	15	½	40	¼	55
14	2½	25	¾	60	½	75
16	3	40	1	85	¾	125
18	4	50	1½	115	¾	175
20	5	75	2	150	1	250
22	5	95	2	190	1	350
24	6	125	3	250	1	475
26	6	160	3	325	1½	600
28	7	200	4	410	1½	750
30	7	250	4	500	2	900
32	8	300	5	600	2	1100
34	8	350	5	710	2	1300
36	9	450	6	850	2	1500

Material Weighing 100 Pounds per Cubic Foot

Width of Conveyor Belt Inches	Speed, 200 Feet Per Minute.		Speed, 400 Feet per Minute		Speed, 600 Feet per Minute	
10	1½	8	½	20	¼	28
12	2	12	½	32	¼	44
14	2½	20	¾	48	½	60
16	3	32	1	68	¾	100
18	4	40	1½	92	¾	140
20	5	60	2	120	1	200
22	5	76	2	152	1	280
24	6	100	3	200	1	380
26	6	128	3	260	1½	480
28	7	160	4	328	1½	600
30	7	200	4	400	2	720
32	8	240	5	480	2	880
34	8	280	5	568	2	1040
36	9	360	6	680	2	1200

Grain Weighing 60 Pounds per Bushel

Width of Conveyor Belt, inches	16	18	20	22	24	26
[illegible]	2500	3250	4000	4750	5500	6250
[illegible]	3000	4800	6000	7000	8500	9500
[illegible]	28	30	32	34	36	40
[illegible]	7000	7750	8500	9250	10000	13000
[illegible]	10500	11500	12500	14000	15000	19500

Gripping pulleys should never be less than 12 inches diameter, and should exceed the width of the belt by the same amount specified for end pulleys.

Bands.—These may vary from about 10 to 42 inches in width and the general width per ply will average about five inches, although, of course, heavier bands may be required for some conveyors in order to give the necessary strength to transmit the horse-power required. The average weight of rubber covered conveyor belts is as follows:

3-ply .15 lbs. per in. of width
4-ply .20 lbs. per in. of width
5-ply .25 lbs. per in. of width
6-ply .30 lbs. per in. of width
7-ply .35 lbs. per in. of width
8-ply .40 lbs. per in. of width

The tensile strength of rubber belts varies from about 35 lbs. to 60 lbs. per inch width per ply. But for usual practice not more than about 25 lbs. per inch width per ply should be utilized; this being calculated from the maximum tension on the tight side of the belt.

Makers of solid woven cotton belting give the following figures for the average tensile strength and weight:

	Average Tensile Strength Per inch width	Average Weight per inch width 100 ft. length.
Single belt ¼ in. thick......	1,300 lbs.	10 lbs.
Extra stout ⅜–7/16 in. thick..	2,300 lbs.	15 lbs.
Triple ½–9/16 in. thick......	3,000 lbs.	20 lbs.

It would seem that comparing these figures everything was in favor of the cotton belt, but from what has been said before it is evident that the life of the cotton belt is very much shorter, and owing to this, the apparent advantage is lost.

The length of these conveyors sometimes run over 1,000 feet, but usually they do not exceed 500 to 700 feet, and if a longer length is desired it is generally better and cheaper in the long run to split it up into two or more sections driving each conveyor separately.

Endless belts are sometimes made for the shorter conveyors, but in the writer's opinion there is not much to be gained by their use, as they make erection work very awkward in most instances, and further, there are plenty of good fasteners of one sort or another on the market, thus doing away with the necessity for the endless belt.

The ideal fastener is one that develops the maximum amount of strength without forming projections or producing flat surfaces in the bands when passing round the pulleys, as the amount of lost arc of contact reduces the driving power of the belt when it is in this position.

The troughing of the belt should not exceed about 25 degrees with the horizontal, although rollers have been made with inclination as high as 35 and 40 degrees, but unless the belts are very flexible no contact will be made with the middle horizontal rollers, and greater wear will result at the edges of the belt.

Some makers advocate the flat band pure and simple, but this is likely to lead to the use of wider bands to get the required capacity, or else a greater danger of spilling.

The maximum amount of slope or inclination that should be given to a plain belt carrying coal, ore, stone, sand and similar material is about 20 degrees, although 25 degrees may be used in special cases if the material is not of a nature that will slip or roll easily. The former is the safer figure, as an increased inclination is likely to occur owing to the belt sagging between the supporting rollers or idlers due to the weight of material carried. If, however, throw-off carriers or trippers are used the maximum inclination should be reduced to 10 or 15 degrees on the portion of the belt leading up to the top pulley on the carriage, and this may be regulated by placing a set of idle rollers on the back end of the carriage.

The speed of the belt depends entirely on the nature and size of the smallest pieces to be carried. Generally, however, the speeds should be kept as low as possible, consistent with other features, as with high speeds there is a danger of spilling and slipping at the loading end, particularly if the belt at this point is inclined. Further, beyond a certain point it is impossible to obtain a greater capacity in any reasonable ratio of the speed as the material cannot be fed quickly enough to the band and, therefore, the stream thins out. If there is any quantity of fine dust in the material it will be found that about 200 feet per minute is the limit, because, with higher speeds the fine material has a tendency to leave the belt and float in the atmosphere, due to the resistance of the air. If, however, ore, stone, coal or other material in lumps is being handled, 600 feet per minute may be safely used without any bad results.

Large lumps cannot be satisfactorily carried on narrow belts without the danger of a good percentage dropping off, and the figures given in Table I. show the practice adopted by the Dodge Manufacturing Company in this respect.

It will also be noticed that capacities for the different belts are given for two different classes of materials in addition to grain, one of the substances weighing 125 lbs. per cubic foot and the other for 100 lbs. per cubic foot, and that three different sets of figures are given corresponding to 200, 400 and 600 feet per minute belt speed.

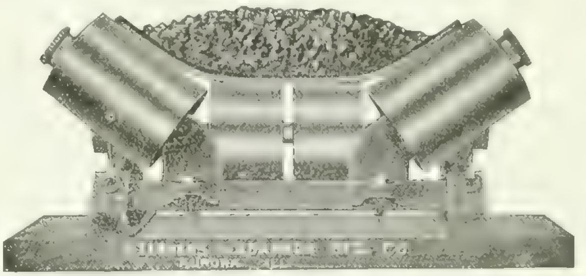


Fig. 12.

It may be said that the most economic designing will be obtained by increasing the width of the belt and keeping the speed at a moderate amount, because it is impossible to load a belt the full width across, and as the amount of clear space will not vary much, whatever the width of the belt, it will be seen that the percentage of lost capacity on this account will be much greater on a narrow than on a wide belt.

Idler Rollers.—The spacing of these should be to a large extent regulated by the material to be conveyed. If the latter is very heavy then the rollers should be put fairly closely together. For most work, however, about four to five feet apart on the carrying side will be suitable for belts up to about thirty inches wide, beyond this they should be about three feet six to four feet. The return strand should be supported about every eight or ten feet, or generally twice the distance of the top rollers.

Both top and bottom rollers should be long enough to leave about one inch margin on each side of the belt for a similar reason to that stated for the end pulleys.

If the top rollers are of the troughing type the design should be carefully laid out to prevent the pinching of the band between the sectional rollers forming a set. That is, no large opening should be left between each section so that the belt can be forced down in between by the weight of the material on top.

The writer has heard of a case where a band was practically cut into two parts longitudinally owing to a circumstance of this sort happening, thus causing a severe loss.

Rough castings for rollers should be avoided. These should either be turned or the rollers made from cold drawn tube and fitted with bearings to revolve on. These latter make a first-class job, and if the parts are made in automatic machines they can be produced very cheaply.

Each set of rollers is mounted on a cross member or stretcher either of wood or steel, and these are generally provided by the contractor, with the rollers all fitted up in position ready for the stretcher complete to be erected in its correct place in the structure. The angle of inclination for troughing rollers has already been mentioned in connection with the band, but should not be confused with the inclination of the whole conveyor with the horizontal. The diameter of the idler rollers is generally from four to six inches, according to the speed of the belt.

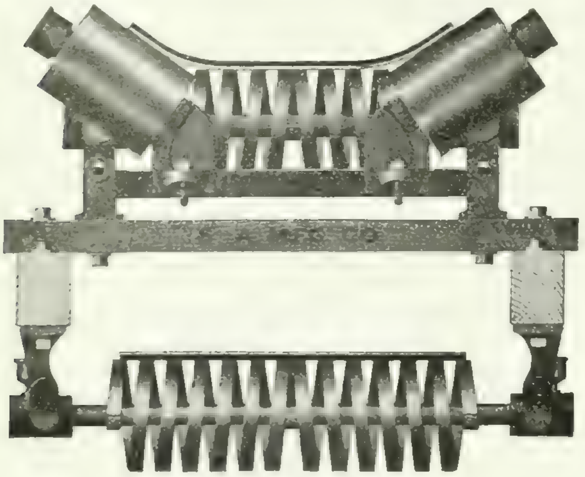


Fig. 13.

Lubrication of these rollers is quite an important item, as the revolutions will vary anything from two to four hundred per minute. A common way to arrange for this is to mount the rollers on a hollow spindle and drill these tubes at right angles at several points along the bearing of the rollers. The ends of the tubes are then closed with grease lubricators of the screw or spring type, which force the grease down the tube and through the holes into the bearings. This leaves the tubes full of grease all the time and practically makes the bearings dust-proof and prevents overheating, as a small percentage rise in temperature will liquefy the grease and cause it to run into the bearings automatically. The length of the bearings or journal of the roller should be of a generous amount to allow for wear, and for most lengths of rollers should be shorter by not more than about 1½ to 2 inches. Thus, for a roller five inches long the bearing should be from three to three and a half inches in length.

Cast iron brackets support the hollow spindles which are secured by means of set screws or other suitable means, and the shape of the bracket will depend somewhat on local conditions and the nature of the stretcher which carries it.

Fig. 12 shows a cross section of the band with the material [illegible] This gives a very good idea of how the belt may be loaded.

Fig. 13 shows a patent carrier troughing roller, the [illegible]

Fig. 14 illustrates a usual arrangement of rollers for a flat belt. It will be noticed that these are of very simple construction.

[illegible]

[illegible] Manufacturing Company, and the writer is indebted to both this firm and the Dodge Manufacturing Company for the loan of the litho blocks given in this article.

It should be noticed that the roller sets shown in the last four figures are mostly made in sections, that is, they are not carried on one set of spindles in a single set of bearings. This enables the troughing rollers to be adjusted easily.

They are quite an important item of the installation, and on them depend to a large extent the proper transportation of the material and the life of the belt.

First and foremost, care should be taken to avoid any direct contact of the shoot with the band itself, as the constant rubbing on this would soon destroy the best fabric. At least one inch clear should be arranged at the loading end and for the delivery end a similar amount, if possible. To properly load the belt the shape of the shoot at the loading point should conform as nearly as possible to the direction of flow of the material at the instant it hits the band. If this is done easy loading and little spilling will be the result.

It will be found a good plan to provide ears on the sides of the shoot projecting along the path of the belt for about eighteen inches to two feet. These will have a tendency to keep the material in the centre of the belt until it has had a chance to settle down into its new direction.

Don't, on any account, try to feed the material on to the band at right angles to the latter, but arrange in such cases for the end of the shoot next the band to be curved round so as to get the flow in the same direction as the belt travels as nearly as possible.

Throw-off Carriages.—These are made in many ways and may be either of the fixed design, hand-gear propelled, or automatic power driven, the power being furnished by the band itself. They are used in cases where more than one point of delivery is required, namely, that at the end of the band. If only one additional point is needed then the stationary type can be used. If, however, it is necessary to deliver into several different hoppers in the line, then the traveling type becomes necessary, and if movement is only necessary at long intervals, the hand-geared traveling type will be found suitable.

Where, however, a small quantity has to be delivered at a number of different points in succession or a continuously moving carriage is necessary, then it will be found more advantageous to use the power driven carriage.

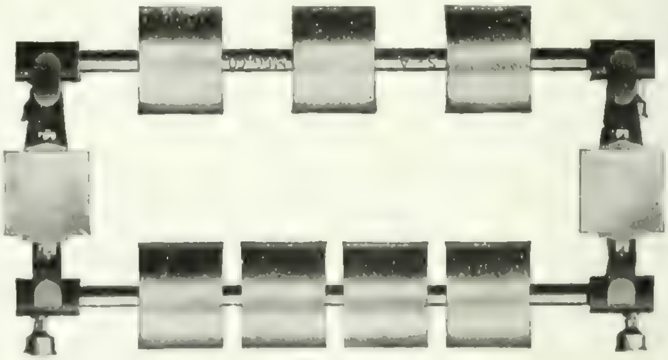


Fig. 14.

It will be an easy matter to settle which of these various types will prove the best for a given set of circumstances. These carriages consist of two pulleys, the shafts of which are mounted on a hinged frame and placed in such a position that it is possible to throw the pulleys clear of the band when they are not required. One pulley is arranged over the band and the other under. When it is required to use the carriage the hinged arm is revolved, the pulley on the top depressing the band and the one underneath raising it, thus making this portion of the band into the form of an ordinary meat hook shape or letter S.

On the carriage is mounted a shoot either of the single, breeches or three-way type, according to where it is required to deliver the material. If it is a breeches shoot, then the two legs straddle the band, the ends of the shoot being deflected enough to allow the band running away from the bottom of the S shape to pass between.

Sometimes the arms carrying the pulleys are not hinged but fixed in the delivery position all the time. In fact, it is possible to make a large number of arrangements to fit any particular circumstance. The traveling carriages are mounted on tee or bulb rails with ordinary flanged wheels to keep them on the track. Fig. 14 shows a tripper or throw-off carriage made by the Dodge Manufacturing Company, and Fig. 15 one by the Stephens-Adamson Manufacturing Company. The latter is of the reversible type.

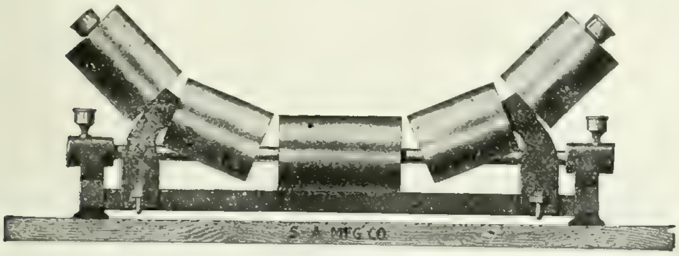


Fig. 15.

Distributors.—Sometimes it is necessary, owing to local conditions, to construct a hopper at the delivery end of the belt of square section, and if the dimensions are fairly large it is then sometimes a problem to utilize the full capacity of the hopper. There are various ways of doing this. For instance, the conveyor can be arranged at a suitable height above the top of the hopper, so that the natural slope of the material will fill it. Or, the conveyor may be run right across the hopper in one direction with points of delivery arranged all along by means of a throw-off carriage.

Or, again, another conveyor at right angles may be put in to divide the hopper into four equal parts.

Another ingenious contrivance consists of a revolving plate on the centre of which the material is fed from the conveyor. The plate is arranged horizontally and due to the action of centrifugal force throws the material outwards as it spins. The speed at which these plates should be run can be found by practical experiment for a particular material. It will readily be seen, however, that they will be of little use for large lumps of material, and for very fine a great deal of dust will be created. The use of these special appliances, however, is determined more by local conditions than anything else.

* * *

Expansion has marked the operations of the British Columbia Electric Railway Company during the past few years, the latest move being the purchase of additional land in New Westminster at a cost of $123,000 for car shop purposes. The company has found it very difficult to get delivery of cars from the manufacturers in the east, and it is proposed to manufacture cars here on a larger scale. With the big system it now has in hand, a very large number of new cars are constantly needed, for extensions are being steadily made and increasing traffic requires quicker schedules on the older established lines, necessitating more cars.

THE HEATING OF BUILDINGS.

A paper entitled "Observations on the Conditions of Guarantees," presented by Mr. A. H. Barker at the summer meeting of the Institution of Heating and Ventilating Engineers held at Southport, dealt with the methods at present in vogue for calculating heat losses from buildings, especially in their relation to the corresponding methods in current use for guaranteeing results.

Calculation of Heat Losses.—The method of determining heat losses now adopted consisted of calculating the amount of heat supposed to pass by conduction through walls, windows, doors, ceilings, etc., adding to this calculated loss another quantity supposed to represent the heat carried away by interchange of air, and estimating the radiating surface from the total number of B.Th.U. so found. The fundamental conditions assumed for the calculation were that the heat delivered to the interior of the room had been continued for so long a time that a constant rate of transmission had been established; in other words, that the amount of heat given by the radiator to the inner air in any one hour was not only equal to that given by the air to the inner surface of the wall, and in succession communicated by conduction from the inner to the outer surface of the wall, and from the outer surface of the wall to the outer air, but also that this flow of heat was constant as between any one hour and the next or any succeeding hour. It was also assumed that there should be no change in the conditions so long as the experiment lasted—that the outside temperature should be absolutely constant and that there should be no wind and no rain. But in practice the conditions did vary, and from this fact alone it followed directly that calculations for rate of heat loss from a room were purely imaginary, that such calculations did not, and indeed that no practicable calculations could, in fact, determine what the rate of transmission of heat actually was at any one time in any circumstances such as ever arose in practice. At the best such calculations only gave what would be the mean transmission in certain imaginary conditions. A still greater difficulty was the effect on the temperature at any one time of the heat capacity of the walls of a building. The amount of heat retained by walls of quite a moderate thickness enclosing a room of moderate dimensions was so considerable that even assuming the whole of the heat given off by a radiator in the middle of the room did not escape but was wholly absorbed in warming up the walls to a temperature half-way between the inside temperature and the outside temperature, it would commonly take several days at full power merely to warm up the walls. Then it was necessary to inquire what was the effect on the temperature of the wall when the outside temperature varied up and down within wide limits as it always did in practice. Obviously the flow of heat into and out of the wall from the inside as well as from the outside would be so irregular that no conceivable process of calculation could determine beforehand what the result would be at any particular time, for the data could not possibly be known in advance. If the exact value of the external and internal temperature throughout a long period of time could be known with some accuracy, the mathematician could probably make the calculation if he had a week to spare to do it in, but in no other circumstances would it be possible, and no person but an expert mathematician could make the calculation at all. Further, the output of heat from the radiator or other warming apparatus in the room was not constant but irregularly intermittent, the furnace was allowed to go down two or three hours during the day, and almost always during the night it was banked up so that it gave off very little heat. This additional factor added enormously to the complication of the problem.

The Question of Guarantees.—The main object of the author was to show how entirely absurd from a practical or scientific point of view were the guarantees which an engineer was accustomed to give to a client or an architect in regard to the efficiency of his apparatus, and how wholly such guarantees were dissociated from the facts and conditions on which the engineer based his calculations. The standard guarantee stated that the apparatus would maintain the room at a temperature of 60 deg. when it was 30 deg. outside. If the engineer was very scientific he added that the rate of interchange of air should not be more than perhaps twice per hour, and sometimes as an additional precaution he claimed that the outside air should be still. The real meaning of the guarantee, strictly construed in accordance with the facts of science, was that if the outside temperature remained constant, the air dry and still, for a sufficient time, say a fortnight, and if the apparatus was maintained at full power day and night all the time, the internal temperature would gradually approximate to a point at least 30 deg. above the outside temperature, whatever that temperature might be. On the other hand, the client expected the guarantee to mean that if at any time within a few hours of starting the apparatus he fixed two thermometers, one inside and the other outside the rooms heated, the latter would read 30 deg. higher than the former, irrespective of conditions. Suppose the outside temperature had for a fortnight been 50 deg., and on the day of the test suddenly dropped to 30 deg., the difference in the temperature of the same room on the two occasions might be 30 deg. if the same apparatus had been continually at work all the time at the same power in each case and although the external temperature at the time of the observations was the same in each case. The difference in the result would be entirely due to the amount of heat retained in the walls of the buildings. Yet of this all-important factor the orthodox calculations and the orthodox guarantee and the orthodox test (if there was such a thing) took no account whatever.

The author's own opinion was that the only satisfactory solution of the problem was that the engineer should guarantee only that he would furnish a scheduled number of B.Th.U. to each room, and that the test should consist of a careful measurement of the temperatures in the flow and return pipes, the surface of the radiator, and the difference between the temperature of the room and of the radiator at the time. The B.Th.U. emitted in such conditions should be calculated from standard co-efficients. When the scheduled numbers of B.Th.U. had been delivered to each room according to this calculation, then and not till then, the en[illegible] weather conditions at the time, and irrespective of the temperature [illegible] B.Th.U. [illegible] guarantee of fuel consumption, and such a guarantee would be [illegible] B.Th.U. [illegible] B.Th.U. [illegible]

client's own responsibility and had nothing whatever to do with the heating engineer as such.

One obvious objection to these proposals was that the client cared nothing about B.Th.U; he only wanted his house warmed to a certain temperature. A client might as well say that he did not mind how much food he paid for; he only wanted his children properly fed. This argument would be all very well if the cost both of apparatus and upkeep was a matter of insignificance, and the heating engineer might very well be held responsible altogether if he were an insurance company who would make an expert examination of the premises with the insurance in view and charge a premium for the insurance. But the trouble was that the lack of understanding of this problem was so complete that at present the engineer took the risk without getting the premium, and very often it was to be feared did not even know that he was taking the risk.

VALUE OF COAL ON A COKE BASIS.

In the course of an address at a meeting of the Waverley Association of Gas Managers, held at Edinburgh on Friday last, Mr. J. W. Napier, of Alloa, raised the question of the buying of coals on the basis of the values of residuals. It was well known, he said, that coals from different seams varied in the percentage amount of what might be termed natural water. If they took the average amount of water present in coals at 5 per cent., this was equal to 13.44 gallons, or 134.4 lbs. of water per ton of coal. A coal with 12 per cent. of water would contain 269 lbs. of water per ton and, compared with the standard of 134 lbs., would show an excess of 135 lbs of water. At 12s. per ton purchase price, the plus quantity of water cost fully 8d. per ton, and this extra charge for mere water was appreciable.

Coke was justly looked upon as the most valuable of all the residuals. With a selling value of 10s. per ton for coke, a difference in yield of 1 to 2 cwts. of saleable coke between different coals made an appreciable difference in the revenue account. The amount of coke produced from coal could easily be determined, even in the smallest works. It required only a weighed quantity of coal to be carbonized in the retort and the coke produced weighed.

In the analysis of a number of coals that had passed under his examination from time to time, in ascertaining the coke produced per ton of coal, he had been struck with the difference between what he might call the "analysis" value and the "saleable" value of the coke produced, and more particularly from nuts and so-called coking dross. For example, one material which gave a yield of 13.1 cwts. of coke, which on analysis showed carbon 96.65 per cent. and ash only 3.35 per cent., would be taken as of excellent value. On putting the material through a trial test in the retort and examining the coke produced, the following results were obtained:—

Saleable coke per ton of coal produced ... [illegible] cwts.
Breeze ... [illegible] cwts.

Percentage of breeze = [illegible]

This [illegible], but the example was valuable as showing the need for ascertaining the absolute market value of the coke. Another example was the following:—Coke per ton of coal, 12.5 cwts.; carbon in coke, 88.71 per cent.; ash, 11.29 per cent. On further examination, to ascertain the saleable amount of coke, the following was the result:—

Saleable coke per ton of coke made ... [illegible] cwts.
Breeze ... [illegible] cwts.

Percentage of breeze = 18.4.

The third example was as follows:—Coke per ton of coal, 12.7 cwts.; carbon in coke, 91.4 per cent.; ash, 8.6 per cent. Examination for value of saleable coke resulted as follows:

Saleable coke per ton of coke made..............	19 cwts.
Breeze " " "	1 cwt

Percentage of breeze = 5.

The breeze was determined by the amount passing through a ¾-inch mesh riddle.

Again, it would be observed that though gas-making material yielded a satisfactory weight of coke, on submitting the coke to a critical examination, a very serious loss to the purchaser would result. With coke selling at 12s. per ton, the breeze at 2s., or a difference in value of 10s., each hundredweight of breeze produced was equivalent to a loss of 6d. per ton of coke, one coke compared with another. It could easily be seen, therefore, how a difference in value of 1s. to 2s. per ton of coal might be brought about from this source alone. He had not referred to the presence of an excess amount of breeze being unsuitable for the working of producers, but this would undoubtedly be the case.

In carrying out the tests referred to the physical character of the coke was noted as of importance, some of the cokes produced being soft and easily broken. Incidental to the amount of breeze produced in gasworks where coke-handling appliances were at work, the physical character of the coke was all-important, as upon this depended the amount of breeze produced, and he had endeavored to show that great loss might accrue from this direction, to which, he ventured to think, sufficient attention had not been devoted. The amount of saleable coke per ton of coal was of vital importance at the present time, not only because of the higher price to be paid for coal, but also on account of the fact that coke might be expected to yield an extra value of about 3s. per ton.

Before departing from the subject of coke, it might be of interest to compare coke made in vertical retorts with what was known as "malting" coke, which realized a high price. The vertical retort coke was produced from the coal ordinarily used at the Alloa Gasworks, and was a sample from a trial test in the experimental vertical setting at Temple Gasworks, Glasgow.

	Vertical retort coke.	Malting coke.
	Per cent.	Per cent.
Carbon	89.20	91.25
Volatile matter	1.05	0.80
Water	0.35	0.15
Ash	9.40	7.80
	100.00	100.00

The sample of malting coke was made from the well-known Bannockburn coal. Malting coke was at present selling at fully 20s. per ton, and vertical retort coke of almost the same quality—as the above analyses showed—should command a high price. This advantage of vertical retort carbonization was best seen by a comparison of the prices of coke produced by that system and coke made in horizontal retorts, selling at only 12s. per ton. He ventured to say that the vertical retort would enhance very much the value of coke, at least in the particular market referred to.

Tar was realizing a high price at present, having increased from 11s. to 17s. per 100 gallons during the last twelve months. The latter price was equal to 2d. per gallon, and the difference in value between coals of high and low yield of tar could at once be appraised.

SELECTION OF ELECTRIC LOCOMOTIVE FOR INTERURBAN FREIGHT HAULING.

In selecting a locomotive and its equipment for interurban freight service, the characteristics of the track, curvature, grades, and the rail weight, strength of bridges, etc., must be considered. The following information is abstracted from a bulletin published by the Railway Department of the Westinghouse Electric and Manufacturing Company. The maximum current which the locomotive can safely take from the substations should be known. It is also advisable to know the probable tonnage to be handled daily in each direction, and at what points it will originate and be delivered. From this information the locomotive can be selected.

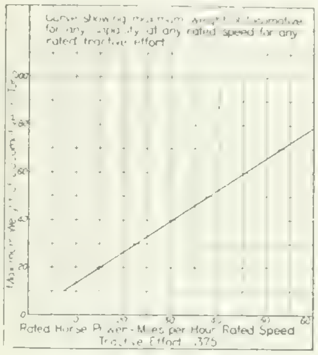


Fig. 1.

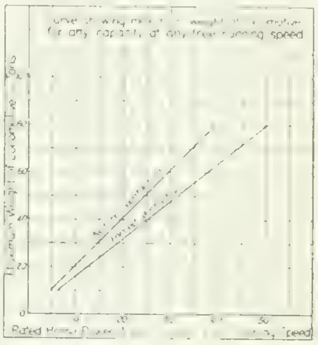


Fig. 2.

The examples given in paragraphs that follow indicate an approximate method of procedure. The curves of Figs. 1 to 7 are used. These give, approximately, maximum locomotive weights and minimum capacities. Results for any specific case may be materially altered by local conditions. In using the curves it should be observed that the gear ratio must be so chosen that the desired speeds will result. In general, the lowest speed gear that an equipment will take is found most suitable for locomotives.

Case I.—Practically Level Road. Horsepower of Motors and Speed in Miles per Hour Known. Find Weight of Locomotive and Trailing Load. Assume that a spare equipment of four 60-horse-power motors is available for locomotive service and that the speed of the equipment at its rated horse-power and voltage is 11 miles per hour. What is the maximum weight of locomotive suitable for this equipment? The rating of the locomotive is 240 horse-power. The rated horse-power divided by the rated speed is 240 ÷ 11 = 21.8. From Fig. 1 it is evident that when the horse-power divided by rated m.p.h. is 21.8, the maximum weight of locomotive is 28.5 tons.

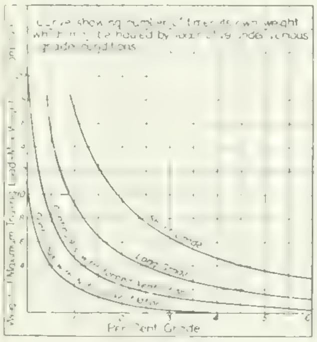


Fig. 3.

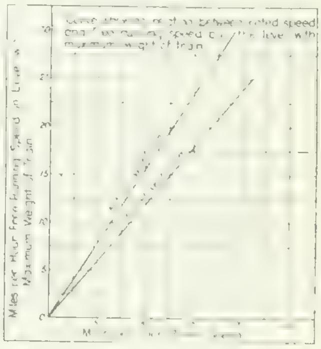


Fig. 4.

The next question is, what load can this locomotive haul? To answer this definitely requires an exact knowledge of the profile of the road. Suppose that the road is practically level except for some over-crossings where there are grades of 2 per cent. for 1,500 to 2,000 feet. The curve for short grades on Fig. 3 is used. At 2 per cent. this curve shows that the locomotive can haul 9.6 times its own weight or the maximum trailing load is about 9.6 x 28.5 which equals 273 tons. The average loaded freight car in many sections is of from 35 to 40 tons gross weight, so it appears that this locomotive can haul seven or eight average loaded cars.

The above determination of tonnage should be checked against the load which the locomotive can handle continuously under average conditions. The assumption was made that the road was practically level. Assume further that the motors are naturally ventilated (no blowers used). The curve on Fig. 3 for continuous natural ventilation shows that at 0 per cent. grade (level) the locomotive will haul 11 times its own weight or 313 tons. Hence, in this case the short 2 per cent. grade is the feature limiting the tonnage. To find the speed running free on the level with the maximum tonnage use Fig. 4. This shows 17 m.p.h.

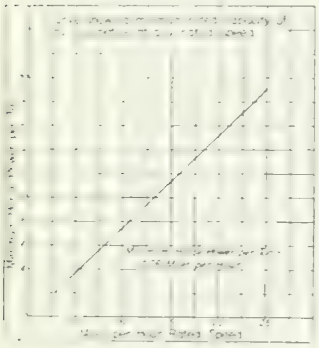


Fig. 5.

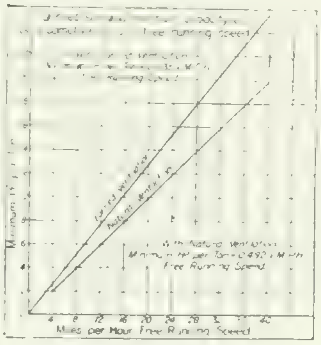


Fig. 6.

Case II.—Rolling Profile. Horse-power of Motors and Speed in Miles per Hour Known. Find Weight of Locomotive and Maximum Trailing Load. Suppose the road is not practically level, but is in a rolling country and that in addition to the short 2 per cent. grades, there are a number of grades of 1.25 per cent., each being from 2 to 2.5 miles in length. Fig. 3 shows that the maximum trailing load on long grades of 1.25 per cent. is 7.7 times the locomotive weight, or 220 tons. If, under these conditions, the two ends of the road have nearly the same elevation, the equipment will probably haul the load of 220 tons continuously with natural ventilation. If, however, the ends of the line have considerably different elevations, forced ventilation may have to be applied or the average load reduced [illegible]

Case III.—Speed and Locomotive Weight Known. Determine Minimum Equipment. Suppose a locomotive with a rated speed of 14 m.p.h. is desired and that the construction of the roadway limits the weight of [illegible] tons. What is the minimum equipment for such a locomotive? Fig. 5 shows that at 14 m.p.h. the minimum rated horse-power per ton is [illegible]. Hence, the rating of this [illegible]-ton locomotive should not be less than [illegible] horse-power and the equipment [illegible] horse-power motors. The performance of this equipment under the conditions pertaining to the road it operates may be determined as previously described. If it is not sufficiently large, more powerful motors may be installed up to the point where the dimensions and weight of the equipment would require a locomotive having a minimum weight of [illegible]

Case IV.—Profile and Trailing Load Known. Find Weight of Locomotive. Assume long and short grades as in Case II. What weight of locomotive will be required to handle 500 tons trailing load? Further, assume that the nature of the road is such as to be equivalent to a continuous pull up a 0.3 per cent. grade. What is the minimum equipment for a locomotive if forced ventilation is used and the free running speed on the level is 12 m.p.h.?

The short grade curve in Fig. 3 shows that a locomotive will handle 9.6 times its weight on the maximum grade. The continuous forced ventilation curve of Fig. 3 shows that on a 0.3 per cent. grade, the locomotive will haul 10.7 times its own weight. Hence, the short 2 per cent. grade fixes the locomotive weight and this should not be less than 500 ÷ 9.6 = 52 tons. Fig. 5 shows at 12 m.p.h. with forced ventilation, the minimum equipment should have 7.6 horse-power per ton. Hence, the locomotive should rate (7.6 x 52) 395 horse-power. The equipment should be four 100-horse-power motors, geared for 10 m.p.h. rated speed and provided with forced ventilation.

The current demand for a freight train depends primarily upon the speed, train weight and grades, and secondly upon the alignment, average weight of car, frequency and duration of stops, etc. The size of locomotive, speed and train weight should be adjusted to the capacity of substations and line in so far as the demands of the traffic will permit. The curves on Fig. 7 will be found useful in selecting the maximum weight of train to be handled within any fixed current limit.

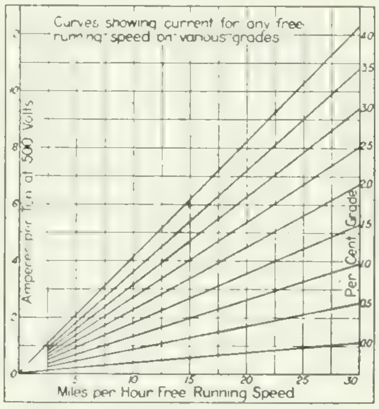


Fig. 7.

Example.—Suppose the maximum grade on a road is 3 per cent. for 1.5 miles and it is so located that all the power for climbing it must be taken from a 500-ampere substation. A speed of 8 m.p.h. is desired on this grade. For such a grade, the substation may work at 50 per cent. overload; i.e., deliver 750 amperes. Fig. 7 shows that at 8 m.p.h. on a 3 per cent. grade 2.5 amperes per ton are required. Hence, the maximum weight of train at this speed is 750 ÷ 2.5 = 300 tons, including the locomotive weight. If 6 m.p.h. were sufficient speed, 415-ton trains could be operated. If 12 m.p.h. were desired, the train weight would be limited to 200 tons. So the effect of speed on power demand is apparent. For any specific proposition, therefore, the choice lies between speed and tonnage in a single train.

* * *

NEW SHAPE OF RAILROAD RAILS TO PREVENT BREAKING.

Engineers of the Harriman lines in the United States have found that the base of a regular 90-pound rail tends to become bowl-shaped in cold weather, and the pounding of the wheels causes surface fractures. By broadening the base of the rail and making it heavier, the breaks are reduced to a minimum. Mr. Kruttschnitt is reported as saying: "We find that the rail with the heavier base gave only two breakages to the 100 miles in the winter months (as compared with [illegible] breakages in the regular rail), the same rate as during the summer months, so that, so far as the Harriman lines are concerned, the rail problem is solved. We feel that we have solved the problem for all the roads."

OZONE: ITS PROPERTIES AND COMMERCIAL PRODUCTION.*

By Milton W. Franklin.

The importance of ozone as an industrial factor in certain lines of engineering is becoming appreciated quite rapidly. The relatively large number of patents which are being applied for the increasing number of advertisements which are appearing and the character and standing of the electrical manufacturers who have entered the field, all point to a realization of Berthelot's prediction that ozone was destined to enjoy a great vogue in its application in the arts and sciences. The commercial future of ozone may be regarded as assured. The many actual applications which have already been made and the numberless fields for its logical invasion, together with recent developments of perfected ozone generators all indicate the growing consideration which this reagent is gaining for itself.

Ozone has been known since 1785, when Van Marum noted the peculiar smell which resulted whenever a static electrical machine was operated, and while its identity was fully established by Schoenbein in 1845 and a method for its analytical determination was developed by the same investigator, it has not enjoyed any extensive application, excepting on an experimental scale, until approximately within the last ten years. This delayed recognition may be attributed to the lack, at the time, or perfected ozone generating apparatus and to the absence of commercial electricity.

The primitive ozone apparatus was designed to produce a phenomenon, the discharge of electricity through air, which, it had been noticed, was ordinarily accomplished by the production of ozone.

It was seen early that the amount of ozone produced in the naked arc, either high or low tension, was relatively small as compared with that due to the brush or "silent" discharge, and the constructional and manipulative difficulties accompanying the production of and operation of static condensers are probably responsible for the introduction of a solid dielectric interpolated between the statically charged plates if the modern ozone generator.

There does not appear to have been any very erudite opinion on the modus operandi of ozone generation among the early designers and the prevalence of the type in question, viz., that with smooth electrodes and solid dielectrics, seems to be due to a desire to produce an electric field of considerable extent, in which the discharge should be uniformly distributed.

It has also been apparent for some time that, at certain elevated intensities, the appearance of noxious nitrogen oxides became manifest, and the objectionable circumstances was ameliorated by lessening the potential difference and increasing the interpolar spacing of the electrodes.

The scientific design of ozone generators as distinguished from the purely empirical method is of very recent inception and its beginning, naturally, is somewhat obscure. There have appeared creditable machines for the purpose, in advance of any theoretical information as to the principal involved.

Production of Ozone: Ozone Generators.—Ozone may be produced by chemical means, by the electrolysis of water and by the action of the electrostatic field on air or on oxygen.

Slow oxydations, as of phosphorous, produce ozone. The process is a curious one and has been studied by Schoenbein, who noticed that when certain substances are oxidized by air a portion of the oxygen combines directly with the substance undergoing oxidation, while another portion of the oxygen forms ozone. Thus ozone is formed during the oxidation of numerous substances. Schoenbein also enunciated the law that precisely the same amount of oxygen is converted into ozone as combines with the substance oxidized. This law has been verified by several other observers for phosphorous, aldehyde, triethylphosphine, turpentine, amylene and numerous other organic substances, and for sodium sulphite, ammoniacal cuprous oxide, etc., in the process of auto-oxidation.

About the only practical application, however, of the chemical production of ozone, has been by means of fluorine. Moisson has obtained fluorine by the electrolysis of anhydrous hydrofluoric acid. Fluorine attacks powerfully all organic materials and decomposes water, combining with its hydrogen to form hydrofluoric acid and at low temperatures, the oxygen forms ozone. The reaction is as follows:

$$3\ H_2O + 6\ Fl = 6HFl + O_3$$

In the preparation of ozone by the decomposition of water by fluorine, the fluorine is introduced in a thin stream into the water which is maintained at a temperature of O°C.

Recent improvements in fluorine generators have made the method practicable but it does not compare in economy with the electrical methods of ozone production.

The Electrolytic Production of Ozone.—Ozone is formed along with the oxygen in water electrolysis. The presence of ozone accounts for the low reading for oxygen obtained when the electrolyte is too strong in sulphuric acid and the current density too high.

The first recorded observation of ozone in water electrolysis was by Schoenbein in 1840. More recently ozone has been obtained by alternating current electrolysis of acidulated water.

In some of the electrolytic processes at Niagara Falls the presence of ozone has been strongly manifest, though there is no recorded mention of its having been used for any industrial purpose.

In the production of ozone by electrolysis, the anode must be of some substance not oxidizable, such as platinum, gold, etc., and the electrolyte must contain no matter which is capable of combining with the ozone.

In certain special applications, ozone prepared by electrolysis seems to be more active and suitable than that prepared by the commoner electrical methods, but the reasons are obscure and the cases uncertain. The method is not economical and has found no general application though higher concentrations are obtainable than by other ordinary procedures.

Electrostatic Production of Ozone.—The common method of ozone production for industrial purposes is by the action of the electrostatic field on air or oxygen.

The types of machines that have been devised are almost without number, ranging from those utilizing the high frequency discharges of the Oudin and Tesla resonators to those making use of the "effluve" or the silent discharge of a leaky condenser with or without solid dielectrics. The variations and the combinations of the fundamental types are too numerous to mention, even, and only a few or the more useful and striking examples will be described.

The ultimate theory of the electrical formation of ozone is still somewhat obscure and it may be said that whatever definite information there is on the subject is rather of a negative than a positive character: e.g., Warburg and Leithauser have shown that the process is not an electrolytic one. The equivalent weight of ozone is 24, and, therefore, if the process were an electrolytic one it would require the electrochemical equivalent, 96,540 coulombs, for the production of one mole, 24 gm., of ozone. In actual practice, however, as much as 130 gm. per kw. hr. has been obtained, which, under the conditions of the operation, corresponds with 240 coulombs only, or the equivalent of ozone has been obtained with about 44 coulombs. This number is far too different from the electrochemical equivalent to be a matter of experimental variation.

---

* A paper presented at the Schnectady meeting of the American Institute of Electrical Engineers, Schnectady, N.Y., May 17th, 1912.

The view is generally held that the process is one of ionization and recombination. There appears a disassociation of the oxygen as soon as the action of the electrostatic field becomes sufficiently intense to cause ionization by collision, and there result numbers of ions from the disassociated molecules. These ions attach themselves to the molecules with which they must inevitably collide and thus form ozone which, on this view, may be composed of aggregates of odd numbers of atoms of the general formula, $O (2n + 1)$.

The relation between the quantity of ozone produced and the quantity of current has been the subject of considerable speculation, but no perfectly satisfactory hypothesis has been advanced. Warburg has advanced the theory that the ozone is formed by those electrons which have attained a certain critical velocity, viz., that at which luminosity ap[illegible].

Ozone is an endothermic compound and, therefore, the equilibrium concentration is greatly increased under certain circumstances, as for example, the influence of the electrostatic field, especially if the temperature is kept low so as to lessen the destructive forces as compared with the constructive forces.

The silent discharge or "effluve" of the French writers, is the conduction of electricity through gases at low and moderate pressure. The phenomena vary with the electrical and physical dimensions, and with the conditions generally, of the electrical and gas pressure. The discharge is quiet and the gas attains a dark violet luminosity. If the pressure is comparatively low the discharge between a point and a plate will be of this nature but the electrical polarity of the point exerts an influence. The discharge between plane parallel or curved concentric surfaces is generally of this character, and when a dielectric is interposed between the plates, the formation of sparks is effectually prevented.

The question as to whether or not a dielectric should be used has been the cause of considerable experimentation and discussion but the general consensus of opinion at present is that the use of the dielectric increases the efficiency [illegible]

Forms of Ozonators.—One of the first ozonators with [illegible] This ozonator (Fig. 1) consists essentially of [illegible] dilute sulphuric acid, and the outer tube, a, [illegible] the sources of current. When the potential difference is sufficiently high there is a luminous silent discharge in the gas in the annular space between the tubes and there is the formation of ozone.

Fig. 1.

The general principles of this ozonator have been retained in some of the later commercial types, e.g., the Gerard ozonators.

The Siemens and Halske ozonators (Fig. 2) consist of a central metallic cylinder surrounded by an annular air space in which the electrical discharge takes place and through which the gas to be ozonized is passed. The outer boundary of the air space is a cylinder, concentric with the central core and in turn surrounded by a water jacket which serves to keep the temperature within proper limits. The potential is applied between the central core and the water surrounding the outer wall of the air space, and the latter may be of glass or of metal. In the latter case there is supplied a lining of glass which forms the dielectric. This type of ozonator has had considerable commercial application and is used in the installations at Wiesbaden-Padderborn, St. Petersburg, etc. The whole oxonator is enclosed in a metallic case which is furnished with inlet and outlet tubes for the air and the ozone.

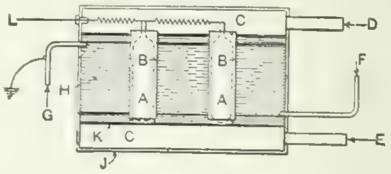


FIG. 2.

A—inner electrode, *B*—outer tube, *C*—ozone space, *D*—air inlet, *E*—air outlet, *F*—water inlet, *G*—water outlet, *H*—water, *J*—outer casing, *K*—partition, *L*—high-tension lead.

The Gerard ozonator has appeared in several commercial forms which differ from each other in minor constructional details. It consists essentially, of two concentric glass tubes about one meter in length; and the outer tube has a diameter of approximately 8 cm. The annular space between the tubes in which electrical phenomena take place varies from three to five mm. in the various modifications. The electrodes are metallic coatings affixed to the outer surface of the outer tube and to the inner surface of the inner tube respectively.

An example of an ozonator without dielectrics is that of De Frise, (Fig. 3). This consists of a trough, semicylindrical in cross section and furnished with a water jacket for cooling. A glass cover closes the trough and from this are suspended a number of semicircular metallic disks which may have smooth or serrated edges. These disks are arranged in parallel planes and are spaced at about one cm. The flat edges are fastened to the glass cover and the curved edges together form a ribbed semicylindrical surface, which, when in position, comes to within five mm. of the bottom of the trough, with which it is concentric. The electrical discharge takes place between the edges of these disks and the bottom of the trough, and the air to be ozonized is drawn through the space which intervenes.

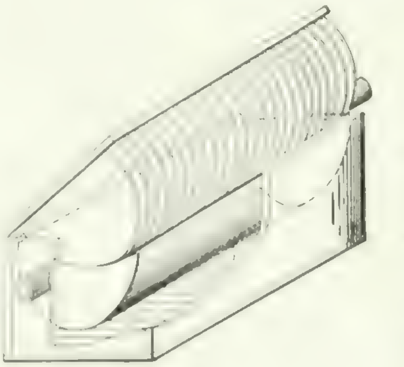


Fig. 3.

There have appeared from time to time, ozonators with devices for obviating the necessity for the solid dielectric. [illegible] has designed several in which the electrodes move with respect to each other, or in which one moves and the other remains stationary. Fig. 4 is a diagram of one of these. It consists of a metallic casing which forms one of the electrodes, and a series of metallic disks mounted parallel on a shaft by which they are rotated. The disks each have two sectoral windows, diametrically opposite each other, cut from them, and when assembled, form the other electrode. The disks are beveled at the edges, and the windows are staggered with respect to the disks which are adjacent. This arrangement assures that if a spark forms at any point, it will be drawn out and ruptured by the rotation of the disks.

Ozonators without solid dielectrics and with rotating electrodes have as yet enjoyed no very extensive application. The absence of the dielectric seems to favor the production of nitrous oxides notwithstanding the precautions to the contrary, and the extra power required to rotate the electrodes does not seem to be compensated for by any corresponding gain in another direction.

Besides the ozonators which have been mentioned there have appeared numerous others, as those of Andreoli, Tisley, D'Arsonval, Tindal, Otto, Vosmaer, etc., but all of the successful commercial types have tended to the same general design, namely, metallic electrodes with smooth surfaces and interpolated solid dielectrics.

All the ozonators which have been mentioned above are for the production of ozone on a large scale and at relatively high concentrations, and are in general intended for the purification of drinking water and for analagous industrial applications. Latterly, however, the subject of purifying and refreshing the air of localities which suffer from overcrowding, inadequate ventilation, and the introduction into the air of the noxious products of industrial activity, has engaged the attention of sanitarians to a considerable extent. From a consideration of the theoretical causes of the objectionable character of such air and the essential properties of ozone it has become evident to many experts that ozone offers a remedy for the conditions, and one which possesses many advantages of simplicity, efficiency and economy. There has resulted, in consequence, the development of numerous ozonators for the specific purpose of treating the air of populated spaces.

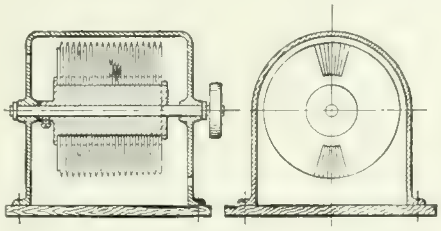


Fig. 4.

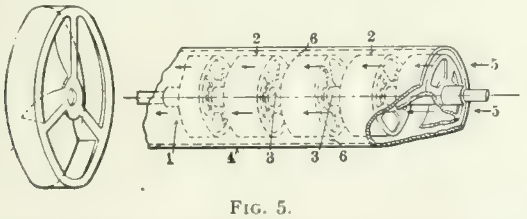


Fig. 5.

1—glass tube; 2—aluminum cylinders, inner electrode; 3—spacing collars, 4—metal coating, outer electrode; 5—direction of air flow, 6—air-gap, 7—enlarged view of 2

The requirements in these small ozonators differ in several important particulars from those demanded in the larger machines. The instruments are, in general, put into the hands of unskilled persons and they must, therefore, be simple, durable, self-contained and automatic to the greatest obtainable degree. They must be small, fireproof, free from danger and reliable in operation, and all of these properties must be possessed in a measure far surpassing that required in the larger machines intended for operation by skilled electricians. Under no circumstances must they produce nitrogen oxides and this prohibition also precludes the employment of means for removing the objectionable by-products after they have been formed in the machine.

Most of these desiderata such as safety, durability, simplicity, space economy, etc., etc., may be obtained by operating at low voltages. To employ low voltages at the frequencies commonly met with in commercial installations, and at the same time to obtain the electrostatic field intensities requisite for the production of ozone, the length of the field in a direction normal to the electrode surfaces must be shortened. This shortening ordinarily has the disadvantage that it lessens the volume of air that may be treated with respect to a given area of electrostatic field and consequently affects adversely the consideration of space economy. Fig. 5 shows a method by which the field has been shortened to a value limited only by the inability of the glass-blower to produce more accurate tubes, without at the same time curtailing the ozone production capacity of the ozonator. The cut represents one form of unit used in the General Electric air ozonators, an assembled machine being shown in Fig. 6.

Referring to Fig. 5, the potential is applied between the metallic coating of the glass tube, 1, and the metallic inner electrode, 2, which is formed of a series of cups of a special design. The electrostatic field is formed in the space, 7, which has a clearance of the order of 0.4 mm. so that with comparatively low voltages the potential gradient may be extremely high. The air to be ozonized is blown along the axis as shown by the arrows, 5, and the peculiar vane shape of the spokes of the cupped electrodes causes a constant intercommunication between the new air and that which has been ozonized in the ozone spaces.

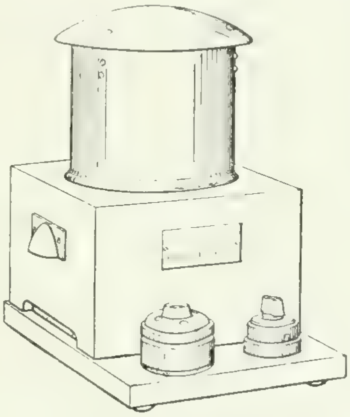


Fig. 6.—Alternating-Current Household Ozonator.

Ozone is an allotropic form of oxygen with the formula O_3, as was established by Schenbein. The nature of ozone was for a long time debated but the researches of Andrews and Tait, Marignac and De la Rive, Brodie, Fremy and Becquerel and particularly those of Schoenbein showed conclusively that when oxygen was converted into ozone, the volume was reduced one-third, and analysis failed to show the appearance of combinations with other elements. Ozone is a faintly bluish gas with a characteristic smell and it was this circumstance that led to its discovery. It has never been obtained in the pure state but it is always mixed with ozygen from which it is derived.

Hautefeuille and Chappuis, on compressing ozone to 125 atmospheres at the temperature of boiling ethylene (— 103 deg.) have obtained a dark blue liquid with highly magnetic properties. The compressed gas above the liquid was also of the same intense blue color, and both the compressed gas and the liquid were highly explosive. When the pressure is removed and the temperature allowed to rise, the liquid soon evaporates.

Ozone is relatively stable at ordinary temperatures when remote from organic or other oxidizable substances, but becomes unstable at elevated temperatures and decomposes into ordinary oxygen. The decomposition is instantaneous at 260 deg.

Ozone possesses enormous chemical activity as compared with ordinary oxygen, for the reason that it parts with the extra atom of oxygen very readily. It is an endothermic [illegible] and the endothermic heat has been investigated by numerous chemists including Berthelot, van der Meulen, Jahn and others. The mean value of the endothermic heat as obtained by numerous methods is 33.380 calories per grammolecule.

Ozone is only slightly soluble in water. Recently, E. Maufang has investigated the subject and found that the solubility of ozone in water is proportional to the temperature and pressure, and conditioned by the chemical composition of the water; a concentration of 1.5 to 10 mg. per liter of water may be regarded as the solubility coefficient at ordinary temperatures (2 deg. — 28 deg.)

The chemical analysis and the volumetric determination of ozone as worked out by Schoenbein in 1845 was the subject of some difference of opinion and discussion, but in 1872, Brodie verified the results and established the theory. Later, 1901, the discussion having again arisen, Ladenburg and Quasig covered the same ground with the same result, though they appear to have been unacquainted with the work of Brodie. Treadwell and Anneler, in 1905, checked all previous results and finally established the correctness of the method of analysis which is now in general use.

The analysis depends on the following reactions:

$$2\,KI + O_3 + H_2O = 2\,KOH + I_2 + O_2 \quad (1)$$

and

$$2\,Na_2S_2O_3 + I_2 + 2\,KOH + H_2SO_4 = Na_2S_4O_6 + 2\,NaI + K_2SO_4 + 2\,H_2O \quad (2)$$

which in actual practice reduce to the following volumetric equation:

$$1\ cc.\ \frac{N}{10}\ Na_2S_2O_3 = \frac{O_3}{20} = [illegible] = 2.4\ gm.\ O_3 \quad (3)$$

The commercial value of ozone consists in the fact that it is so powerful an oxidizing agent that many of the reactions of oxidation which take place with ordinary oxygen only on the addition of heat, may be effected with ozone without previous heating, and in a much shorter time.

The many applications of ozone have been adequately treated in previous publications and aside from the purification of air and water they are of general interest to the chemist rather than to the engineer, and will not be dilated on here.

The fact that there was transacted about seven million dollars' worth of business in ozone apparatus in Europe last year indicates the trend of modern thought with respect to ozone.

* * *

CROSS-TIES USED BY RAILWAYS

There were 9,213,962 cross-ties, costing $3,535,628 purchased in 1910 by the steam and electric roads of Canada. [illegible] per cent. from the number purchased in 1909, due to the decreased purchase of ties for new steam railway lines.

This decrease was general throughout the important species except with Douglas fir. The average cost of these [illegible] an increase [illegible] 1909.

The data upon which the report, compiled by Mr. H. R. [illegible] were [illegible] of Canada. The [illegible] the point of purchase.

[illegible] per cent. of all the ties [illegible]. These were cedar, jackpine and hemlock. [illegible] used in Canada. In [illegible] per cent. in 1909. Nearly all the cedar used is eastern cedar (Thuja occidentalis), as western cedar (Thuja plicata) is too soft for satisfactory use as cross-ties, except for electric lines where the traffic is light.

Jack pine is the second in importance in cross-tie production. In 1910 it supplied 23.5 per cent. of the ties used in Canada, which was practically the same percentage as used in 1909.

Hemlock, supplying 13.8 per cent. of the total consumption, occupied third position in 1910. Hemlock has now for the first time passed tamarack as a tie-producer. The advance of hemlock from the fourth position, which it previously held, is due not to an increase in the use of hemlock, but to a decrease in the use of tamarack. Douglas fir formed 9.6 per cent. of the ties purchased in 1910 as against 4.6 per cent. in 1909. About 232,000 more Douglas fir ties were purchased in 1910 than in 1909. This species was used to a greater extent by both steam and electric railways. Tamarack ties have dropped from third place in 1909, when they formed 19.8 per cent. of the total, to fifth place in 1910, when they formed only 7.1 per cent. In 1910 only 663,922 tamarack ties were purchased, compared with 2,811,820 purchased in 1909. This great decrease of 2,147,898 ties is found entirely in the number used by steam roads, and is due to the fact that the purchase of ties for the eastern half of one of the new transcontinental roads was completed previous to 1910. The above five species, namely, cedar, jack pine, hemlock, Douglas fir, and tamarack, represent 94 per cent. of the total number of ties used. Nearly all the remainder is made up of oak and spruce.

The number of oak ties purchased in 1910 was 264,647, or an increase of 230,258 over the number purchased in 1909. This is due to one United States Railway, operating in Canada, which is using a great proportion of durable woods. Aside from this road the railways of Canada use oak ties chiefly for switch ties. The use of spruce, one of the cheapest ties, has fallen off greatly, 657,871 ties less being purchased in 1910 than in 1909. The decrease in the purchase of spruce is due to the same reason as that ascribed to tamarack.

The remaining species, cypress, chestnut, and white pine, are used to a small extent for ties. All the cypress and chestnut ties and practically all the oak were imported from the United States. Red pine and yellow pine, which were used in 1909, were not reported in 1910. The average price of ties in 1910 was 38 cents as compared with 37 cents in 1909. Of the important woods oak cost the most, 74 cents per tie, and spruce the least, 28 cents per tie. Cedar cost 41 cents per tie, as compared with 45 cents per tie in 1909. Douglas fir cost 30 cents per tie in 1910, or 4 cents less per tie than in 1909. The remaining woods, or all excepting these two, have advanced in price from 3 to 12 cents per tie.

The electric railways used four per cent. of all the ties purchased [illegible] ties were used by electric roads [illegible] an increase of 182,[illegible] cedar and Douglas fir. This [illegible] construction. Nearly 50 per cent. of the total number used were cedar ties at a cost below the average, namely, [illegible] cents.

Douglas fir constituted [illegible] per cent. of the total. Jack pine, [illegible] from the electric railways, was used only to the extent of 0.6 per cent., the ties costing 51 cents each. In steam roads [illegible] per cent. of the ties used were jack pine, and they cost only 33 cents each. Very little spruce and no chestnut or white pine were used in the construction of electric roads. Over [illegible] cypress ties were imported at an average cost of 40 cents each. This is the first report of cypress ties being used for electric roads.

The average cost of ties used in 1910 by electric roads was 41 cents, as compared with 47 cents in 1909. This is due largely to the decrease of 2 cents per tie in the cost of cedar ties and 12 cents in the cost of Douglas fir ties. It is an interesting fact that, although the average tie used by electric roads is smaller than that used by steam roads, the price paid for it is generally greater, viz., 3 cents per tie more in 1910. This is due not only to the disadvantages incident to contracts for smaller quantities of material, but also to the fact that the electric roads are more likely to purchase ties at points where the price includes railway transportation charges. This is shown by the electric roads paying not less than 37 cents for their ties, while many used by the steam roads were bought for 27 cents per tie.

◆

POWER FACTOR, ITS INFLUENCE AND VALUE.*

By D. H. Ross.†

Considerable time has been devoted to the study of load factor and its importance and the improvements this study has brought about have been very beneficial to central stations. But, little attention has been paid to the importance of high power factor and the necessity of including it as a basis of rates which will be fair not only to the operating company, but to the many classes of consumers as well.

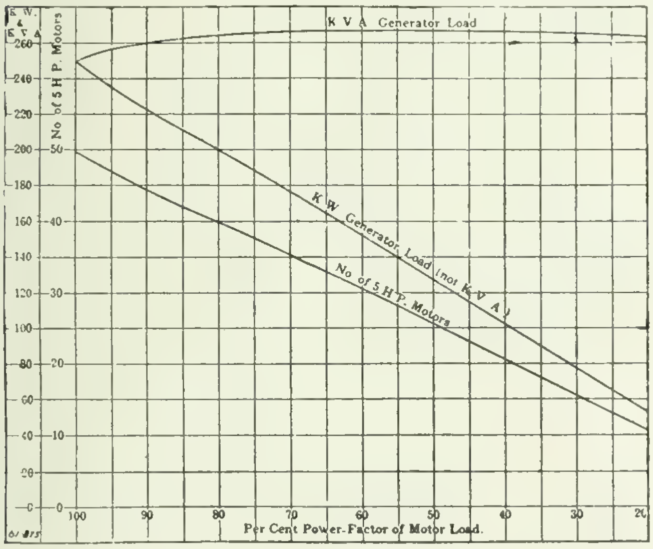


Fig. 1.—Effect of Power Factor on Generator Capacity.

The recent invention, however, of unity power factor motors has turned the attention of the operating companies to the possibilities of saving in cost of service, reduction in over-head charges, etc., to be derived by improving the power factor of their systems. A careful analysis of this subject by the engineering or cost departments of a company will convince the management of the necessity of constant improvement in this respect.

Consider that to supply a given kilowatt load at a low power factor involves:

(1) Unnecessarily large, then hence, expensive generating machines, which are rated according to their current capacity.

(2) Similar expense in generating station, transforming and switching equipment.

(3) Large increase of transmission line, copper cost and distributing transformers.

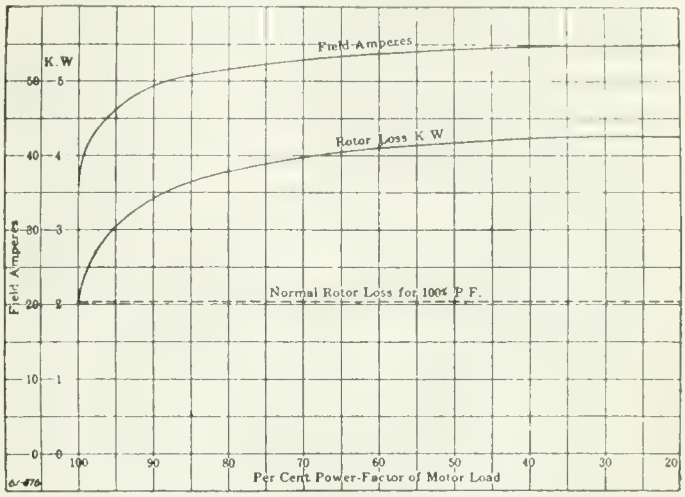


Fig. 2.—Effect of Power Factor on Field Current and Rotor Loss.

(4) Increased core loss in transformers.

(5) Poor regulation of generators on low power factor.

(6) Underloaded prime movers, hence unnecessary capacity and decreased efficiency in their operation at low loads.

(7) Increased maintenance charges due to size and, in many cases, number of units of transformers, switch gear and transmission.

The actual reduction in generator capacity as the power factor is reduced is shown in Figure 1. The lower curve shows the number of 5 h.p. motors which may be operated from a generator of 250 k.v.a. capacity at the different power factors. You will note that at 100 per cent. power factor the generator will drive 50 five h.p. motors, but at 50 per cent. power factor 25 motors only may be carried on the generator and transmission system. Note also that the generator load has increased from 250 to 270 k.v.a., due to the effect of poorer regulation at low power factor.

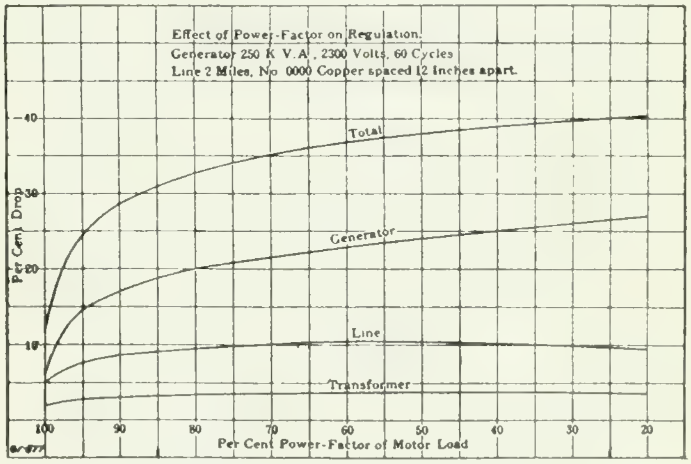


Fig. 3.—Effect of Power Factor on Regulation.

Referring to Figure 2 you will find that not only does the actual productive load to be carried decrease with low power factor, but in itself causes a decrease in efficiency of the generating station, as the field loss is greater owing to the increased excitation, and the exciter sets are either overloaded or larger than is necessary, besides adding to the total loss.

---

* Paper presented at the twenty-second annual convention of the Canadian Electrical Association, Ottawa, June 19-21, 1912.

† Of Wagner Electric Mfg. Co., of Canada.

Figure 3 clearly shows the serious effect of power factor on the regulation, and it is interesting to note that while the slightest increase in power factor is highly desirable, it becomes increasingly important as unity is approached.

From these considerations it is evident that power factor and costs of service are very intimately related, the cost depending almost proportionately one on the other in a water power development and also in a steam plant, except for the extra cost of coal. Should not, therefore, all rate schedules contain a power factor clause which would require the customer with the low power factor to pay for the increased losses and investments as previously listed? The customer when he finds it to his advantage will install high power factor apparatus, and will pay an equitable amount for the power he receives. This state of affairs has been made possible by the production of a unity power factor motor.

This motor, which has been recently placed on the market by a well known manufacturing firm, is unique, and marks a radical step forward in the design of single phase motors.

Note Figure 4, showing the normal running curves of the motor. The power factor is most interesting. You will note that running idle, the motor draws a leading current of 30 per cent., which falls off rapidly as the load comes on, and is practically unity from half load to load and a half. In cases where it is desired, this motor can be connected over compensated, i.e., it will give a leading current of 5 per cent. to 10 per cent. at full load, and 40 per cent. to 50 per cent. running idle. Note also that the slip is practically negligible, being about 1½ per cent. at full load.

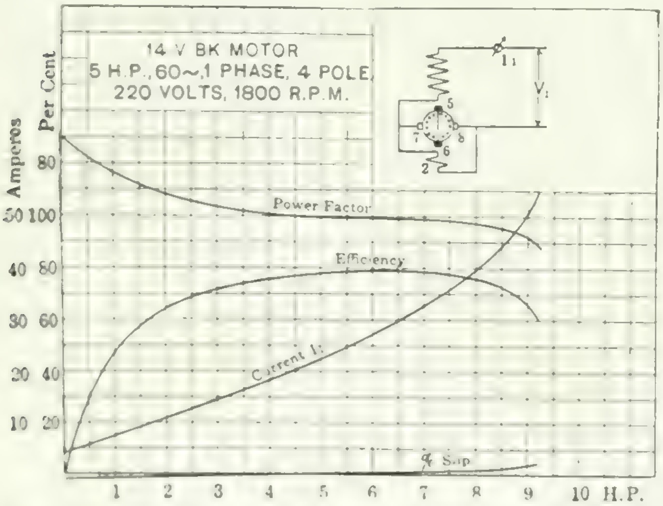


Fig. 4.—Type B K Wagner Motor Normal Running Curves.

Figure 5 shows the comparison of speed torque curves of the Arnold and unity power factor motors. It is interesting to note that while the torque at the instant of starting [illegible] start, which the Arnold type motor will not do, owing to the torque falling off rapidly as the speed increases. [illegible] This motor is not radically different in operation from the [illegible]

[illegible]

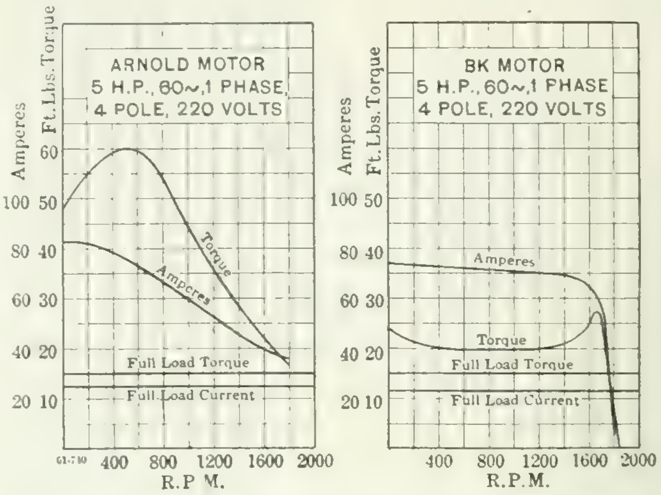


Fig. 5.—Comparison of Torque Characteristic Curves of Arnold and Unity Power Factor Motors.

portance of these unity power factor motors will be inestimable as a means not only of saving to the central station in installation, maintenance, metering, etc., over a polyphase installation, but maintaining a system of practically unity power factor.

This paper is not attempted as a treatise on this subject, rather as a rough outline which may serve to promote valuable discussion among the members interested in central station economies.

CALGARY'S NEW UNIVERSITY.

Mr. Dunnington Grubb, the Toronto landscape artist who is associated with Mr. Mawson, the English landscape artist in several projects, was recently in Calgary with landscape sketches of the grounds and buildings of Calgary University which provide for the building which, when completed, will provide accommodation for students for many years to come when the population of the province has more than doubled, and which when completed will cost $15,000,000.

Two magnificent sketches prepared by Mr. Grubb show the main building of the university to be in a line with Eighth Avenue. The arts block, library museum, dormitories and the residence of the professors is also provided for in the plans and are laid out with the greatest of care and skill both from utilization and artistic viewpoints. Work on the coonstruction of the building will be commenced as soon as the plans are approved by the building committee. This building alone will cost $5,000,000.

The university will have a campus of 30 or 40 acres and an athletic field of seven or eight acres on which a stadium in amphitheatre shape will be placed with capacity for several thousand spectators.

Several attractive drives and walks have been arranged for in the plans and they also call for handsome flower beds and other plots for outdoor ornamentation.

CANADIAN INDUSTRIAL EXHIBITION, WINNIPEG.

A visit should be paid to the Canadian Industrial Exhibition at Winnipeg, one of the finest exhibitions on the continent. The prospects are for a better show than even that of last year, which is strong testimony to its merits and attractions. The exhibition will be in full swing until next Saturday.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc. Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc. Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:
One Year **$3.00** (12s.)
Six Months **$1.75** (7s.)
Three Months **$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."
Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.
Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.
London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, JULY 25, 1912. No. 4

CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Faculty of Applied Science and Engineering of the University of Toronto 221
United States Railroads in Canada 222
Steel Industry for British Columbia 222

Leading Articles:

The High Tension Transmission System of the Hydro-Electric Power Commission of Ontario .. 201
Lock Gates on the Panama Canal 206
Some Notes on Band Conveyors 206
Value of Coal on a Coke Basis 212
Selection of Electric Locomotives for Interurban Freight Hauling 213
New Shape of Railroad Rails to Prevent Breaking ... 214
Ozone, Its Properties and Commercial Production .. 215
Cross Ties used by Railways 218
Power Factor; Its Influence and Value..... 219
Calgary's New University 220
Canadian Industrial Exhibition, Winnipeg 220
Irrigation Project of the Canadian Pacific Railway in Alberta 225
Curves in Track and Grade Resistance 228
Contract Obligations in the Steel Trade 229
Hydro-Electric Station at Gatun Spillway 231
The Canadian Niagara Power Company 234
Personal 235
Coming Meetings 236
Engineering Societies 236
Market Conditions 24-26
Construction News 67

THE FACULTY OF APPLIED SCIENCE AND ENGINEERING OF THE UNIVERSITY OF TORONTO.

The growth of engineering education has been tremendous during the last twenty years, and particularly in the last ten years. From departments of comparative insignificance in University curricula the faculties of engineering have become so important that they are now taking first place in the minds of university authorities. The Faculty of Applied Science and Engineering of the University of Toronto very well exemplifies this growth and change of sentiment. In a recent article by Prof. H. E. T. Haultain, of that Faculty, on "Mining and the University," a résumé of the history of the Faculty was given. It affords most interesting reading. Perhaps the most striking feature of the article is the emphasis laid on the work done by the present Dean of the Faculty in developing the different courses which are now the several departments of the Faculty's work.

Dean Galbraith was appointed Professor of Engineering in 1878, and for the first few years of the School's existence he did all the engineering teaching. It is a noteworthy fact that the main features of the course, as then laid down, still control the policy of the Faculty. As Professor of Engineering, Dean Galbraith held that the practice of engineering should be learned in the field, and that the course in the School should consist of a groundwork of pure mathematics, and a broad training in principles, followed by illustrations of the applications of the principles. He believed, and has consistently followed his belief in directing the trend of development, that everything should be made subservient to the idea of the application of principles. His oft-reiterated statement: "We do not make engineers; we prepare them to become engineers," is worthy of record.

The consistent growth and the wonderful success of this department of the work of the University of Toronto is largely due to the man, John Galbraith. Too much credit cannot be given him when one knows of the early struggles of the School before it became an integral part of the University. On the placing of the School of Practical Science under the University of Toronto, Professor Galbraith was appointed Dean. Of the men who have been associated with engineering education in Canada, he is, without doubt, the outstanding figure. He ranks as an engineer, as he does as an academician and educator. The report of the Royal Commission on the Quebec Bridge stands to the credit of Mr. Holgate, Mr. Kerry and Dean Galbraith. With such a record of achievement, it is hard to understand the attitude of the Board of Governors of the University of Toronto as shown in their last report. There we see that several others of the University staff are getting salaries far larger than that allotted to the Dean. Aside altogether from his personal record, the position of head of one of the most important faculties of the University demands recognition at least equivalent to the other members of the University staff. When this question was brought to the attention of the Board of Governors recently, they stated that the present financial condition of the University would not allow the matter to be adjusted. It is hard to understand their position in this matter when it is remembered that on the first of June last the Professor of Biology was allowed to retire, in full health, five years before his regular time, and was allotted an annual allowance of nearly three-quarters of the Dean's present salary. Certainly in giving this $14,000 the University did not feel in very straitened financial circumstances.

UNITED STATES RAILROADS IN CANADA

A despatch from New York states that Newman Erb, president of the Minneapolis and St. Louis Railroad, has left for a trip, during which he expects to complete the incorporation of a new company to build branches to the Canadian border. The southern terminal of the new line is to be Watertown, S.D. Plans for these extensions, which, it is said, will eventually mean a new Canada-to-the-Gulf line, by a connection with the Missouri, Kansas and Texas, were interrupted some time ago by the sudden death of Edwin Hawley. This is another reminder of the growing and natural tendency of United States railroads to extend to Canada, and vice versa. The United States railways have 1,485 miles of track in Canada, while the Canadian railways have no less than 7,197 miles of track in the United States, divided as follows:—

	Miles.	
Grand Trunk Railway—		
Grand Trunk Western Railway	336	
Detroit, Grand Haven and Milwaukee Railway	191	
Toledo, Saginaw and Muskegon Railway	116	
Cincinnati, Saginaw and Mackinaw Railway	53	
Pontiac, Oxford and Northern Railway	100	
Central Vermont Railway	612	
Island Pond to Portland	150	
Detroit and Toledo Shore Line Railway	78	
		1,636
Canadian Northern Railway—		
D.R.L. and W. (Fort Frances to Duluth)	170	
		170
Canadian Pacific Railway—		
D.S.S. and A. System	614	
Soo System	4,295	
Spokane International	140	
Sumas to Seattle	125	
Megantic to Vanceboro (Maine)	217	
		5,391
Total		7,197

The Grand Trunk had a big fight to obtain admission into New England, but its efforts were successful. The main purpose of extending that road into the rich traffic territory of New England is, according to the Grand Trunk's own contentions, to balance their business between the Eastern and Western States. The Grand Trunk's double track main line lies across Canada like an arm, the elbow at Montreal, the forearm across Ontario, the hand upon five fertile and productive States, with Chicago, the great traffic centre, in its palm. The fingers of this hand are the feeders, which will bring through this American gateway the traffic of the West, the North-West, and the South-West. The trend of this traffic, eliminating the Grand Trunk, is to the Atlantic seaboard. With the system, the traffic organization, and friendly connections at Chicago, the Grand Trunk gathers a vast volume of the freight and carries it eastward across Canada. When they do this they contribute not only to the earnings of the Grand Trunk, but to the prosperity of the Dominion.

The interchange of traffic in the two countries recalls the suggestion of the late Judge Mabee, when chairman of the Dominion Railway Board that an International Railway Board should be formed. The Canadian Minister of Railways has correspondence with the United States government on this matter. It is [illegible] that importers on both sides of the line are often compelled to pay two local rates, one to the border from the place of shipment and the other from that point to destination. Under existing conditions neither the Canadian Board nor the Interstate Commerce Commission has power to make a through rate, and it was suggested that an International Board be formed, made up of members from the two boards mentioned, and that this international body be given power to make through rates. A draft arrangement was discussed on both sides of the border. To this proposed agreement the railway companies took exception. There are prospects, however, that the consideration of the matter will be continued by the two governments concerned.

◆

STEEL INDUSTRY FOR BRITISH COLUMBIA

The opening of the Panama Canal will develop the coal industry in British Columbia. That in turn may draw greater attention to the iron deposits in the province, and later mean the establishment of iron and steel works on our Pacific coast. Important bodies of high-class magnetite are known to exist, the most familiar being Texada Island, Bugaboo Creek, on the west coast of Vancouver Island; at Qwinsam, near Campbell River, and on Louise Island, of the Queen Charlotte group. Of these, Texada Island is considered the most important, as the quality is high grade and as the quantity is large. Its situation is such that with moderate equipment it could deliver ore on ship at tide water at a very low figure, possibly not to exceed 70 cents per ton. At Quinsam a crew has been kept on development all winter. Little has been done on the other properties, but mining engineers had spoken highly of them, both with respect to quality and quantity.

In the opinion of Mr. R. R. Hedley, one of the foremost mining experts in Canada, and a particular authority on British Columbia, the building of a plant on our Pacific Coast to manufacture iron and steel is not only justified, but required. There is a large increase in the use of structural steel and reinforced concrete. Railway construction and maintenance and the general rapid progress of the country are also good reasons for the construction of such a plant. During the last quarter of a century the Union Iron Works of San Francisco have made the best of pig iron at Irondale, Wash., from Texada ores. More recently the Western Steel Corporation, with modern plant at the same place, made pig iron, using Fernie coke costing $10 per ton. This was intended as the nucleus of structural iron and steel works, but it was found that Chinese pig iron could be laid down at a cost of $10 per ton, and smelting of local ore was abandoned. With equipment none too good from the economy point of view, the costs were reasonable, but the enterprise was not properly financed, and operations ceased. Given a good quality of metallurgical coke costing not more than $5 per ton, which it is reasonable to expect in the near future, there is no reason why British Columbia pig iron should not take the place of Chinese, and a profitable industry be established on our own side of the line. Cheap power is also available.

◆

EDITORIAL COMMENT.

This week there will be found the first instalment of a series of four articles on the high-tension transmission system of the Hydro-Electric Power Commission of Ontario. In the light of the recent very successful operation of the system as compared with private companies, this series will be of particular interest to our readers.

In a recent issue of the Yorkton "Enterprise," of Yorkton, Sask., a firm of real estate brokers state in an advertisement that they handle real estate collections and civil engineering, and are financial agents. They add that they have numerous pieces of valuable "inside" and "outside" property, suitable for business houses, etc. It is hard to see in what particular way this firm are interested in carrying on the profession of civil engineering. Some users of the term, like the above, do much towards detracting from the dignity and standing of the profession. There is at present, however, no means of taking the matter up in the courts, and this is one argument at least for making the profession a closed one. At present the term is a most convenient one for those who wish to use it.

◆

LETTERS TO THE EDITOR.

A WARNING TO ALL CIVIL ENGINEERS.

Sir,—The following is a word of warning to all civil engineers when being engaged by a certain class of corporations that they should be most careful to have a note in writing of the amount of their salaries, because some engineers have appointed assistants and then gone back on their word and thought to settle the matter of a salary by a reduction of 20% of the amount previously arranged. When engineers cannot trust each other there is little confidence of the public in such representatives of the engineering profession. The writer has seen three-quarters of this world, and except in the Dominion of Canada, he has never encountered such underhand practice as outlined above, and has found that the members of the profession have always upheld the standard of straight and clean dealing amongst themselves and in their dealing with public affairs.

DISGUSTED A.M.I.C.E.

* * * *

ENGLISH ENGINEERS FOR CANADA.

Sir,—I should like, as an engineer living in England, to put before your readers the case of the hundreds, probably thousands, of English engineers of all kinds who are anxious to settle in Canada, but are unable to do so because they can hear of no jobs there. We are told in England that if a man wants work in Canada he must go there to look for it and take the first job that comes along.

I, myself, have written from time to time to several large firms, railway companies and consulting engineers in Canada, stating my qualifications and asking for the promise of a few months' trial in any fairly paid engineering capacity; a not unreasonable request, as the risk is practically all on my side. I received courteous replies in, I believe, every case. One railway company offered me a job, as they kindly said, to go on with until I could find something better, but at half the salary I was getting. Another firm said they could make use of me, but did not commit themselves to anything more definite. The other people all regretted that they had no vacancies, but at the same time several of them advised me to come to Canada, as they had no doubt I should get a good post there.

Now, this is well enough, as far as it goes, but it does not go far enough. It would go far enough for a man who could absolutely find no work in England, or for a single young fellow who had enough money to keep himself for some months in Canada while he was looking for a job, but the men I have in mind are those who are already in berths, steady, hard-working fellows, ambitious to get on, but seeing very little prospect before them in England and, therefore, turning their thoughts to other parts of the Empire.

Many of these men have a wife and young family to keep on a small salary and have no private means of their own and no rich relations to help them. However much such a man might wish to try his fortune elsewhere he feels that he is not justified in doing so merely on speculation. He has no money to leave with his family in England while he goes to Canada, and he dare not take them with him unless he has other work to go to at once.

This question does not affect the single man, but as they feel their feet on the first rungs of the ladder they are not willing to give up what they have unless to take something better. They are quite ready to go abroad. and they do go abroad, even to the most dangerous and unhealthy parts of the world, but they want something to go to.

The case of the engineer already in a good position in England, but who wishes to settle in Canada for various reasons, is rather different, although it still turns on the same point.

Take the case of a works manager getting £500 or £600 a year, a good salary from an English engineer's point of view. Such a man may be from 35 to 45 years of age and he probably has a family to whom he is giving the best education he can afford, so that he is not able to save much out of his salary. He may be ambitious and feel that Canada will give him more scope than England; he may think that his children will have better chances there; he may be an imperialist, as very many of us are, and wish to do his little share in building up the newer parts of the Empire, or he may have various other reasons for wishing to earn his living in the overseas Dominions.

He may be able to find enough money to take his family with him to Canada and to keep them there for six months or a year, but unless he has a definite position to go to he has much to make him hesitate. In the first place, his wife will probably object strongly, as the ladies in these cases generally have a firm belief in the old adage that "a bird in the hand is worth two in the bush."

He knows that he has worked hard to attain and to keep his present position, and he also knows that there are hundreds of men ready to take that position, many of them fully as well qualified in every way as he is, and if he gives his job up he may find it impossible to obtain another similar one in England, should he be unsuccessful in finding a suitable post abroad. Such a man would be naturally unwilling to take a less important job in Canada than he had filled in England.

The above are the reasons, I believe, which prevent the best engineers from going to Canada, except to take up positions which have already been offered them. There are really only two main reasons: want of money to go out on spec., and unwillingness to throw up a job until another one is secured.

It is possibly owing to the fact that not enough of the best classes of English engineers have been attracted there that American engineering practice is general in Canada. This seems a pity, as I am Britisher enough to believe that our engineers are at least as good as the Americans. I have no quarrel with American engineers; they talk too much perhaps, and they do not show up to advantage in England, but it cannot be denied that as a body they are quicker and more alert than English engineers, which, however, I believe is due more to the climate of America and to the fact of its being a new country than to anything else.

When we consider that the British Empire embraces a fifth of the entire surface of the globe and more than a fifth of its inhabitants, and that this result has been brought about largely by the help of British engineers, we must admit that they are not quite played out yet.

But, while engineering in Canada is advancing and will advance by leaps and bounds, the engineering trade in England is practically stationary, and will probably decrease in volume in the future owing to the much more severe European competition, so that many of our engineers will be obliged to transfer their services to other parts of the Empire.

I believe that it would be a benefit all round if some kind of exchange or employment bureau could be arranged for English engineers wishing to settle in Canada, and there are various ways by which this might be done.

One way would be through the engineering societies of the two countries. There are, roughly, 15,000 members of all grades in the three English institutions of civil, mechanical and electrical engineers, and as these societies already do something in the way of bringing their members into touch with employers or employees they would no doubt be very willing to work in conjunction with the Canadian Society of Civil Engineers to provide Canadian firms with suitable engineers from England. The English institutions, for instance, might collect the names of all of their members who wished for work in Canada, together with full particulars of each man's career and experience and the salary he desired, and these lists would be forwarded, say, twice a month to the headquarters of the Canadian society, where they would be on view and copies posted to any employer who desired one. The employer could then communicate direct with the man he thought most likely to suit him, making a definite offer for a three months' trial, and by cabling his offer he might have his man in two weeks' time.

This plan would, I believe, work well and the Canadian employer would have some guarantee as to the character and professional abilities of the men whose names were put before him, but there are great numbers of good engineers who do not belong to any of the institutions mentioned above, and who would be left out of such a plan.

Perhaps a better arrangement would be to deal with the question through the Canadian Government Emigration Department. This department, through its chief London office, might invite particulars as to experience, etc., from any English engineers desiring to settle in Canada, by advertising from time to time in some of the English technical and daily papers, and by sending circulars to all the engineering societies. The names and particulars sent in would be tabulated, numbered, and sent to Canada, where the lists would be distributed in various centres, where employers could see them or write for copies.

The essence of the scheme would be that each party took a certain amount of risk. The man from England would pay his own passage to whatever part of Canada he was going to take the risk of suiting his employer and being able to hold his position, while the employer guaranteed to give him a three months trial at a stated salary and to take the risk of him being suitable or otherwise. The risk to the Canadian employer would not be great, as the English engineer already in a berth would not be likely to pay his passage to Canada and probably take his family out on the [illegible] could be specified that the employer had power to break the contract by reason of [illegible]

[illegible] to Canada would [illegible] but most employers would [illegible] the [illegible] the Canadian employer could cable to London [illegible] address, the number of the man he wanted and the salary he offered, and the London office could communicate with the engineer, who would make his arrangements to sail as soon as possible, or reply at once if he was unable, through any reason, to take the post offered.

I believe that some such scheme as outlined above would be practicable. It would be a boon to a great many engineers in England who are struggling along with very slight prospects of bettering their positions in this country, and it would provide Canada with some very useful citizens.

R. D. SUMMERFIELD,
11 School Road, Moseley, Birmingham.

A MOVING-PLATFORM SUBWAY LINE.

A moving-platform subway line has been laid out in New York City by the Public Service Commission. It is to be a crosstown line on 34th St., from Second Ave. to Ninth Ave., a distance about one mile east and west. The end portions are to form loops, the easterly loop extending through 34th St., Second Ave., 35th St. and Third Ave. to the corner of 34th St. and Third Ave., while the westerly loop, beginning at a point in 34th St. between Eighth and Ninth Aves. passes under 34th St., Ninth Ave. and private property to the point of beginning. The route has been laid out as a result of the proposals of the Continuous Transit Securities Co. (M. E. Schmidt, pres.), which company has been promoting moving-platform proposals in New York City for a number of years past, hitherto without success. In order to provide against the risk of failure of the moving-platform method of operation, the Public Service Commission's resolution laying out the route provides that it may be operated "either by moving-platforms or by separate cars or trains, or by any other device or means in the construction of which stationary means for guiding a conveyance in a definite path and means for propelling such conveyance are necessary elements." In this way the resolution will also cover operation by ordinary rapid-transit trains if this is considered necessary after trial of the moving-platform method.

The proposed moving-platform line will pass through one of the busiest parts of the city, crossing seven north-and-south rapid transit lines (four elevated lines, three subway lines) and ten north-south street-car lines. At Broadway it will be within one-half block of the present northern terminus of the Hudson tunnel system, which communicates with Hoboken and Jersey City and indirectly with the lower part of New York City. At Seventh Ave. it will be within one block of the Pennsylvania R.R. station. The 34th St. district at present contains half a dozen large department stores, and shopping business has in recent years concentrated in this region very strongly. The present theatre district extends north from 34th St., and the principal hotels of the city are grouped along Broadway in this neighborhood.

A NEW ENGINEERING FIRM.

Mr. P. W. Sothmann, recently chief engineer of the Ontario Hydro-Electric Power Commission, has opened a consulting office in the Kent Building, Toronto. The firm name is P. W. Sothmann and Co., and the organization includes Mr. P. W. Sothmann, Mr. J. A. Brundige and Mr. F. P. [illegible]. The field covered by the new firm will be hydro-electric development, high tension power transmission and other work connected with the generation and distribution of electrical energy.

IRRIGATION PROJECTS OF THE CANADIAN PACIFIC RAILWAY COMPANY IN ALBERTA.

By A. S. Dawson.*

(Continued from last week.)

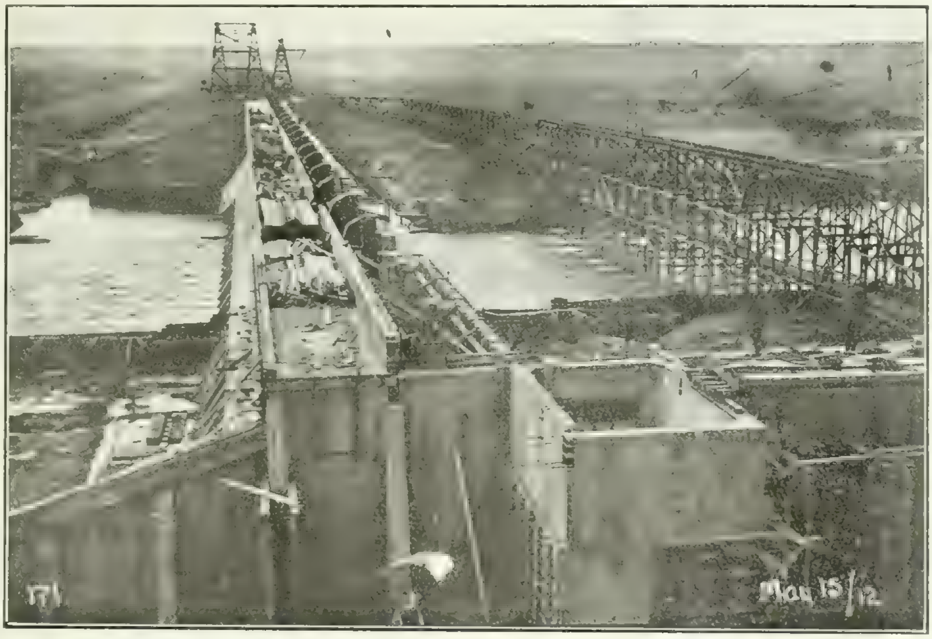
The abutments connecting the spillway with the earth dam are in the form of reinforced concrete retaining walls of the "counterfort" type, with a view of cutting off all possibility of leakage at this point. Provision has also been made for a road bridge on top of the structure.

The gates will be operated by a small power plant consisting of vertical turbines with direct connected generators installed inside the dam for this purpose, as well as for lighting and the operation of other headgates at the end of the main canal about five miles distant.

The canal headgates will form an integral part of the structure at its easterly end, and will consist of five openings each of 20 feet, controlled by "Stoney" sluices. These gates will control the discharge through a main canal of 90 feet bed width, carrying 11 feet of water, with 1 to 1 slopes, on a grade of .016 per cent. This canal is designed to discharge 3,800 cubic feet per second, and has a summit cut of 55 feet at about Station 10.

The contract for the spillway structure was let on October 1st, 1910, and work immediately started, it being anticipated that it will be completed within 18 months from that date.

The earthen embankment referred to is part of a very large contract awarded in June, 1910, which includes the handling of about 20 million cubic yards of excavation in this sec- of the Block.



Ambursen Type Dam on Bow River, near Bassano, Alta. Headworks of Eastern Section, C. P. Railway Irrigation Block, Alta.

At a point about five miles from the intake, an earth dam 1,280 feet in length, 35 feet maximum height, containing 80,000 cubic yards, was built across the valley, thus forming a tail pool into which the main canal will discharge. This dam has a top width of 12 feet, six feet above high water; has 2 to 1 slopes on the rear face and 3 to 1 on the wetted slope. Its face is paved with heavy rip-rap well bedded in gravel.

From this point two canals ahead a north and east branch. The north branch with its distributaries will water about 90,000 acres, its dimensions being 29 feet bed width, carrying 6½ feet of water, with 2 to 1 slopes, on a grade of .03 per cent. After crossing the railway line about one mile east of Bassano, its location follows the west flank of a deep valley known as Crawling Valley At a point about eight miles from its intake it drops 18 feet and crosses the valley by about 1,700 feet of flume, and runs northerly, gradually reducing in size until it reaches the Red Deer slope.

The east branch, like the north branch, heads out in the tail pool of the main canal, its size at the outlet being 68 feet bed width, carrying 9.3 feet of water, with 2 to 1 slopes, on a grade of .015 per cent. Near Lathem the first branch takes off, dropping 25 feet to cross the railway and water an area of about 107,000 acres between the Mat-zl-win and the One Tree Creeks. This branch is known as the Spring Hill Canal and is about 35 feet bed width, carrying 7 feet of water, with 2 to 1 slopes, on a grade of .025 per cent.

The east branch continues south-easterly along the northerly flank of the watershed as a 45.3′ by 7.8′ canal with a grade of .02 per cent., reaching the height of land at the head of Antelope Creek, which is crossed by a flume 2,200 feet long with a maximum height of 22 feet. At this point it again forks, the south-easterly branch being known as the Bow Slope Canal, which is about 17 feet bed width, carrying 5 feet of water; and will serve all the land on the Bow River slope of the divide and lying west of the Rolling hills, amounting to about 42,000 acres.

At Cassils a smaller canal to cross the railway is taken off, to serve about 12,500 acres; and just south of Brooks the east branch discharges its waters with a drop of about 17 feet into Lake Newell reservoir, which will be formed in a depression in the Little Rolling Hills, by the construction of a number of earth dams, the largest of which will be about 2,000 feet long and 30 feet in height. This reservoir will be about 9 miles long and 4½ miles wide, and its storage capacity will be about 180,000 acre feet. It will be filled each season after the close of the irrigation period, and was the means of materially reducing the cost per acre of the project as a whole.

A tract of about 50,000 acres south of the reservoir will be served by a canal heading out at the south end. This will be known as the Rolling Hills Canal, of about 19 feet bed width, carrying 5½ feet of water, on a grade of .02 per cent.

The outlet from the north end of the reservoir will serve about 118,000 acres known as the Bantry system, and its dimensions are 44 feet bed width, carrying 7.7 feet of water, on a grade of .01 per cent, and about five miles in length. At its easterly end it will discharge into a reinforced concrete flume 10,500 feet in length with a maximum height of 54 feet and a sectional area of 129 square feet.

---

*Chief Engineer, Department of Natural Resources, Canadian Pacific Railway Co.

Considerations of storage values fixed the elevation of both ends of this structure, and under these conditions the type of crossing which gave the highest velocity for a given fixed friction head was imperative.

Numerous preliminary studies were made for the purpose of comparative estimates of cost, with the result that a somewhat unique design is likely to be adopted. The actual channel is of the suspended type commonly used in steel flumes. The exact section proposed is the elastic curve or hydrostatic catenary. For the purpose of a flume this curve has the advantage that it is the equilibrium polygon for a liquid filling it to the chord of the arc; the tension is everywhere the same; and there is neither moment nor shear at any point. When the structure runs partially full, there are both moment and shear, and these are the factors which fixed the thickness of the shell. The substructure of the flume will vary with the head, and it is probable that multi-arched design will be adopted, with spans varying from 30 to 100 feet. For the depressed portion under the railway line it is intended, as previously intimated, to use a reinforced concrete siphon; and in order to save excavation and provide means of measuring the discharge it is proposed to form a Venturi meter with a throat section of about 6 feet. The structure as a whole will probably contain about 25,000 cubic yards of concrete and upwards of two million pounds of reinforcing steel.

This flume will carry the water over a broad divide in the water-shed with [illegible] point about three miles south-east of Brooks, and will serve all the country east of that point.

At the easterly end of the flume the canal section [illegible] width, carrying 7.7 feet of water, [illegible] .01 per cent., and in the north-east quarter of section 23, township 18, range 14 it splits, one branch of 37½ feet bed width, carrying 7.2 feet of water, on a grade of .01 per cent., running north; and another branch of about 16 feet bed width, carrying 5 feet of water, [illegible] the railway line.

In [illegible] the northerly branch [illegible] feet bed width, carrying 5½ feet of water, on grades of .01 per cent., one [illegible]

The [illegible] mileage of canals and ditches [illegible] this portion of the Block is as follows:—

	Miles.
Main canal	5
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

[illegible]

[illegible]

The different cross sections of canals and ditches are modified to suit conditions, such as discharge, available grade, nature of soil, and transverse slope of the country. On ditches 2½′ by 1′ to 3½′ by 2′, 1 to 1 slopes are used, and on ditches 4′ by 2′ to 4½′ by 3′, 1½ to 1 slopes are standard, with banks 3 feet wide on top and one foot above water level. On small ditches no dependence is placed on banks as part of the canal prism unless the grade is one foot below the under side of the sod, or about 1½′ cut on an average. On larger ditches on level ground the area of the water prism is generally about the cube of the depth; the banks being half the depth of water level, with a maximum of 3 feet; and a width equal to the depth of water on the upper side, and 12 feet on the lower side, where a roadway is required. Where the depth of water is over about 5 feet, 2 to 1 slopes are standard, although this is changed to 1½ to 1 where extreme cross slope exists. Where the depth of water is less than 5 feet, 1½ to 1 slopes are standard under ordinary conditions. Endeavors are made to balance cut and fill, with an allowance of about 15 per cent. for shrinkage, unless it happens that shorter locations with heavy cutting through a ridge would result in a reduction in quantities.

The grades are so selected as to give a uniform velocity of about 2½ feet per second, and not to exceed 3 feet per second; consideration being given to the character of the soil, and the depth of water in the ditch.

Where the slope of the country is so great that the velocity would be too high if the canal were given a bed slope to correspond therewith, the excess fall is concentrated by vertical drops; and where such drops occur too close to one another for safety or economy, a short section of flume or lined channel is employed for the purpose of overcoming the excessive grade. Losses by seepage and evaporation are allowed for as follows:—

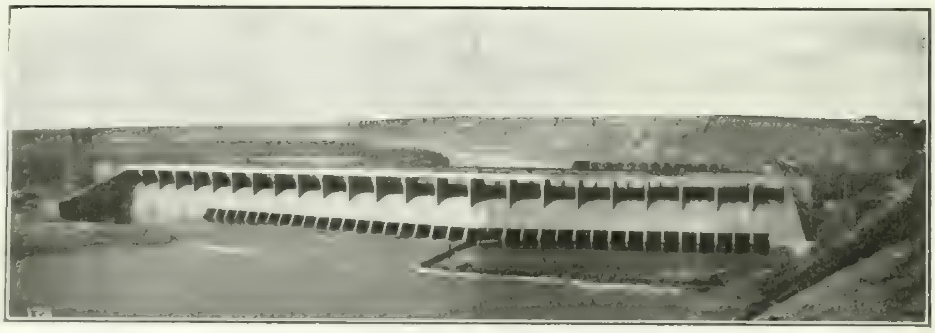


Fig. 9.—Ambursen Type Dam on Bow River, near Bassano, Alta., Eastern Section C.P. Railway, Irrigation Block, Alta.

In preliminary projection:

		Per Mile.
Canals	2 to 100 sec. feet	1
"	100 to 500 "	.5
"	500 to 1000	.25%
"	1000 and over	.10%

For final projection and design the following formula is used:

$$P = C\ W\ d$$

where P = loss in second feet per mile of canal.
W = the width at full supply level.
d = the depth of water.
C = a constant [illegible] for sand
[illegible] for gravel and sandy soil.
[illegible] for average earth.
.0150 for clay
[illegible] for dense hard clay

Curvature is carefully considered and on the larger canals curves are regularly run in with transit and chain, the radius allowed on the larger secondary and branch canals being between [illegible] and [illegible] times the depth of water. On smaller distributing ditches a radius of [illegible] to 8 times the depth of water, with a minimum of about 10 feet, is aimed at. As far as possible the land lines are adhered to in laying out the distribution system.

At each point where water is divided by a branch gate, an alternative path is provided to carry off tail water to some drainage channel, the capacity of these tail channels bearing a constant proportionate relation to that of the various irrigation ditches above them. In no case is this less than 2 second feet, and otherwise is 25 per cent. of the capacity of the canal or ditch just above. These tails are located on the land lines as far as possible; otherwise they are made to reach the drainage channels by the shortest possible route.

Cross drainage is provided for in three ways: (1) it is taken under the canal; (2) if small in extent of catchment area, it is taken into the canal system by an inlet; (3) it is carried over the canal. The type of crossing adopted depends to a large extent on the importance of the drainage line; on the character of its channel; and to some extent on the size of the canal. No definite rules can be laid down to meet all cases, but as a rule the cross drainage is handled in the order above referred to, with due consideration of cost. The material chiefly used in connection with the smaller under crossings has been corrugated metal culverts, up to 36 inches in diameter, manufactured from both Ingot and Toncan metal. For larger structures reinforced concrete pipe and arch culverts will be used.

Flooded areas are avoided by the use of double fills or levees, combined with means of taking care of the cross drainage as above referred to.

Spillway or escape channels, with the necessary structures on the canal system, are provided at frequent intervals, averaging about 6 miles where possible, on all secondary and branch canals, their capacity being at least 10 per cent. and not exceeding 25 per cent. of the canal in which they head.

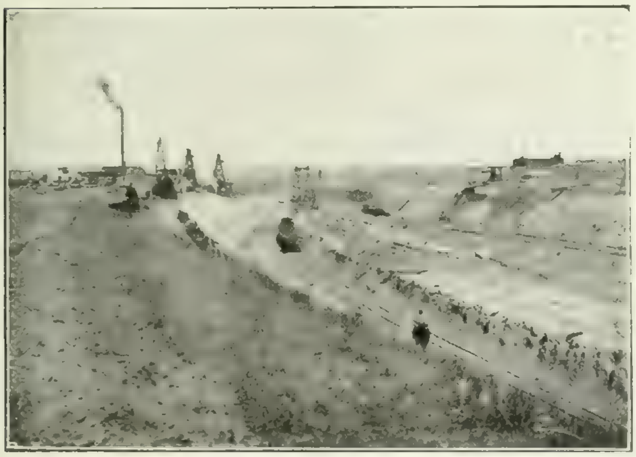


Fig. 10.—Excavation, Main Canal, Eastern Section of Irrigation Block.

Overhaul is calculated by the well-known methods of Mass Curve, the limit of free haul being 100 feet parallel to the canal axis. In case of borrow pits not on the ordinary cross section, the length of haul is measured in a straight line between the centres of gravity of cut and fill.

Necessary waste is used to widen the banks uniformly, and to strengthen the higher fills. Borrowing where necessary is done by (1) deepening the canal; (2) widening it; and (3) both if required. If neither is practicable, borrow pits are made well away from the canal on the high side and so arranged as to drain into the canal. Where side borrow is absolutely necessary, a berm equal to at least the height of the bank is left between the toe of the bank and the edge of the borrow pit.

Embankments are in all cases put up with material from adjacent cuttings or from borrow pits if the former is unsuitable or deficient in quantity. In determining the outer slope, the plane of saturation is considered as sloping from high water level at the rate of 3½ to 1, and this plane is not allowed to intersect the outer slope or to approach the toe nearer than 10 per cent. of the base width. In very high fills where the above requirements lead to excessive material, the slope of saturation is increased by draining the rear or outer half of the embankment, or by constructing the first three feet of the outer third of the bank with sand, gravel or other porous material.

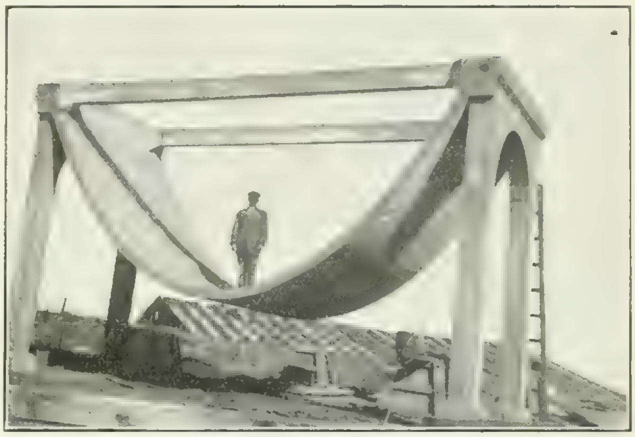


Fig. 11. Test Section, Proposed Aqueduct, 18 Ft. Wide, 9 Ft. Deep, 1,000 Ft. Long. Eastern Section of Irrigation Block.

The under surface of the embankments is bonded when the head against the banks is 2 feet or more, and less than half the top width, providing two furrows and one additional furrow for each extra two feet, with one furrow just inside the upper or wet toe, one under the centre, and the balance, if any, between them. The surface is stripped when the depth against the bank exceeds half its top width; when the cross slope exceeds 1 in 6; in boggy ground; or when the soil exceeds plow depth. The surface is bonded and stripped when the head against the bank exceeds 10 feet; when the surface is hard and dry after stripping; or when the cross slope exceeds 1 in 4. The width of stripping is determined by the plane of saturation above referred to.

This portion of the system is being designed with a view of rotation in supply being adopted, which will result in each individual farmer obtaining a satisfactory head; a fair division of water; and simplification of operating problems. This is a matter which cannot be worked out in detail until the lands are settled, but the system is being designed on the basis of giving parcels of between 80 and 160 acres a supply of two second feet for a period of 96 hours, and parcels smaller than 80 acres a similar flow for 48 hours.

It is the intention that daily records of the receipt and delivery of water and of the outflow through all branches of the system shall be maintained from the beginning; such data being as necessary in irrigation management as is bookkeeping in any commercial institution. The information thus obtained is essential in enforcing proper water economy; in preventing land from being injured; and in keeping farmers from getting into bad habits in using water, which if once acquired, result in reduced crop production, increased cost of operation, and needless annoyance to the management.

World-wide experience in the use of water on cultivated lands under any kind of crops during long periods of years, shows that the duty varies with, (1) the nature of the soil; (2) the age of the soil; (3) the kind of crop; (4) the weather conditions; (5) the slope and condition of the conveying channels of supply; (6) the distance the water is carried in the ditches and channels to the fields; and (7) the experience and skill employed in irrigation. As you are aware, the legal duty in the province of Alberta is fixed by the Irrigation Act as a continuous flow of one cubic foot per second per 150 acres for 153 days between May 1st and September 30th. Measurement of this supply is arranged for by weirs approved of by the Commissioner of Irrigation.

The company has adopted the plan of constructing the complete distribution system so as to deliver water at the boundary of each farm unit of 160 acres or less; as it was considered impracticable to leave to the settlers the building of the smaller ditches, which would have resulted in delays to the work, excessive cost and a retarding of the development of the area, followed by increased difficulties in operation. In constructing the distribution system, 160 acres has been considered the farm unit, although in the western section several colonies have been established on the so-called "ready-made" farms of 80 acres. In the eastern section of the Block about five per cent. of the farm units will be sold as 80-acre farms, in addition to the establishment of a number of colonies on farms averaging from 80 to 120 acres.

The successful outcome of any large irrigation project is only partially solved by good construction; and in some cases the administrative heads of large schemes have failed to realize that the ultimate success of such enterprises cannot be fully brought about without farmers; and that it is their labors which determine the real value of such properties. With this realization, the sale of the lands in this Block warranted the establishment of a very large organization which has extended over all important points in Canada, the United States, Great Britain and parts of Continental Europe; and which has resulted during the past five years in the disposal of over 1,300,000 acres.

Everything that follows in the wake of increased population is an argument in favor of irrigation and the cultivation of small areas; which can only be carried out by this means of farming. Moreover, this results in a better type of farmer, greatly improved living conditions, and correspondingly elevated social conditions.

No practical agriculturist can fail to realize the fact that the [illegible] for irrigation in semi-arid conditions in northern latitudes is very great; and that this system of farming will ultimately become a leading factor, and occupy a vitally important place in the agricultural development of Southern Alberta.

MUNICIPAL EXHIBITION IN BERLIN.

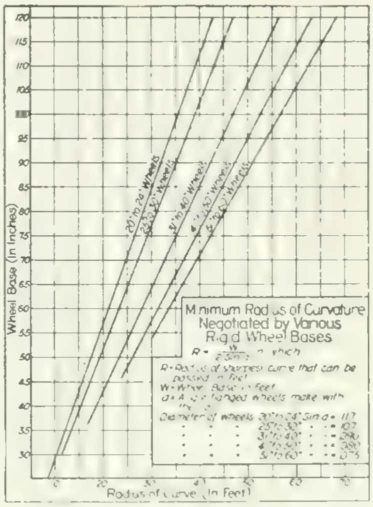
[illegible] the wonderful manufacturing abilities of this young city.

[illegible]

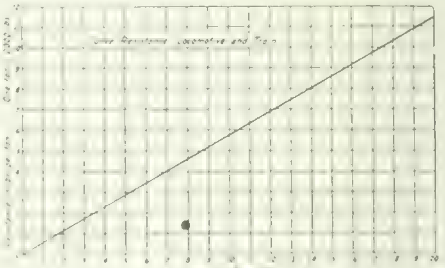
[illegible]

CURVES IN TRACK AND GRADE RESISTANCE.

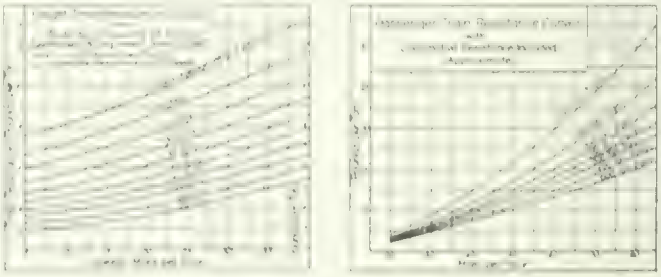
In the United States it is customary to express curvature in degrees, noted by the deflection from the tangent measured at stations 100 feet apart. The following information is abstracted from a bulletin published by the Railway Department of the Westinghouse Electric and Manufacturing Company. The number of degrees of the central angle subtended by a chord of 100 feet represents the "degree curve." One degree of curvature corresponds to a radius of 5730 feet. Therefore, the number of degrees divided into 5730 gives the radius of the curve in feet. Or, the number of feet radius divided into 5730 gives the number of degrees. This assumes that the 100 feet are measured on the arc instead of on the chord, but the error thereby introduced is so slight with curves commonly used that it may be ignored in ordinary calculations.



In English practice it is common to define a curve as one of so many chains (66 feet) radius. Thus the radius of a one-degree curve expressed in chains would be 5730 ÷ 66 equals 86.81, therefore, 86.81 divided by the degrees equals the radius in chains, or 86.81 divided by the radius in chains equals the degrees. The curve shows the value of train resistance on curves.



In the metric system instead of the stations being 100 feet apart they are taken at 20 meters (65.61 feet). The central angle remaining the same, the radius must necessarily be less. This is represented by 65.61 ÷ 100 of 5730 feet for a radius for a one-degree curve or approximately [illegible] United States measurement, which can be used as a factor for converting the United States to the French system.



Curves Showing Train Resistance.

Grade Resistance.—When a train is hauled up a grade, the resistance due to friction is increased by that due to lifting the train against gravity. The amount of this increased resistance is determined as follows:—One mile equals 5,280 feet, and if the grade be one foot per mile, the pull necessary to lift a ton of 2,000 pounds will be $\frac{2000}{5280} = .3788$ pounds.

If the grade is expressed in feet per hundred or per cent., the resistance will be $\frac{2000}{100} = 20$ pounds for each per cent. of grade. Therefore, the grade resistance in pounds per ton = 20 x % grade.

To the grade resistance must be added the train resistance due to speed and friction for level running; i.e., total train resistance on grade equals grade resistance plus train resistance for level running.

The following table is based on the following assumed data:—

Train friction .... 10 pounds per ton
Acceleration .... 20 pounds per ton
Coefficient of adhesion .... 25 %

Weight of Train That Can be Started on a Given Grade.

Weight of Locomotive	TONS WEIGHT OF TRAILING TRAIN				
	GRADE				
	1%	2%	3%	4%	5%
25 tons	225	155	115	90	70
30 "	270	185	135	105	85
40 "	360	245	180	140	115
50 "	450	310	230	180	140
60 "	540	370	270	210	170
70 "	630	430	320	250	200
80 "	720	490	365	280	230
90 "	810	550	410	320	255
100 "	900	615	455	355	285

CONTRACT OBLIGATIONS IN THE STEEL TRADE.*

By E. A. S. Clarke.†

The average buyer of steel has for some years looked upon his contract as an option, the material to be taken if the prices remain satisfactory, but the entire contract to be repudiated if conditions are not favorable. This custom does not apply to all forms of steel, and not at all to raw materials entering into the manufacture of steel. Contracts covering the sale and purchase of ore, coal, coke, pig-iron, and in most cases billets and sheet bars, are practically always strictly carried out. Cancellations of rail contracts are practically unknown. Evidently in the case where the buyer regards his contract as a mere option, a situation arises under which the seller has a heavy tonnage of obligations which he may have to meet, but which the buyer will not take unless conditions are favorable to him. The seller, realizing this, and particularly if the market is advancing, deliberately contracts for the sale of more tonnage than it is possible for him to deliver. The result is dissatisfaction on the part of the buyer at not getting proper deliveries, so that he, in turn, contracts with several sellers for a total of far more than he can use, with the idea that out of the combined contracts he will be able to get the deliveries and amounts that he needs.

As to the causes of this unfortunate situation, the one which in my judgment is chiefly responsible is stated by Mr. J. A. Farrell as follows:—"For the purpose of making a good showing in the volume of sales and contracts, buyers, and particularly the large wholesale merchants, have not infrequently been induced, not to say inveigled, into placing contracts covering as extended a period as possible, for tonnages which they may hope to sell, and in some instances which they can have no reasonable expectation of being able to sell."

Suggested Remedies.—For the correction of these conditions, Mr. Farrell's suggestion that the salesman's remuneration and chance of advancement be made to depend, not upon the volume of his sales and contracts, but upon the profits derived from the goods actually delivered to the buyers, is most excellent. Mr. Bope's suggestion of short-time contracts, no guarantee against decline, preventing the buyer from buying more than he requires for use in any given period, and an equal obligation put upon the seller not to sell more than he can deliver within that period, if properly carried out, would accomplish most of what is necessary, provided that the sales contract contains the elements of mutuality and fairness; and particularly if the seller gives proper heed to his obligations in respect of making deliveries in accordance with his contract.

Investigation shows that the laxity as regards contract obligations which prevails in this country is practically unknown in Europe, and that many of the remedies suggested for the correction of the evil here are in current use abroad. There are in practically every country in Europe certain general sales conditions which vary but slightly between countries and which govern all sales of steel. These fundamental conditions are always stated at the time of making quotations, so that the buyer understands clearly the conditions which will govern the execution of the contract, and there can be no question of some new condition arising after the contract has been signed. These general sales conditions which obtain in Europe seem to the writer eminently fair and reasonable, particularly when stated in advance of signing the sales contract.

A form of sales contract, uniform as to certain fundamental conditions, seems to the writer essential to the proper enforcement of contract obligations. Some of the fundamental conditions which he suggests should be embodied in such a contract are as follows:

(1) The material should be sold for the buyer's use only, and not be re-sold unless first further manufactured. This would have to be modified in the case of sales to merchants or jobbers.

(2) Stipulations as to quality and variations should be clearly stated. In the writer's judgment the best way is to sell the material subject to the seller's standard variations for rolling and shearing, but these should be stated in a list to be published by the seller.

(3) Differentials and extras in the way of price should be clearly understoood, and the seller should publish a similar list covering these items.

(4) Even if prices are quoted at final destination contract delivery should be f.o.b. cars at the seller's works, with freight allowed to destination, the delays and risks of transportation being borne by the buyer.

(5) If the prices quoted include a freight charge, the same should be subject to adjustment in case of increase or decrease in the published freight rate.

(6) Terms of payment and character of funds in which payment is to be made should be clearly stated, and the amount and terms of discount, if any, clearly set forth. It should be made clear that freight charges are to be paid in cash by the buyer, and that they are not subject to discount.

(7) It should be clearly stated that shipments and deliveries under the contract are at all times subject to the ap-

---

*Abstract of a Paper read at the New York meeting of the American Iron and Steel Institute.

†President of the Lackawanna Steel Company.

proval of the seller's credit department, and that in case of doubt arising as to the buyer's responsibility, further shipments may be suspended until satisfactory assurance as to responsibility is given.

(8) Specifications in detail should be furnished in substantially equal monthly quantities not later than the 15th of the month preceding the month in which delivery is desired; all material to which the buyer is entitled under the contract to be specified at least thirty days prior to the expiration of the contract. Buyer's failure to furnish specifications as aforesaid to be treated at seller's option, and without notice to buyer, as a refusal to accept and receive the unspecified portion of the goods.

(9) The seller should promptly acknowledge receipt of specifications and at the same time advise buyer of the date on which it is expected to begin deliveries against such specifications, and the approximate date at which it is expected to complete the same; such deliveries to begin as soon after receipt of specifications as condition of seller's mill and of its previous sales obligations will permit.

(10) There should be a clause defining the seller's liability for non-performance, and the following is suggested as fair:—"The seller shall not be liable for non-performance of this contract in whole or in part, if such non-performance is the result of fires, strikes, differences with employés, casualties, delays in transportation, shortage of cars or other causes beyond the seller's reasonable control; nor shall these exemptions be limited or waived by any other terms of this contract, whether printed or written; but in the event of unavoidable delay due to fires, strikes or other causes beyond the control of the seller, the buyer may, subject to previously obtaining consent of the seller, cancel the portion of the goods not manufactured or in process of manufacture at the time his request to cancel reaches seller's works. The seller is hereby given the right to have any company in the United States furnish material of the same kind and quality at the same cost to the buyer, in whole or part performance of this contract; and it is agreed that shipments and billing of material by or in the name of such company, as well as any payments made to such company therefor, shall be as effective and binding as if made by or to the seller direct."

(11) The seller's guarantee in regard to defective steel should be clearly stated, and the time and manner in which claims for shortages or other errors, deficiencies or imperfections must be made.

(12) All tests by buyer for physical or chemical requirements and all surface inspection, should be made at seller's mills before shipment, and should be final.

(13) There should be a statement that the contract is made and executed in the State in which the seller's works are located, so that in case of dispute the laws of that State shall govern.

(14) There should be a statement that there are no understandings or agreements relative to the contract that are not fully expressed therein, and that no changes shall be made unless reduced to writing and signed by both parties.

[illegible] the above conditions [illegible] [illegible] should leave little room for [illegible] would be perfectly fair and equitable [illegible] [illegible] [illegible] set of conditions will make a [illegible] [illegible] the conditions which must be lived up to [illegible] and the seller must stand willing to be penalized if he does not make the deliveries agreed to, just as he expects to penalize the buyer for breach of any of his covenants.

Differentials and Extras.—One custom among European steel manufacturers which has struck the writer as being of great value, is that of publishing very complete lists of differentials and extras, covering not only sizes and quality, but also the quantity of one size or section in an individual specification. From these the buyer can tell just what his material will cost him, and is thus enabled to so design his work as to utilize the lowest priced material. The writer believes that a proper differential in price, for quantity of one size specified at one time, would prove a satisfactory solution to all concerned on the question whether large consumers are entitled to a better price than small consumers. Such a basis of differentials is logical because the extra price is charged on account of extra cost. In other words, the buyer, if he requires more expensive service, has to pay correspondingly for it. The writer believes that if a properly prepared schedule of differentials and extras for size, quality and quantity of individual specification were in force, the base price of steel could be considerably lower than under present conditions, without reducing the profits of the seller.

Mr. J. A. Farrell (President of the United States Steel Corporation) in the discussion remarked that contracts for future delivery of material were in a certain sense a means of insurance accorded by custom from sellers to regular consumers to enable buyers to make provision against the future and resell or consume the material at a profit. It was essential that merchants and consumers should be able to calculate precisely the cost of material, to enable them to manufacture and sell over a fixed period. But this period should be a reasonable one and should be limited, so far as possible, in the case of the merchant trade for re-sale to three months from date of contract, and in the case of manufacturing consumers to six months. It was self-evident that in insisting upon buyers carrying out their contract obligations with the same due regard as they expect from sellers, there should be no guarantees against declines. But if any modification of this rule should at any time be permitted, particularly if any deviation was made in contracting for longer than the recognized period, it should be solely against seller's own decline. And there should be a reasonably compensating provision to the effect that if prices should subsequently advance, contract prices should be correspondingly adjusted. It was a distinctly unbusinesslike proceeding to permit buyers to reap any advantage that might accrue from a reduction in the contract price without allowing sellers a similar advantage when there was an advance in price. If contracts were to be made on a fluctuating basis, they should provide for advances during the life of the contract as well as for declines. In other words, the contract should be in all respects mutual. At the time of the formation of the United States Steel Products Company it was found necessary to formulate general conditions of sale. These conditions were made necessary by reason of many practices in vogue in export markets. It might be said that they were acceptable to buyers throughout the world, as an ordinary matter of course, because they clearly defined the obligations of both seller and buyer. Mr. Clarke's suggestion of a uniform sales contract was excellent. The stipulations in such contracts as had been devised by foreign manufacturers and by a number of American manufacturers need only be those which conformed to authenticated legal decisions and which were fair alike to buyers and sellers. If material was sold on contract form which clearly indicated the obligations of both buyer and seller even though the provisions must necessarily be of considerable length, they would form a recognized standard, favorable alike to both buyers and sellers. And they could in turn be made effective between the buyers and their clients, obviating the possibility of misunderstandings and the necessity for legal actions.

THE COATING OF STEEL PIPES.

The commission appointed to report on the water mains of West Australia, known as the Coolgardie main, make certain pertinent comments on the corrosion, which are of considerable interest to engineers.

The commissioners state that the two facts which have brought about external corrosion appear to be:—

(1) Deterioration of the protective coating, regarding which they state:

"It has been found that a coating which appears perfectly satisfactory to the naked eye, contains when examined with a magnifying glass, small holes due to minute bubbles which penetrate right through to the metal beneath. On removing one of the nodular incrustations which form as a result of corrosion, the coating at first sight appears to be sound. A more minute examination, however, reveals the fact that the metal has decayed below the coating, having been attacked by the penetration of the water through one of these minute holes to the metal surface. Were the pipe to be dipped a second time as recommended by the commission, care having been taken that the first coating remained uninjured, the odds against two air bubbles one above the other, giving direct access of the water to the metal, would be enormous.

"It is unfortunate that this recommendation, though no doubt a somewhat difficult one to comply with, does not appear to have been carried out."

(2) The fact that the pipe was buried in trenches when it should have been carried on trestles, so as not to be in contact with the surrounding soil, the soluble salts contained in which give rise to corrosion when moisture is present, regarding which they state:—

"Had the pipes been laid above ground, as recommended by the commission, the external corrosion, as influenced by the soluble salts contained in the soil, would have been entirely done away with."

It is understood that the sandy soil along this pipe line is so impregnated with salt that in many places it absolutely glistens, in which case it is hardly surprising that external corrosion set in.

The coating of steel pipes is a subject to which a great deal of attention has been devoted. If circumstances point to corrosive influences being present from within or without, it is best to order the pipes dipped in special solution, wrapped in hessian and recoated. On reference to the notes quoted from the Coolgardie commissioners' report it is observed that, in their view, had the pipes been dipped twice as this treatment provides, no corrosion would have taken place internally, while, externally, the thick and tough protection provided by the addition of hessian would also have prevented the abrasion of the coating in transit. As evidence of the efficiency of such coating reference may be given to the case of some thirty miles of 30-in. lock-bar pipes for high-pressure gas (similar to the water mains of Coolgardie) which were laid in Staffordshire ten years ago. These mains were laid through heaps of slag and ashes, well known to exercise a highly corrosive action on steel. Inspection of these a year ago shows them to be in as good a state of preservation as when laid, the pipes and coating being intact and bearing every indication that they will remain so for an indefinite period. This main is of particular interest, in that it has remained tight and efficient in spite of the subsidence amounting to feet, due to underground workings.

HYDRO-ELECTRIC STATION AT GATUN SPILLWAY.

Specifications and requisition for auxiliary electrical equipment for the Gatun hydroelectric station have recently been forwarded to the Washington Office for purchase in the United States. This equipment is in addition to the plant purchased some time ago, the first contracts embracing the hydraulic equipment, with the electric generators and exciters. The principal items of the present requisition are the switchboards, oil-switch group, station battery, light and power transformers, and an air compressor, all necessary for the equipping of three complete generating units. A brief description of the waterpower project of the Panama Canal follows:

From the storage in Gatun Lake, there will be available sufficient water to warrant the installation of 6,000 kilowatts in generating capacity, including reserve. The average head throughout the year will be approximately 75 feet, the elevation of the tail race being about eight feet above sea-level. During the rainy season, water will be plentiful and must be wasted over the adjacent Spillway. During the dry season, however, it will be necessary to draw upon the storage in Gatun Lake above elevation plus 79. The maximum quantity of water diverted for hydroelectric development is approximately seven per cent. of the minimum water supply and is the excess which is not required for lockages, evaporation, and leakages. Water will be extremely abundant for several years, until such a time as the traffic through the canal approaches full capacity.

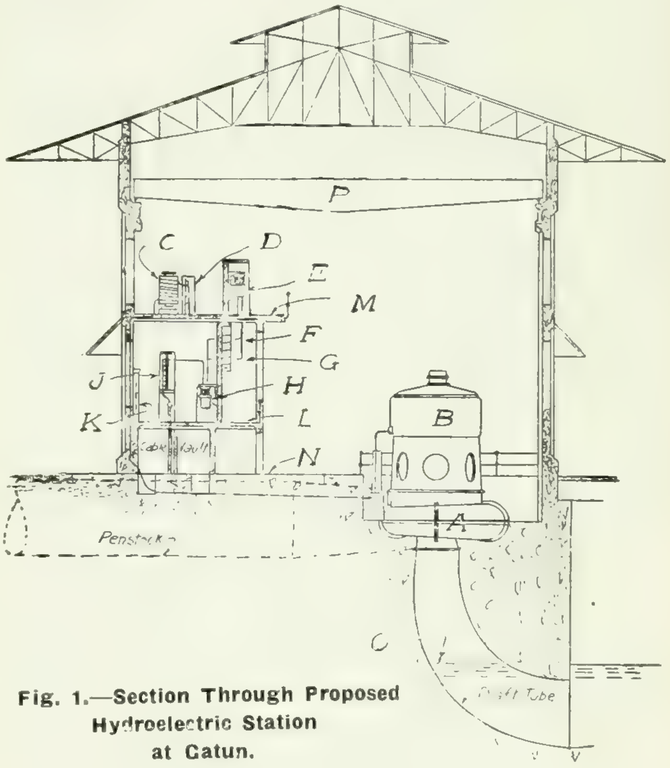


Fig. 1.—Section Through Proposed Hydroelectric Station at Gatun.

The electrical load, which will be connected to the hydroelectric station, consists for the most part of power feeders, which will distribute energy to the machinery of the three locks, to the permanent machine shops, to the dry dock, to the coal handling plant, to the batteries, and to other smaller electric drive which is now giving service. In addition, there will be the lighting load of the locks and of the Zone towns. In all probability, considerable load will be obtained through a service for domestic purposes, electric cooking utensils replacing the stove, in order to create a saving in the cost of fuel, which is an expensive item upon the Isthmus.

There is a slight possibility of an electrification of the Panama railroad over the relocated lines, the electrification depending entirely upon the nature of the traffic conditions that result after completion of the canal. The circuits from the station to the load centres, in general, will be in duplicate, insuring as far as possible an absolutely continuous service. The station will be connected by means of a high voltage transmission line to the present steam generating station at Miraflores, which station will be held in reserve to tide over either shut-down or low-water periods of the Gatun station.

The hydroelectric station is to be situated adjacent to the north wall of Gatun Spillway. The building will be constructed of concrete and steel, and will be of a design suitable for a permanent power house in a tropical country. The dimensions of the building are such as to permit the present installation of the three 2,000-kilowatt units, and provision is made for a future extension of three additional similar units. The building will be rectangular in shape, and will contain one main operating floor, with a turbine pit and two galleries for electrical equipment. The station equipment will include a 30-ton crane to be used during erection and whenever repairs are to be made. The building, with the machinery and electrical equipment, is laid out upon the unit principle. Each unit consists of an individual headgate, penstock, governor, generator, exciter, oil-switch, and control panel. The position of the main features of the development relative to the Spillway channel are shown in Figure 1.

Water is to be taken from Gatun Lake, the elevation of which will vary with the seasons from 79 to 87 feet above sea-level through a forebay which is constructed as an integral part of the curved portion of the north Spillway approach wall. The curved portion of the Spillway wall contains five large apertures into the forebay and will serve as a fender wall to prevent floating debris from accumulating at the headgates.

From the forebay, the water will be carried to the turbines through three steel plate penstocks, each having an average length of 350 feet. The penstocks are to be constructed of [illegible]-inch plates riveted together, and are to be 10 feet 6 inches in diameter inside. The exterior of the penstock is to be surrounded by a thick concrete coating to serve both as a protection against corrosion, and as a means of strengthening the penstock against superimposed earth pressures. The concrete will have a minimum thickness of 12 inches and will be anchored to the steel by means of Z-bars, which are riveted to the plates. The position of the station building relative to the headgates requires that each [illegible] [illegible] and masonry will be entirely covered by the fill of Gatun Dam. Near the lower end of the penstocks, at the building wall, there will be installed a testing link, the purpose of which is to measure, by the velocity method, the quantity of water flowing [illegible]

[illegible] iron headgates, and bar iron trash racks, the latter being [illegible] switch, all operating automatically. The driving machinery [illegible]

present requirements of three headgates, and provision is made for a future addition of three more units.

The turbogenerator units are to be of the vertical type, the entire weight of the rotating element being suspended from an overhung thrust bearing, which is supported from the top shield of the generator. The water turbine proper will be of the spiral casting, one runner, Francis type, and is to be set in heavy masonry foundation. The water will enter the turbine through a tapering joint from the penstock and discharge into an increasing, elbow draft tube, made of ¼-inch steel plates and will be imbedded in the concrete foundation. A section of the station, showing the arrangement of penstock, turbine, and draft tube, is illustrated in Figure 2. The turbine is rated at 2,250 kilowatts at a speed of 250 r.p.m. and will consume approximately 500 second feet of water at full load.

Superimposed upon the turbine casting is to be the generator, a distance ring, six feet in height, separating the two. The generator is to be rated at 2,000 kilowatts, and will deliver 3-phase 25 cycle current at 2,200 volts potential. The turbine, generator, and auxiliary equipment are to be of the best mechanical and electrical construction obtainable. The governor is to be mounted upon one side of the distance ring and is to be geared solidly to the main shaft.

The path of the electrical energy from the generator to the outgoing feeders is shown diagramatically by the heavy line in Figure 2. The leads emerge from the lower part of the generator and pass through a manhole at the base of the turbine into a duct line, which carries the cables to manholes in the cable vault; thence the leads are taken up the building wall in tile ducts to the generator reactances. The reactances are to give protection to the generators in event of severe and protracted short-circuit outside the machines and consist of air insulated coils mounted upon concrete cores; a reactance coil is inserted in each of the three phases of each generator.

Adjacent to the reactances is a concrete cabinet which contains small series and shunt transformers for energizing the instruments and protective devices on the main control switchboard. The generator leads next enter a concrete compartment which houses a pair of oil switches. The two switches permit a selection of connections to either of the duplicate buses, which are situated on the first gallery floor, directly underneath the generator oil switches. The buses are to distribute the energy among the several circuits, each of which is equipped with oil switches. The distributing circuit passes from the circuit switch to an instrument transformer compartment, which is quite similar to the generator instrument transformer compartment. From the instrument transformers, the circuit cables drop into the vertical duct shelves in the cable vault below, thence make an exit from the station through manholes at either end of the building into duct lines at the crest and toe of Gatun Dam. As far as practicable, the entire electrical equipment is in duplicate, and is designed with continuity of service, operating accessibility, and protection of human life as the prime considerations.

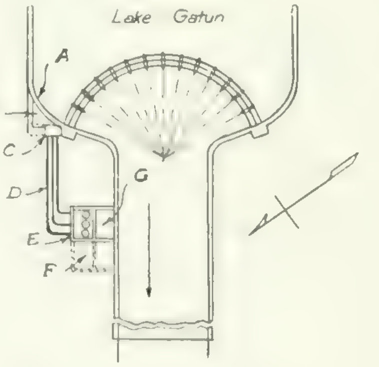


Fig. 2.—Location Plan.

A. Fender Wall.
B. Forebay.
C. Gate house.
D. Penstocks.
E. Power House.
F. Possible extension.
G. Tail race.

One feature of a well designed, modern power house is the remote control of all auxiliary machinery and equipment, particularly of the dangerous switching operations on high voltages. The control and the protecting devices of the Gatun station have been worked out carefully and will permit of an extremely flexible and reliable operation of the generators upon any probable condition of loading. A main control switchboard of the unit panel type is to be erected upon the second gallery floor, where the operator possesses a good view of the entire station. Command of all operations is obtained through master control switches, and indication thereof is procured by means of small pilot (signal) lamps. The operator at the switchboard remotely controls all switching operations, both on the high tension and the exciter buses, and, in addition, controls the headgates, the governors, the rheostats, and the field circuit breakers.

Besides the control switches, the main switchboard contains all indicating, integrating, and recording instruments, which are essential for an intelligent and economical operation of the station. Time limit relays are mounted upon the rear panels to serve as a protection to circuits and generators in case of overload. Continuity of the operating circuit for the control of switches will be obtained by the installation of a storage battery upon the first gallery floor, the switches being mounted upon one panel of the main control switchboard. A voltage regulator, which will automatically maintain a uniform bus pressure, will be assembled upon a smaller station panel at one end of the main board.

The canal commission will try one slight variation from standard practice in an attempt to secure the greatest reliability in the excitation system without the necessity of installing additional water turbine exciter sets. In any alternating current station, it is absolutely necessary that the fields of the alternators be supplied continuously with direct current, usually at 100 to 125 volts potential. When the station is running smoothly, this direct current supply is obtained most economically through motor-driven exciter sets, which are operated directly from the 2,200 volt buses. Two such units, each of 100 kilowatts capacity, will be erected in the Gatun station. Difficulty is encountered, however, when the station is inoperative, as no source of 2,200-volt energy is available to drive the exciter sets. It is customary practice in hydroelectric stations to install independent exciters, which are driven by small water turbines. The small water turbines are more complicated than motor-driven sets, requiring adjustment of governor and of valves, and also additional penstocks and gates, with the resulting complication of operation. At Gatun, each main will be equipped with a 50-kilowatt exciter mounted upon the vertical shaft in the 6-foot space which separates the turbine and the generator. When starting, after complete shut-down, the direct-connected, 50-kilowatt exciters will furnish the necessary excitation until such a time as the motor-driven exciter may be connected to the system. This selection of exciter equipment results in a very simple and easily operated system which possesses ample capacity under all conditions of operation and exceptional reserve in event one exciter is accidentally damaged.

RAIL BREAKAGES.

The weather generally gets the blame for the great railway accidents which are so characteristic of this continent. It is a happy explanation because it is a verdict which doesn't hurt anybody. Extremes of cold and heat are held responsible for the breaking and warping of rails and it has been rather hastily assumed that such "accidents" were unavoidable. The Union Pacific has, however, according to the Wall Street Journal, discovered the secret of avoiding the "unavoidable." Our esteemed contemporary says: "While a joint committee of the railroads and rail manufacturers is wrestling with the problem of eliminating the dangerous breakage of rails, Julius Kruttschnitt and his consulting engineer, John D. Isaacs, have solved the rail problem to so complete a degree that the Harriman lines are far in advance of any other roads in the country in the matter of reduction of rail breakage.

In crucial form the rail problem has been a winter problem. During the winter of 1911-12 there was an epidemic of broken rails on a score of roads, attributed without exception to the severity of the cold weather. The Harriman lines have discovered a remedy for the cold weather rail breakage so effective that the number of the new rails broken during the winter months of 1909, 1910 and 1911 was no greater than the number broken in July or August. Moreover, the cold weather breakage of the new style of rails is far below the breakage of the old style rails in summer months, when they are under least stress.

The secret of the elimination of the broken rail from the Union and Southern Pacific is fundamentally a matter of "section," that is, the shape of rail. The Harriman officials solved the problem by giving the rail a heavier base During the cold weather the base of the rail has a tendency to become bowl shape. In forcing the rail back into shape there is great likelihood of starting a surface fracture. Rails, highly tempered as they are, act like glass. A good scratch on the surface is all that is necessary to cut glass. It is the same with rails. In laying rails the rail is never cut. A slight incision is made on the surface and the rail is broken. With a rail whose base is heavy enough to prevent change of shape in cold weather, obviating the necessity of forcing the rail back into shape, causing surface breaks, the percentage of breakage was reduced to practically nil.

"With 20,000 miles of road offering different styles of rail, all different sorts of climate and traffic conditions, it is obvious that the possible combinations of conditions surrounding rail breakage were infinite," said Mr. Kruttschnitt, "and it is probably for that reason that the task of solution has struck the average railroad official as hopeless. When a series of rail breaks occur, the division officials get panicky and attribute the event to some mysterious factor instead of sitting down to work out the cause.

"We simply went at the situation systematically. Mr. Isaacs suggested that we chart our rail breakages and see if it were possible to discover some law of breakage. We went over our record of breakages to discover whether any blame could be attached to the various kinds of rail, localities or traffic. The result was as simple as astounding.

"We found that the 90-pound rail of the shape in general use gave an average of 6 breakages to the 100 miles during the summer months when the mean temperature was about 75 degrees, and 23 breakages per 100 miles in winter with the temperature around 40 degrees. We found that the rail with heavier base gave only two breakages to the 100 miles in the winter months, the same average as during the summer months, so that so far as the Harriman lines are concerned the rail problem is solved. We are proud of our rail record. We feel that we have solved the problem for all the roads. Of course, we have been careful in giving our orders to the mills we had found most reliable and have insisted on a high grade rail, but it is the shape of rail that has solved the problem fundamentally."

The experience of the Union Pacific is important, because if there is any way of preventing at any cost the deplorable accidents that occur every year through broken rails, there will be a public demand for its adoption, which neither the railway companies nor the legislatures can afford to ignore.

THE CANADIAN NIAGARA POWER COMPANY.

The annual report of the Queen Victoria Niagara Falls Park Commission states that in the month of August, 1911, the Canadian Niagara Power Company, Niagara Falls, Ont., asked permission of the commissioners to proceed with certain alterations and improvements at the entrance to their forebay. The officers and engineers of the company represented to the commission that they had encountered serious difficulties in operating their plant when the ice conditions in the river rendered it practically impossible to keep their intake clear. These conditions were acknowledged to exist by the superintendent of the park, but before taking action the commissioners thought it desirable to submit the matter to an hydraulic expert of large experience, Mr. Henry Holgate, C.E., of Montreal. The nature of the relief asked for by the Canadian Niagara Power Company was:

First.—The building of an ice shield some sixty feet in front of the present ice racks or about one hundred and fifty feet distant from the centre line of the bridge spanning the intake, and parallel with it.

Second.—The construction of an open canal to extend from the water's edge of the Niagara River to the southerly extremity of the forebay for the purpose of increasing the current of water across the intake arches northward to the ice sluiceway, in order to force the ice entering the forebay to pass out into the river.

Third.—The alteration to the entrance of the ice sluiceway so as to provide for more easy access for the water currents carrying ice.

Fourth.—Placing a submerged weir from the northerly side of the intake into the rapids at an angle with the lines of current, so as to provide for the mean water being raised about three feet.

Mr. Holgate reported upon the plans submitted and practically agreed with the company that the works of improvement were necessary for the efficient operation of the plant. He also expressed the belief that they might be carried out under proper restrictions without doing violence to scenic effects.

The commissioners, however, while fully realizing the importance of the company of ameliorating the ice difficulties, could not see their way to adopting the entire scheme of improvements without certain modifications. It was represented by the commissioners that an open canal, however important from an hydraulic point of view, was not a desirable feature for the park at this point, particularly when so much bridge work already existed, and they suggested that the company should construct underground conduits in place of an open canal. Apprehension was also felt that the construction of a submerged weir would tend to destroy the naturally turbulent condition of the surface of the rapids for some distance upstream, and create an artificial millpond appearance. Approval, therefore, of the construction of a submerged weir was withheld until a reliable expert in [illegible] could be consulted on this phase of the matter. To this end the company obtained expert opinion on that special feature of the proposed works from Mr. William Kennedy, Jr., hydraulic engineer, Montreal, acting on behalf of the [illegible]; Mr. [illegible], engineer, [illegible] of the International Waterways Commission, and [illegible] hydraulic engineer, Mr. C. C. Egbert, [illegible] [illegible] [illegible] [illegible] of the water [illegible] the [illegible] of the water surface [illegible]. This plan received the approval of the advisory hydraulic engineer for the board, and the whole matter is now being reduced to an agreement accompanied by plans and specifications. The commissioners, however, are safeguarded by a clause in the agreement distinctly stipulating that, in the event of the irregular blocks not accomplishing the object sought, after a reasonable test, the work shall not be proceeded with.

Simultaneously with the intake improvements the Canadian Niagara Power Company conveyed to the commissioners its intention of proceeding with the power house building to its entire completion, instead of finishing the work by sections as the development and sale of power necessitated. The company also presented a plan for altering the architectural outline of the riverward elevation of the power house, showing a new structure in the centre of the building to be used for office purposes. This slight addition, which was at once approved, completely changes the forebay facade of the building and breaks the lines of a building six hundred feet long without any relieving features. While the company is not adding to the capacity of the station beyond the sixth unit, the additional equipment from time to time required will be placed without serious disturbance to the park, so that the complete restoration of the park surface surrounding the power house may be now finished.

The company now has the following installation completed:—

Generators.	Normal Capacity.	Total.
5	10,000 h.p.	50,000
1	12,500 h.p.	12,500

FORTIER & KILPATRICK, LIMITED.

The prospectus has been issued of Fortier and Kilpatrick, Limited, incorporated under the Dominion Companies Act and licensed to do business in Ontario. The company's authorized capital is $250,000. This company has been formed for the purpose of taking over, for the province of Ontario—excepting Port Arthur and the territory lying north of the Canadian Pacific Railway between Port Arthur and Mattawa—the patent rights and also the sole right to manufacture sewer pipe with the Thomas glazed cement sewer pipe machine, also, the sole rights to manufacture and deal in Trojan partitions and ceilings, stonewood plastic flooring, sarco asphalt and waterproofing. The company have several side lines, such as washable water paint, asphalt, etc., and the right to engage in any other manufacturing and mercantile business which may be conveniently carried on therewith.

Patent rights for the Thomas glazed cement sewer pipe machine and the right to manufacture Trojan partitions and ceilings and stonewood and Trojan flooring and Sarco asphalt and waterproofing and Trojan washable water paint are being purchased and acquired by Thomas Mills for $90,000, payable as follows:—$20,000 in the capital stock of Fortier and Kilpatrick, Limited, consisting of 200 fully paid and non-assessable shares, and $[illegible] in cash.

Fortier and Kilpatrick, Limited, in addition to the purchase of the Thomas glazed cement sewer pipe machine, and all rights connected therewith for the territory named, have also purchased the rights, patents, formulas, secret processes, etc., of the Interior Construction Company of Winnipeg for the following utilities: "Trojan" partitions, ceilings, etc., "Trojan" plastic sanitary floors, and Thomas glazed cement sewer pipe.

An offering of $[illegible] [illegible] of the company is being made at par. The proceeds from the sale of this stock will be devoted to acquiring the above named rights and patents and for putting money into the company's treasury to manufacture the same. The following are the directors of the company:—Messrs. John H. Hudson, manufacturer, 93 Bernard Avenue, Toronto; George R. C. Merriam, president Traders Limited, 31 Adelaide Street West, Toronto; W. E. Whitehead, manufacturers' agent, 355 Palmerston Boulevard, Toronto; James Aitchison, barrister, Canada Life Building, Toronto; Thomas Mills, banker, 79 Clarence Street, Kingston.

◆

PERSONAL.

MR. S. HETT. B.A.Sc., has been appointed engineer in charge of revision for the Hudson Bay Railway.

MR. McARTHUR is being mentioned for the position of engineer for the municipality of Regina.

MR. E. M. KINDLE, A.B.M.S., Ph.D., a member of the United States Geological Survey, has been appointed invertebrate palaeontologist on the Geological Survey of Canada.

MR. DUNCAN McDONALD has retired from the position of manager of the Montreal Tramways Company. His position is being taken by Mr. James E. Hutcheson, of Ottawa.

MR. W. H. FISK, who has been connected with the Mackenzie-Mann interests in Mexico for the past five years, will probably be appointed to succeed Mr. W. B. Boyd as Chief Engineer of the Toronto Power Company, the Electric Development Company and the Toronto Railway Company.

MR. JAMES MILNE has been appointed electrical and mechanical engineer for the city of Toronto. Mr. Milne is at present manager of the Ontario Salt Works, Windsor. He is of Scottish birth, is 45 years of age, and has resided in Canada for twenty years. Eighteen years ago he was a teacher of mechanical and electrical engineering in the Toronto Technical School, and he has had a wide experience since that time. Mr. Milne is a street railway expert in addition to his other qualifications.

MR. ALFRED STILL, who left England in the early part of last year to take up the position of electrical engineer to the Lake Superior Power Co., of Sault Ste. Marie, Ontario, Canada, has lately been appointed chief electrical engineer the the mining department of the Algoma Steel Corporation. His headquarters will be at Magpie Mine, Ontario, where he will have charge of the electric power equipments at the various mines controlled by the company, and will also be responsible for the completion and operation of the 4,000 h.p. hydro-electric generating station connected to the mines through an 18 mile three phase overhead transmission. Mr. Still is an Assoc. M. Inst. C. E. and a member of both the American and British Institutions of Electrical Engineers.

◆

TOWN PLANNING CONGRESS.

Uuder the auspices of the Winnipeg Town Planning Commission and the Winnipeg Industrial Bureau, the first Canadian Housing and Town Planning Congress was opened in the auditorium of the bureau on July 15th last.

The president of the Winnipeg association occupied the chair, and introduced Mayor Waugh, of Winnipeg, who spoke of the object of the gathering, why it was convened, what had been done, and what it was hoped to do. The congress was called together to devise plans and means to make every city and town more beautiful, and a more attractive place in which to live—to get residents to take more pride in their houses and the surroundings.

At the afternoon session of the congress W. Sanford Evans presided, and the meeting was addressed by Dr. Charles A. Hodgetts, medical adviser to the commission of conservation, Ottawa, on "The Housing Problem"; Dr. M. M. Seymour, Regina, commissioner of public health for Saskatchewan, on "The Tenement House Question"; and a paper by Frederic Law Olmstead, chairman of the International Housing and Town Planning Congress Committee, Brookline, U.S.A., on "The Four Cardinal Points of Town Planning," was read by Dr. Perry. The general trend of the papers was in strong condemnation of the tenement residence and apartment house, which subsequently degenerated into a tenement against the evils of overcrowding; and an earnest appeal for legislation empowering the municipality to have stringent control over such houses and conditions within them, for the good of public health and the vitality of the people.

In connection with the congress an exhibition of town planning, garden cities and schemes for improvement was illustrated by plans, photographs, charts and other data. The exhibit was displayed on the four walls of the room in which the meetings were held.

The Social Museum of Harvard University contributed a series of pictures and plans. The series included views of housing conditions in several cities; of garden suburbs; of city planning; of model cottages and modern dwellings. A feature of this exhibit was the illustrations of slums and slum life in larger cities of the old and new worlds. Attention was drawn to the dark bedrooms of the slum-areas where crowded humanity lives and suffers, from which sunlight and fresh air are excluded by gigantic skyscrapers. The methods adopted to remove the eyesore by the erection of attractive dwellings and by the creation of open spaces is indicated. There was a large assortment of exhibits from cities in the United States, New York, Kansas, Minneapolis, Tampa, Florida, New Orleans, Louisville, Harrisburg, all contributing; but the feature was supplied by a few of the plans of the proposed improvements in Chicago; and which represent a scheme which had foresight been employed a few years ago would have saved the city no less a sum than $300,000,000. Kansas City views showed park situations before and after improvement. Pittsburg was represented by an eyesore, as the exhibit is a view of an open sewer in the middle of a street which exists to-day.

The model towns of England, Bournville and Port Sunlight were beautifully illustrative of the ideal the city-planner aims at. Liverpool had an exhibit showing the improvements effected in the slum district of the Bevington area, necessitated by the "Housing of the Working Classes" Act. The garden suburbs of Hampstead, with the grouping of co-operative housing which eliminates the servant problem, were effectively shown. Edinburgh, old and new, its magnificent streets and fine buildings were illustrated in a series of photographic views. Manchester and Birmingham each had their representative exhibits. Germany and conditions in Germany were adequately shown, but of especial mention were certain Mannheim views, where the usually hideous gas tank is made an architectural centre from which the streets of the town radiate, and the interior park arrangement for sunlight and fresh air, adapted in the "Alfredshop" colony, Essen.

France was illustrated in a garden suburb and model village views. Perhaps the most interesting exhibit of all was the newspaper cuttings of the plans for the new federal capital of Australia, Vass-Canberra, New South Wales, which took first and second places respectively in the competition; while also shown was a copy of one of the competitive designs for the city improvement of Montevideo, conducted by the Republic of Uruguay.

The following is a partial list of delegates:—

Mayor Waugh, C. D. Sheppard, J. W. Harris, Dr. Mattice, J. D. Atchison, C. F. Bennett, H. Falk, H. Edwards, W. W. Willis, Winnipeg; J. T. May, C. Chambers, Toronto; J. P. Gilroy, Isaac Cowie, N. T. McMillan, W. Fingland, R. S. Ward, R. Martinson, W. Pearson, C. F. Roland, W. Sanford Evans, Paul Clemens, G. F. Chapman, W. Furnival, Winnipeg; M. H. Ross, Regina; M. Wilson, F. Saunders, J. Antonison, T. J. Townshend, Moose Jaw; Dr. T. H. Hodgetts, Ottawa; A. W. Boilfus, Chicago; M. L. Kenzie, Brandon; J. East, Dr. Whitlaw, Edmonton; Victor Mager, St. Vital; J. P. Marshall, Battleford; W. Smith, Kirkella; H. Goodie, Port Arthur; Mayor Armstrong, Edmonton; J. Caldwell, Virden; A. M. Jeffries, Edmonton; H. D. Pickhard, Brandon; G. W. Hayler, London.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention at Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton; [illegible] Treasurer, Mr. K. W. [illegible], County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George [illegible]; Sec.-Treasurer, E. Hingley, Regina, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; Sec.-Treasurer, [illegible], Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, [illegible]; Hon. Secretary-Treasurer, J. W. McCready, City Hall, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible]; Sec.-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor [illegible], B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey [illegible].

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, [illegible], Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5 Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phoenix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-5—	Electric Generating Machinery, Canora, Sask (S.)	7-18

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Boisedale, N.S., wharf	July 24.	July 11.	68
Calgary, Alta., three bridges	July 31.	July 11.	67
Canora, Ont., electric generating machinerv	Aug. 5.	July 18.	78
Edmonton, Alta., gas holder and tank	Aug. 9.	July 4.	67
Edmonton, Alta., gas plant	Aug. 23.	July 18.	67
Edmonton, Alta., steel pipes and specials	July 31.	Julv 4.	67
Hamilton, Ont., motors, etc.	July 24.	July 11.	78
Islington, Ont., storm sewer	July 23.	July 18.	78
Kingston, Ont., steam roller and heating kettle	July 23.	July 18.	78
Kingston, Ont., model and gun shed	July 29.	July 11.	68
Kirkfield Park, Man., incinerator	Aug. 8.	July 18.	78
Marble Cove, N.B., dredging	July 23.	July 18.	67
Miniota, Man., bridge, Ten Mile Creek	July 24.	July 18.	67
Moose Jaw, Sask., steam-electric machinery	Aug. 1.	July 4.	80
New Liskeard, Ont., sidewalks	Aug. 1.	July 18.	80
North Toronto, Ont., pavements	July 30.	June 27.	80
Norway House, Man., school and hospital	Aug. 19.	July 11.	68
Orillia, Ont., concrete walks	July 29.	July 18.	80
Orillia, Ont., wharf and approach	July 29.	July 11.	68
Ottawa, Ont., Hudson Bay Rly.	Aug. 1.	June 20.	80
Ottawa Ont., designs for monument	Oct. 1.	Apr. 18.	60
Pas Reserve, Sask., school building	Aug. 19.	July 11.	68
Point Grey, B.C., plans for university	Julv 31.	Feb. 7.	60
Regina, Sask., office building	July 27.	July 18.	68
Reeds' Point, N.B., breakwater	July 24.	July 4.	68
River Bourgeois, N.S., dredging	July 30.	July 18.	67
Sault Ste. Marie, pavements	July 29.	July 18.	78
Seaforth, N.S., breakwater	July 24.	July 11.	68
Ste. Felicite, Que., landing pier	July 31.	July 11.	68
Sudbury, Ont., sewage disposal works	July 29.	July 18.	68
Toronto, Ont., pavements and storm sewers	July 30.	July 4.	78
Watrous, Sask., pump house, machinery and well	July 31.	June 27.	68

TENDERS.

Banff, Alta.—Tenders for the erection and completion of a public school building at Banff, will be received up to July 27th, 1912, plans and specifications at the office of the architects, Messrs. Lang and Major, Suite 11, Board of Trade Bldg., Calgary, or William Mather, Banff, Alta.

County of York, Ont.—Mr. Frank Barber, engineer of this county, will receive tenders up to noon Monday, July 29th, 1912, for the construction of a concrete retaining wall at Eagle Bridge on the Humber River. (See advt. in this issue of Canadian Engineer.)

Edmonton, Alta.—Tenders for the supply of hardwood doors for the south wing and rotunda of the Parliament Buildings, Edmonton, will be received up to July 26th, by John Stocks, Deputy Minister of Public Works, Edmonton. Specifications etc., at the structural engineer's office, New Parliament Buildings, Edmonton, and at the branch office of Dept. of Public Works, Calgary.

Fort William, Ont.—Tenders for a new public school, Wayland addition, will be received until July 25th. Plans and specifications at the office of R. E. Mason, architect, Victoria Block, Fort William.

Fort William, Ont. — Tenders for alterations and additions to public school, Schreiber, Ont., to be received until July 24th. Plans and specifications at the office of R. E. Mason, architect, Fort William.

Fork River, Man.—Tenders for the erection of a steel bridge across Fishing River, 30-ft. span, will be received by D. F. Wilson, sec-treas. Massey River Municipality, Fork River, Man., until July 27, 1912.

Hamilton, Ont.—Tenders for the construction of sewers on a number of streets and avenues will be received until July 24th, 1912. Plans and specifications at the office of the City Engineer. S. H. Kent, city clerk.

Moose Jaw, Sask.—The City Commissioners will receive tenders until August 1st, 1912, for the supply and delivery of the following f.o.b. cars Moose Jaw:

160 6.6 ampere series metallic flame lamps.
150 automatic cut out hangers.
Mercury rectifier and other station equipment for 200 6.6 ampere lamps.

Specifications, etc., may be obtained on application to J. D. Peters, electrical superintendent, Moose Jaw.

New Liskeard, Ont.—Tenders for the construction of about 26,000 square feet of cement sidewalks in the town of New Liskeard will be received until August 1st, 1912. Plans, etc., at the office of C. H. Fullerton, town engineer. J. I. Dixon, clerk. (See advt. in Canadian Engineer.)

Ottawa, Ont.—The Dominion Government is calling for tenders for the construction of the Government elevator at Port Arthur, bids to be in by August 1st.

Ottawa, Ont.—Tenders for the construction of a new drill hall at Minnedosa, Man., will be received until noon of July 24th, 1912. Specifications at the office of the Officer Commanding Military District No. 10, Winnipeg; Officer Commanding "D" Squadron, 12th Manitoba Dragoons, Minnedosa, Man.; the Director of Engineer Services, headquarters, Ottawa, and at the office of the District Engineer, Fort Osborne Barracks, Winnipeg. E. Fiset, Deputy Minister, Department of Militia and Defence, Ottawa.

Ottawa, Ont.—Tenders for the supply of coal for the public buildings throughout the Dominion will be received by the Secretary Dept. of Public Works, Ottawa, up to August 28th, 1912. Specifications, etc., at the secretary's office. (See advt. in Canadian Engineer.)

Ottawa, Ont.—Tenders for the construction of a Model and Gun Shed at Royal Military College, Kingston, Ont., will be received by the Director of Contracts, Dept. of Militia and Defence, Ottawa, up to noon of July 2[illegible], 1912. Specifications, etc., at the offices of the Officer Commanding the No. 3 Divisional Area and the Commandant Royal Military College, Kingston, Ont.; and the Director of Engineer Services, headquarters, Ottawa. E. F. Jarvis, Acting Deputy Minister, Dept. of Militia and Defence, Ottawa. (See advt. in Canadian Engineer.)

Ottawa, Ont.—Tenders for dredging required at Weymouth, N.S., will be received at the office of R. C. Desrochers, Sec. Dept. of Public Works, Ottawa, until July 24th, 1912. Full particulars at the office of the secretary.

Ottawa, Ont.—The Dept. of Militia and Defence will receive tenders up to noon of August 6th, 1912, for the construction of a new drill hall at Omemee, Ont. Specifications, etc., at the offices of the Officer Commanding the 3rd Division, Kingston, Ont.; Officer Commanding "D" Company, 45th Regiment, Omemee, Ont.; and of the Director of Engineer Services, headquarters, Ottawa.

Ottawa, Ont. — Tenders will be received by the Secretary Department of Public Works, Ottawa, up to July 31st, for interior fittings, post office, Strathcona, Alta. Plans, etc., to be seen on application to Mr. D. F. McHardy, clerk of works, Strathcona, Alta., and at the Department of Public Works, Ottawa.

Ottawa, Ont.—The Dept. of Militia and Defence will receive tenders up to noon of August 6th, for the construction of a new drill hall at Norwood, Ont. Specifications at the offices of the Officer Commanding 3rd Division, Kingston, Ont.; Officer Commanding "E" Company, 40th Regiment, Norwood, Ont.; and the Director of Engineer Services, headquarters, Ottawa.

Ottawa, Ont.—Tenders for the construction of an extension to West Breakwater at the entrance of Cobourg Harbor, Ont., will be received until August 14th, 1912. Plans, etc., at the offices of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto; J. L. Michaud, Esq., district engineer, Merchant Bank Building, Montreal, Que.; on application to the Postmaster at Cobourg, Ont., and at the office of R. C. Desrochers, Secretary Department of Public Works, Ottawa. (See advt. in Canadian Engineer.)

Regina, Sask.—Sealed tenders for "electrical plant" will be received by the City Commissioners up to noon of September 14th. (See advt. in Canadian Engineer.)

Toronto, Ont.—Tenders will be received up to and including the first day of October, 1912, for the right to cut white and red pine and spruce in the district of Nipissing, Ont. For full particulars apply to W. H. Hearst, Minister of Lands, Forests and Mines, Toronto. (See advt. in Canadian [illegible]

Toronto, Ont.—The Chairman of the Board of Control will receive tenders up to noon on Tuesday, August 13th, 1912, for the construction and erection of the drip guards on the Lansdowne Avenue subway. (See advt. in this issue of Canadian Engineer.)

Vancouver, B.C.—The Dept. of Public Works will receive tenders until August 1st, for alterations to Lobnitz Rock Cutter No. 1. Plans, etc., at the office of William Henderson, Esq., res. architect, Victoria, B.C.; C. C. Worsfold, [illegible] Westminster [illegible] British Columbia, Post Office Bldg., Vancouver, B.C.

Victoria, B.C.—Tenders are being invited by the De- [illegible] Public Works [illegible] at Crescent Valley and Nicola, and for the construction of a [illegible]

Watford, Ont.—Tenders will be received up to August [illegible]

Winnipeg, Man. [illegible] advt. in Canadian Engineer.)

York Township, Ont.—Tenders for concrete sidewalks [illegible]

CONTRACTS AWARDED.

Arden, Man.—The contract for the erection of the steel bridge, with concrete abutments, over Grassy River, has been awarded to the Algoma Steel Bridge Company, at $4,586.

Edmonton, Alta.—Wharf: Contractors, Smith Bros., Ltd., of Edmonton.

Embro, Ont.—Messrs. Bain and Ross have the contract for building a large cement breakwater at London.

Fort William, Ont.—The contract of Messrs. Stewart and Hewitson for the grading and graveling of Southern Avenue has been accepted.

Gananoque, Ont.—The contract for the new armouries building in Gananoque has been let to John Dillon, of Seeley's Bay. His tender was $1,500 less than the next lowest. Work is to be commenced at once.

The tender of E. A. Blakeley, Ottawa, has been accepted by the department of public works, for the erection of the new post office building in Gananoque, at the corner of King and Stone Streets. It is understood that work will be started at once.

Guelph, Ont.—Messrs. Taylor Bros., of this city, have secured a contract from the authorities of the Agricultural College to erect a large barn. The moving of a residence for the same authorities has been awarded to Mr. Rogers.

Kemptville, Ont.—Public building: The Dominion Concrete Co., Ltd., of Kemptville, Ont.

Kerrisdale, Point Grey, B.C.—At the meeting of the council contracts were awarded as follows: Grading Salisbury Street, J. Cameron; clearing Eighteenth Avenue, Linberg and Lund.

Medicine Hat, Alta.—The contract for the building of the new Union Bank has been awarded to Mr. N. Healy, of Calgary, whose tender was $27,000.

The Lussier Construction Co. have the contract for the erection of the public school at South Yuill. The contract price is $40,000.

Miramichi Bay, N.B. — Dredging: Contractors, The Northern Dredging and Construction Co., Ltd., of Chatham, N.B.

Moose Jaw, Sask.—Messrs. A. P. Smith Manufacturing Company, East Orange, N.J., have been awarded the contract to furnish a number of water gates as required by the municipal council.

New Westminster, B.C.—The Powers Construction Company, of Vancouver, have been awarded the contract to erect the horse show building and arena. The price for this work is $17,5[illegible]5.

New Westminster, B.C.—The contract for the supply and erection of the steel roof trusses for the horse show building and arena has been awarded to Messrs. John Coughlan and Sons of this city, at a price of $5,500.

New Westminster, B.C.—The municipal council accepted the tender of the Schaake Machine Works to supply a number of manhole covers at $12.80 each.

New Westminster, B.C.—Messrs. Gilly Bros. have been awarded a contract to supply about 2,000 feet of sewer pipe to the municipal council.

Province of British Columbia.—The Dominion Bridge Co., of Lachine, Que., and the Canadian Bridge Co., of Walkerville, Ont., have been awarded the contract to supply and erect the super-structures of ten railway bridges for the Canadian Northern Railway in this province.

The Armstrong Morrison Co., Vancouver, and the John Galt Engineering Co., of Winnipeg, have received the contract to supply and erect the substructures of eight bridges for the C.N. Railway in this province.

Sault Ste. Marie, Ont.—Dredging: Contractors, The Soo Dredging and Construction Co., Ltd., of Sault Ste. Marie.

Toronto, Ont.—Tenders for the new wing of Pape Avenue School and also for the enlargement of Perth Avenue School were opened and the following tenders accepted:

For Pape Avenue School:—G. T. Gayton, mason and steel work, $[illegible]; [illegible] and [illegible], carpenter work, $7,400; F. Armstrong and Co., heating and ventilating, $[illegible] and plumbing, $[illegible]; [illegible] Flowers, roofing and tinsmithing, $[illegible]; fireproof floors, R. Bennett, $1,0[illegible]; and plastering, [illegible] Jackson, $[illegible]

Main Street, Picton, Ont., showing the Tarvia Modern Pavement.

Picton's Experience with Tarvia Modern Pavement

Mr. C. B. ALLISON, Mayor of Picton, Ont., has written the following letter, which constitutes so complete an account of Tarvia that we will let it serve for our whole advertisement:

Corporation of Picton
Office of the Mayor Picton, Ont., November 25, 1911.

"Last year the Council of the Corporation of Picton decided to build as good a road as possible on part of the main street where the traffic is very heavy.

After careful investigation they came to the conclusion that the Tarvia road was the best suited for the existing conditions and the amount of money to be spent. The road was built *in the summer of 1910* and has given excellent satisfaction in every way. The surface is very hard and has withstood the heavy traffic without showing any signs of wear. Some doubt was expressed as to the possibility of the road standing the heavy frost, but on examination *in the spring* the road did not show any sign of having been damaged during the winter.

Judging from the satisfaction that this section of the road has given, I feel sure that during the year 1912 the Council will build more of the Tarvia road on our main street, and continue doing so from year to year, until the whole of our main thoroughfare is constructed of this most excellent road.

I might state that personally I do not believe a better road can be built, considering the amount of money expended and material used, than that which is built with Tarvia.

Yours very truly, (Signed) C. B. ALLISON, Mayor."

THERE are three kinds of Tarvia—"Tarvia X" for road and pavement construction, "Tarvia A" for surface work, and "Tarvia B" for dust suppression and road preservation. The first two are very dense and viscid and require heat for application. "Tarvia B" is applied cold.

Booklets free on request.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

At Perth Avenue the contract for mason and steel work was awarded to W. T. Joy, $18,550; carpenter work, Crocker and Ledrew, $9,800; plastering, G. White, $2,595; painting, R. G. Johnston, $1,115; iron stair, Canadian Ornamental Iron Co., Ltd., $3,300; roofing and tinsmithing, A. Matthews, Ltd., $1,698.

Welland, Ont.—Mr. W. E. Hardison, of Welland, under the firm name of The Welland Dredging Company, has been awarded the contract to remove the sandbars which block the entrance to the canal at Kingsville.

Winnipeg, Man.—Mr. C. W. Hall, of this city, is the successful tenderer for the building contract for the new arena of the Winnipeg Fair and Live Stock Association. The contract for the steel work of the structure was some time ago awarded to the Wisconsin Steel and Iron Company of Chicago.

◆

RAILWAYS—STEAM AND ELECTRIC.

British Columbia.—The experiment of burning oil in the locomotives of the Canadian Pacific Railway through the Rocky Mountains has so far proved a decided success.

British Columbia. — Messrs. Waddell and Harrington, consulting engineers, have prepared designs for ten railway bridges, the contracts for which have recently been awarded. They are for the Canadian Northern Railway.

Halifax, N.S.—The operation of the Halifax Electric Tramway Company still continues to make increased profits as shown by the following: Receipts for the week ending July 14th, 1912:

1911.	1912.	Increase.
[illegible]	[illegible]	$416.45

Montreal, P.Q.—A company known as the National Steel Car Company has been organized with offices at the Transportation Building with a capital of $6,000,000.

Revelstoke, B.C.—Canadian Pacific officials here are considering the report of the engineers in the field trying to get a better grade for the proposed double-track of the line through the mountains. It is stated that surveys show that by driving of a tunnel for a distance of five miles through the Selkirks, starting at Bear Creek and emerging below Glacier, a new grade that will be less than one per cent. against western traffic will be available. By a diversion at Notch Hill, just east of the Kamloops, the grade there could be cut down to the same, which would make one per cent. the maximum from Calgary to the coast. It is stated that the company will proceed with this work of double-tracking in order to have the easy grades available for the handling of wheat crops by the time of the opening of the Panama Canal.

◆

LIGHT, HEAT AND POWER.

Harrison, Ont.—There is a possibility of new electric lighting methods being adopted in the town owing to the [illegible] of the plant now furnishing the supply that the service will be discontinued after [illegible]. The plant is badly in need of repair.

Ottawa, Ont.—The Dominion Government Commission [illegible] countries, [illegible] of others. [illegible] commercial exploitation [illegible] demonstrated.

Portsmouth, Ont.—The council of this municipality are [illegible]

◆

COPIES OF THE ENGINEER WANTED.

[illegible]

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—The city council has passed a by-law providing for the construction of a filtration plant at a cost of $400,000.

Fort William, Ont.—Owing to a mistake in the estimation of a tender for the construction of a sewer the contractors have asked to be released from the agreement. The council will do the work by day labor and apply the contractors' deposit cheque toward the expense of the same.

Montreal, P.Q.—The medical health officer has petitioned the council in order that the practice of cutting off the water supply of persons in arrears of payment be stopped claiming that in many instances these persons are the ones most in need of the substance.

Moose Jaw, Sask.—The following tenders for the supply of high pressure hydrants have been received by the council:

Florence Iron Works, per R. D. Wood and Co., 8 inch connection with main three nozzle openings, $175 each; same with flange connection, $175; same with universal connection, $177.

Wilson, Townsend and Saunders, same hydrant as per specifications furnished by city, $180; with flange connection, $180; with universal connection, $190. Second proposition delivery of 40 hydrants in 90 days at $180 each and balance by May 15, 1913, at $170 each.

The A. P. Smith Manfg. Co., East Orange, N.J., U.S.A., hydrants as per specifications, $134.55; flange connection, $134.55; universal connection, $135.85. Second proposition to deliver in 45 days forty hydrants at $134.55, and balance by May 15th, 1913, at $134.55.

The Kerr Engine Co., of Walkerville, Ont., hydrants as per specifications, $242.30; with flange connection, $242.30.

Drummond McCall Co., of Montreal, hydrants as per specifications, $147.50; flange, $151.75; with universal connection, $150.40. Second proposition to deliver forty hydrants in ten weeks at same price and balance by May 15, 1913, at the same price.

Ste. Cecile, P.Q.—Owing to a severe pollution in a well which serves many families in this community with water, the city of Montreal will lay a temporary pipe line. The distance between the two municipalities is several miles.

Toronto, Ont. — The municipal council have ordered plans prepared for an extension of the filtration plant. Mr. Allen Hazen will execute this work.

Welland, Ont.—The new municipal water plant has been placed in operation with satisfactory results.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Eburne, B.C.—A report states that the British Columbia Electric Railway are making preparations for a new station and freight shed for this point.

Fraser River, B.C.—The Department of Marine and Fisheries are making preliminary arrangements for the erection of a lighthouse on this river. Tenders will be called for its construction soon.

Fredericton, N.B.—The Fire Committee have received instructions from the council to proceed with the erection of a new fire station at a cost of $12,000.

Galt, Ont.—The management of the Galt Robe Works are making preparations for an expansion of their present plant.

Mitchell, Ont.—The White Packing Company, of Stratford, are making arrangements for the erection of a cold storage plant at this point.

Montreal, P.Q.—The Christian Brothers, of Longueuil, are making preparations for the erection of a technical school. Government aid will be sought for the new project, and, if secured, work on the building will be inaugurated without delay.

Port Arthur, Ont.—A British firm of iron workers trading under the name of [illegible] Company, will locate a branch factory in this city. The firm specialize in valves, hydrants and structural steel.

Port Arthur, Ont.—A report states that preliminary arrangements are under way for an enlargement of the Prince Arthur Hotel. Mr. McLean is manager of this business.

Quebec, P.Q.—Tenders for the construction of pier No. 2, which will extend from the Louise Embankment northeast into the river St. Charles, parallel with the breakwater extension, will be advertised in a few days. The construction of

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

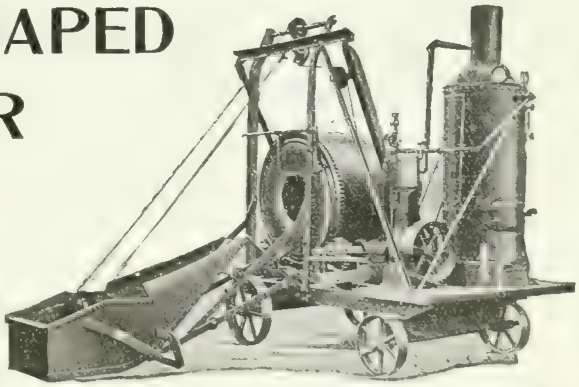
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER
HEART-SHAPED
MIXER

Write for
1912
Catalogues.



A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH.
BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

this pier with the dredging necessary is estimated to cost about $1,000,000.

Saskatoon, Sask.—Mr. Frank Cahill is making preparations for the erection of a $75,000 business block in this city.

St. Catharines, Ont.—The Canadian Bank of Commerce has started work on a new office structure in this city. Mr. Connelly is the local manager.

St. John, N.B.—The management of the Union Foundry and Machine Works are making preparation for several changes which are to enlarge the plant to a considerable extent. Mr. George H. Waring is president and manager of this concern.

St. Thomas, Ont.—The local corps of the Salvation Army are making arrangements for the enlargement and remodelling of the barracks. This work will entail an expenditure of about $7,000.

Toronto, Ont.—The management of the Union Stock Yards in the western portion of this city have let a contract for the construction of a cattle pen with a capacity of five thousand head of sheep. Many additions to the cattle pens are planned for the early part of 1913.

Victoria, B.C.—The municipal council are about to alter the market building in order to improve the police station accommodation.

Welland, Ont.—The management of the Metal Chemicals, Limited, have purchased the property formerly occupied by the Electro Steel Company and ten acres of adjoining property. They will reconstruct the plant for the purposes of refining cobalt and other ores. Officials of the company are all New York men. They are: President, Joaquin W. de Aguero; vice-president, E. de Aguero; secretary-treasurer, J. H. Charles; director, G. W. Van Ness; chemical expert, Prof. Richardson. Mr. Charles is also secretary-treasurer of the Mussen Book Company.

Western Canada.—The management of the Hart Accumulator Company, of London, England, are considering the establishment of a branch factory in this country. Winnipeg and Fort William are being considered as probable locations.

Winnipeg, Man.—The Knights of Columbus and Catholic Club of Winnipeg have had plans prepared and will start work on a new building 120 x 70. The building will be of fireproof construction and will cost about $150,000. The contracts will be awarded this fall.

◆

BRIDGES, ROADS AND PAVEMENTS.

Moose Jaw, Sask.—Moose Jaw Construction Co., laying 373,380 square feet of walks at 15⅞ cents per square foot, or $59,274.07; laying 78,000 lineal feet of curb and gutter at 62½ cents per lineal foot, $48,750.

Rawlins, Lowndes, laying 373,380 square feet at a price of 18 cents per square foot, also laying 78,000 lineal feet of curb and gutter at 55 cents per lineal foot.

L. C. Gibson and Co. tender for work north of the C.P.R. tracks approximately 200,000 square feet at 18 cents per square foot; laying 50,000 lineal feet of curb and gutter at 55 cents per lineal foot. For work in South Hill curb and [illegible] cents per lineal foot, and sidewalks [illegible] cents per square foot.

Moose Jaw, Sask.—Plans have been submitted to the council showing the method of strengthening the Fairford Street and Athabasca Street culverts. This work is estimated [illegible]

◆

FIRES.

Quebec, P.Q.—The [illegible] and power house, [illegible] River, at St. [illegible] Railway, Light, Heat and Power Co., [illegible]

Vancouver, B.C.—A business block and the car barns of the British Columbia Electric Railway were destroyed by fire [illegible] million dollars.

◆

CURRENT NEWS.

Montreal, P.Q.—The [illegible]

water and coming from the plant of a local manufacturer. It is the intention of the authorities to prosecute on account of a possibility of disease producing organisms being among the number.

Ottawa, Ont.—The Federal Government are considering the construction of two fishery protective cruisers for the Pacific Coast and are inviting proposals for their construction. They are to replace the cruisers now in place and are to be much faster.

Ottawa, Ont.—Government jobs aggregating four million dollars will be put at tender this week. There are two big harbor works, one at Quebec and the other at Victoria, each costing two million dollars. The Quebec improvement consists of the construction of another large pier for ocean liners, along with sheds, and considerable dredging and filling.

Ottawa, Ont.—A peculiar circumstance is again noted in connection with the recent outbreak of typhoid fever in this city and while there are quite a number of cases on the Ottawa side of the river, in Hull there is only one case of typhoid known to the authorities. It will be remembered that while Ottawa suffered from the severe epidemic of typhoid last year, the disease was practically unheard of in Hull. This is taken by some to indicate that the source of contamination of the Ottawa water is not the general condition of the river but is after the river water enters the intake pipe.

Ottawa, Ont.—A peculiar accident necessitated the temporary closing of the Booth Lumber Mills. The flume which carries the water for turbine driving became choked with sawdust and closed the supply.

Port Arthur, Ont.—The local newspapers publish a report of an interview with Sir Donald Mann, the Canadian Northern Railway regarding the steel works to be erected in this city. According to this report the investors joining the enterprise are sending out experts to gain first hand information on the project.

Toronto, Ont.—The municipal council will call tenders in a few days for the concrete and steel work in connection with Bloor Street Viaduct.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending July 8th, 1912:—

An English firm manufacturing liquid metal polish desire to introduce it to the Canadian market, and would like to hear from importers and agents.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.

A Scottish company manufacturing soap and candles are looking for an energetic Canadian firm to handle their agency.

A London company manufacturing tar products, such as coal tar, pitch, creosote oil; and also disinfectants such as carbolic powder, pine fluid, disinfecting fluid, etc., wish to arrange for representation in Canada.

◆

PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout & Maybee, Manning Chambers, Toronto, from whom further particulars may be obtained:—

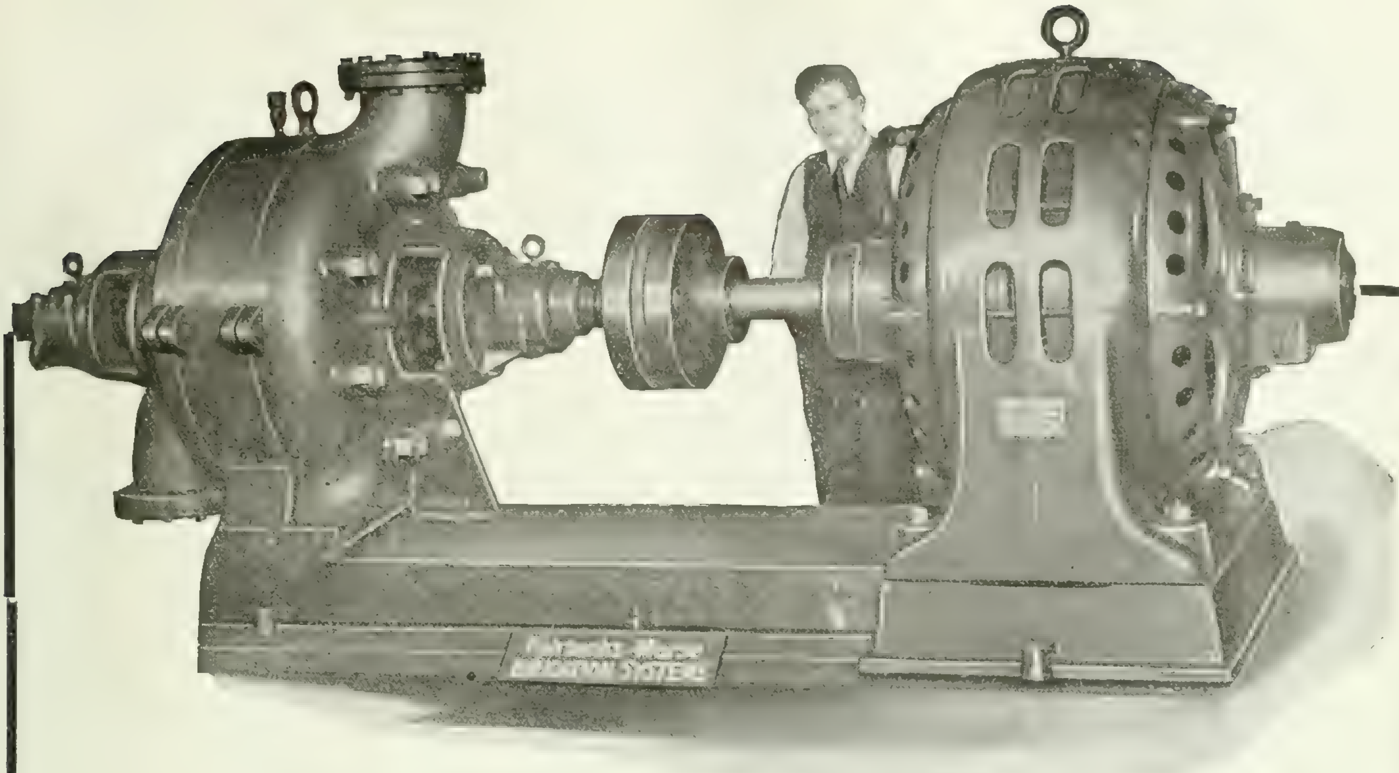
Canada:—G. G. Bell, electric cooking apparatus, (storage); Charles Caille, process and apparatus for heating steam or feed water (Case F); A. Brake and A. A. Dickson, molding machine; F. S. Henning and G. Murchison, chlorinating apparatus, (suction); Sydney Moody, saddle pillars and attachments for cycles; J. T. Drury, manually operated air pump.

United States:—A. D. [illegible], pencil sharpener; A. D. Welker, starting and stopping device for motor mechanism.

◆

PATENT FOR SALE.

Will sell Canadian rights and patents just issued on the [illegible] Rotary Pump. Most powerful pump manufactured for its weight and size. Extensively used in the United States, being adopted by the leading [illegible], breweries, creameries and for agricultural purposes. Low cost to manufacture. Simple in construction. Address inquiries to J. M. Crennan, Braddock, Pa.



The Largest Direct Connected Centrifugal Pumping Unit in British Columbia.

The Vancouver Power Company have recently installed at their works at Coquitlam Dam, B.C., the largest direct connected centrifugal pumping unit in British Columbia. This outfit is to operate in parallel with a number of other pumps that are to furnish water under pressure for sluicing into place the material for their new dam.

This pump is a 10-inch, class "F," two-stage centrifugal, with bronze inpellers and renewable bronze diffusion vanes. It has a normal capacity of 1833 imperial gallons per minute when operating at 1160 r.p.m. against a total head of 355 feet or an equivalent pressure of 154 lbs. per square inch. It is mounted on a common sub-base with a 300 h.p. type "B," Fairbanks-Morse squirrel cage, induction motor, 2200 volts, 60-cycle, 3-phase, 1160 r.p.m. at full load, being direct connected thereto by means of a flexible leather link coupling.

The motor possesses a feature in rotor construction that is unique. The end rings are welded on to the rotor bars by a new process, making a perfect joint, free from the troubles common to the purely mechanical or riveted joint, such as oxidation, working loose, and solder-throwing. This improvement marks a long step forward in the elimination of rotor trouble.

Our Vancouver Branch supplied and assembled this complete pumping unit. We are in a position to quote on the necessary equipment for any pumping requirements on receipt of specifications.

The Canadian Fairbanks-Morse Co., Limited

Fairbanks Standard Scales, Fairbanks-Morse Gas Engines
Pumps Safes Vaults

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

A NEW WIRE CATALOGUE.

We have just received an advance copy of the new wire rope catalogue of the B. Greening Wire Company, Limited, and we feel that we must congratulate this firm upon the very handsome brochure they have issued. It is evident that no pains whatever have been spared in the production of the work. The very best paper procurable in Canada is used throughout. The cover which was evidently specially designed for this issue is in excellent taste and a very striking design. The color scheme throughout is gray and black. The illustrations are off the very highest grade of halftones, and the whole is bound with a fine silk cord which will no doubt make it very serviceable and avoid the annoyance so frequently experienced with trade catalogues in their falling to pieces after they have little use. The type used in the letterpress while necessarily small on account of the size of the book is fine and clear, and the whole production reflects the greatest credit not only up on The B. Greening Wire Company, Limited, but upon the designers and printers, The Reid Press of Hamilton.

The B. Greening Wire Company, Limited, issue different catalogues for their different lines of business. This new catalogue relates to their wire rope department. The first thing that strikes the ordinary man in looking at it is the great variety of wire rope that is used. Here we have wire ropes from the heavy 2¾-in. diameter (8⅝-in. circumference) composed of 114 wires with a breaking strain of 305 tons, weighing 12 lbs, per foot, down to the finest copper cord 1/16-in. diameter composed of 42 wires with a breaking strain of 100 lbs., weighing .007 lbs. per foot. We find in wire rope of ½-in. diameter there are no less than twenty-five different kinds listed. Wire ropes of varieus constructions from galvanized strand for guying purposes, composed of seven wires, to the extra pliable hoisting ropes composed of six strands of thirty-seven wires each with a hemp centre, or 222 wires, are shown, but in addition to the large variety of qualities and constructions of wire rope shown, The B. Greening Wire Company, Limited, frequently have to make up specially wire rope of an entirely different construction to suit special extraordinary conditions or circumstances, and their experts are at all times at the disposal of their friends for consultation or advice.

Our readers will understand by the above that this catalogue embraces practically every kind of wire rope that is at all likely to be called for and for almost any purpose—all kinds of hoisting, haulage, stay or guy ropes, drilling ropes, sand lines, ships' rigging, standing, running and hawsers, ferry ropes, sash cord of bright steel wire, galvanized steel wire, or solid copper, pliable tiller ropes with 252 wires such as used for clock weights, elevator hand ropes, vessel tiller ropes, and such purposes. Hay fork rope both for the track and running rope; railway ballast plow ropes, switch ropes, and separator ropes for threshermen and traction plowing, but in addition to the ropes there are a very large number of wire rope fittings and accessories such as blocks, pulleys, sheaves, wheels, turnbuckles, clevices, hooks, thimbles, rope grease and a very explicit description of splicing wire rope, but in many instances the greater value of this catalogue to our readers would be in the notes on how to care for and use wire [illegible] ving the best kind of rope to use for different purposes.

We strongly advise any of our readers interested in wire [illegible]

◆

MONTREAL WATER AND POWER COMPANY.

[illegible]

The usual table is given, showing the steady increase of the company since the gross revenue reached the sum of $100,000,000.

Years.	Gross Revenues.	Gross Increase.
1898-9	$160,922.01	
1899-0	177,922.01	$16,[illegible]69.86
1900-1	127,230.96	10,044.86
1901-2	140,816.66	13,579.70
1902-3	148,774.70	7,958.70
1903-4	165,826.96	17,052.26
1904-5	184,838.05	19,011.09
1905-6	213,668.07	28,830.02
1906-7	263,524.36	49,856.29
1907-8	300,836.83	37,312.47
1908-9	352,810.47	51,973.64
1909-10	388,112.10	35,311.63
1910-11	432,150.87	44,028.77
1911-12	506,504.13	74,353.26

A reference to the Profit and Loss Account will show that, after providing all operating expenses, including all cost of repairs, full maintenance charges and all general and legal expenses amounting to $228,900.30, the gross profit for the year amounted to $277,603.83. From the profits of $32,822.26, brought forward from last year, there was paid a dividend on the income securities of the company, leaving $5,957 35 to be added to the $277,603.83 gross profits of this year, or a total of $283,561.18. Out of this latter sum $132,575.02, being the net cost on operating account of interest charges, was paid, leaving a net profit of $150,986.16.

This balance was employed in further strengthening the various reserves of the company, as follows, namely; $32,912.20 was set aside to provide the year's proportion of the premium due at maturity on the outstanding bonds of the company and in meeting the year's proportion of the discount, etc., on the prior lien bond issue. The sum of $20,000 was provided for meeting possible bad debts, $65,000 was added to the general reserve account for depreciation, etc., and $1,897.22 for meeting special depreciation. This still leaves a balance of $31,176.64 to be carried forward.

The system of filtration has not progressed with the rapidity hoped for and construction work on the new reservoir has also been delayed.

About eleven miles of new mains were laid during the year, and this included the sinking of a 48-in. and a 36-in. main from the site of the new reservoir to the distribution system in the Laurier Ward. The total length of pipe in the entire system is now 157.61 miles, while the average size of pipe is 12.51 inches.

The intensely severe weather conditions of the past winter coupled with the lack of snow covering, resulted in the operating expenses of that period being largely increased. The frost was in the earth to a depth of about nine feet, and consequently there was an abnormal number of frozen services requiring repairs, and the pumping charges were increased owing to householders wasting large quantities of water to prevent further freezing within their houses. In this connection, it may be stated that the consumption of water per capita was the highest in the company's history, the increase over the preceding year being about 10 per cent.

TENDERS CALLED FOR

CITY OF WINNIPEG.

Tenders for Pipe Line to Poplar Springs.

Separate or bulk sealed tenders addressed to the Chairman, Board of Control, will be received at the office of the undersigned up to 11 a.m. on Wednesday, August [illegible]th, [illegible], for the supply of labor and materials required in the construction of a [illegible]-inch Pipe Line from Winnipeg to Poplar Springs (approximately [illegible] feet long). Alternative bids are invited for cast iron, sheet steel, and wood stave Pipe. Specification and form of tender together with conditions governing tenders as prescribed by By-law may be obtained at the office of the City Engineer, [illegible] James Avenue, Winnipeg. The lowest or any tender not necessarily accepted.

M. PETERSON,
Secretary.

Board of Control Office,
Winnipeg, July [illegible].

For further Tenders see pages 78 and 80

Volume 23 Toronto, August 1, 1912

Contents of this issue on page 253

The Canadian Engineer

An Engineering Weekly

THE HIGH TENSION TRANSMISSION SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

SECOND ARTICLE.

Insulators.—Suspension-type insulators are employed exclusively on the high-tension system. The specifications called for an insulator capable of withstanding an electric strain of 330,000 volts (three times normal) dry, 220,000 volts (twice normal) under a precipitation of ½ inch of water a minute at an angle of 45 degrees and a mechanical longitudinal stress of 8,000 pounds. The strain insulators employed to take up the horizontal strain on the cable were required to withstand a tensile load of 10,000 pounds without injury.

A number of insulator factories were visited before these specifications were prepared. Data was collected regarding methods of manufacture, and the facilities of the various manufacturers were investigated for producing insulators of the required quality in sufficient quantities. The data secured from the insulator tests carried out at the different factories was so varied that the commission decided to make independent comparative tests under similar conditions on the various types and three complete sample insulators called for with each tender.

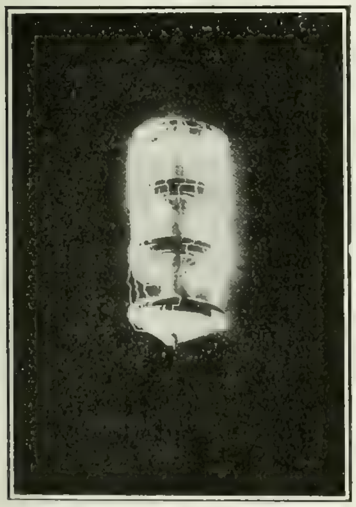


Fig. 12.—Insulators Under Test.

The insulator tests were made in the transformer station of the Ontario Power Company at Niagara Falls, Ontario. This company courteously offered the commission the use of all necessary apparatus, machinery and power, and during the tests assisted the engineers of the commission. The 330,000-volt dry test (Fig. 12) was performed in all cases. However, the 220,000-volt rain test constituted the real test of efficiency. The water was applied through a series of spray nozzles directed toward the insulators at an angle of 45 degrees. The flow was adjusted to give a precipitation of at least ½ inch a minute, which was called for in the specifications. The nozzles were arranged to subject all insulators to exactly the same conditions. These tests were performed in absolute darkness, and a large number of photographs were taken to compare the more or less vivid luminous display due to leakage and flashover. The mechanical strength of the sample insulators was also investigated and a large number of tests were performed to ascertain the ultimate breaking loads.

All tests were made entirely independent of the prices submitted in the various tenders, and the question of cost was not considered until after the final selection had been made, based on the above tests. As an evidence of the thoroughness of the tests and inspection of quality of manufacture, it may be mentioned that during the year and a half that the system has been in operation no interruptions have occurred through mechanical or electrical insulator trouble. An insulator of American manufacture was finally chosen after a few alterations in design had been made at the recommendation of the commission's engineers. The suspension type of insulator consisted of eight sections with a ball and socket connection, as shown in Fig. 13. The strain type consisted of ten reinforced sections with similar connections. These insulators were shipped assembled in crates to various railway sidings, and from there transported by team to the railway sites. The eight-section suspension-type insulators were used on standard towers. The ten-section strain type insulators were used on the line anchor, corner and long-span towers, and all special towers at railway, transmission line and navigable water-way crossings.

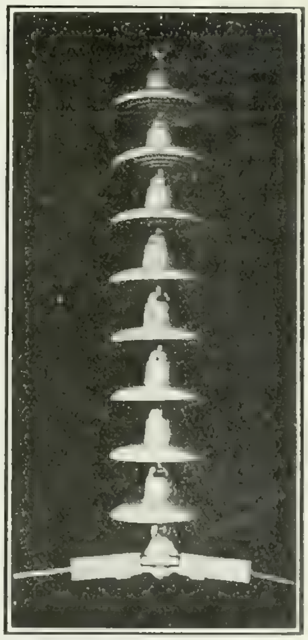


Fig. 13.—Standard High Tension Suspension Insulator.

The suspension type insulators weigh, assembled, about 100 pounds, and have an over-all length of 5 feet 2 inches, including the clamp. They are attached to the tower dross-arm by means of an eye-bolt, which is suspended from the tower arm by a galvanized U-bolt supplied by the tower contractor and placed in position by this assembling gang. The suspension insulators were hung by a gang of three men and a foreman, the insulator being raised to the arm by a line and pulley, the eye-bolt slipped into the socket in the cap of the top section and then keyed in place with a small cotter-pin. The greater portion of this work was performed in the winter and the rate of progress varied considerably, but under favorable working conditions, the gang could cover forty towers a day on single-circuit sections, three insulators to a tower. The strain insulators were not hung by this gang, but were delivered where required, and later erected by the cable gang.

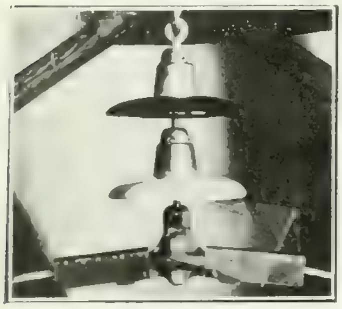


Fig. 14.—Standard High Tension Suspension Insulator Clamp.

The cable clamp employed with the standard suspension-type insulator is shown in Fig. 14. It was specially designed for this insulator and consists of a malleable-iron casting with supporting grooves and a bolted cast clip for clamping the cable. An aluminum sleeve of 1/16 inch plate surrounds the cable and serves to protect it from abrasion. The clamp for the suspension insulator is also provided with two galvanized sheet-iron shields, projecting over the cable at either end of the clamp and preventing burning of the cable by short-circuits occurring from the flash-over or failure of an insulator. All clamps and iron and steel parts are galvanized.

The strain insulator clamp, illustrated by Fig. 15, consists of two ¼ inch galvanized pressed-steel plates bolted together and provided with grooves to receive the cable. Aluminum sleeves and iron shields are also employed with these clamps to protect the cable from abrasion and burning. During the course of construction it was found advisable to place an order for a portion of the insulators with an European manufacturer, who furnished insulators of the same design and quality as those supplied by the American company. The total order [illegible] of the [illegible] the [illegible] of the [illegible] together with the necessary clamps, [illegible].

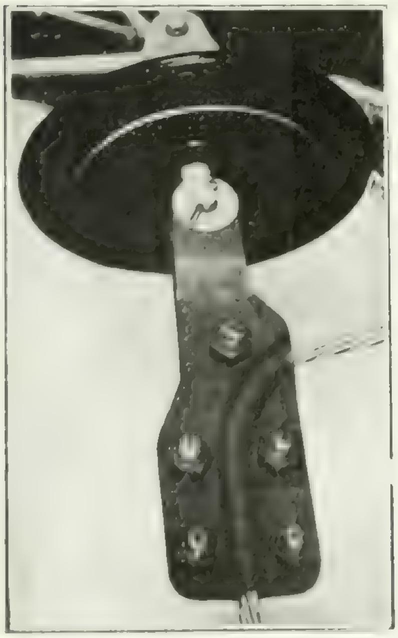


Fig. 15.—Standard High Tension Strain Insulator Clamp.

Cable.—[illegible] about three miles of copper [illegible] of Toronto, aluminum cable was used throughout the system. Two sizes were employed, No. 4/0 B &S gauge being used on the double-circuit line from Niagara Falls to Dundas, and No. 3/0 throughout the rest of the system. The cable was delivered on the field in reel lengths of 4,000 feet, and has the dimensions and characteristics specified in Table IV.

The cable gang consisted of twenty-five men, one foreman, one sub-foreman and two teams. The reels were mounted on portable frames and the cables run out three at a time by a team. As each tower was reached the cable was raised to the cross-arms and placed on wooden pulleys, suspended at the same height and adjacent to the cable clamps. When the cable on the three reels had been run out one span on each line was adjusted for sag by the commission's inspector, the sags on the other spans were allowed to adjust themselves over the pulleys.

The cables were then snubbed and men working on swings suspended from the arms removed them from the pulleys and clamped them to the insulators. While this was being done part of the gang with the sub-foreman and the other team worked in advance erecting ground cable. The ground cable is 5/16 inch, seven-strand galvanized steel, and was pulled up to the proper sag and clamped directly on the towers. On the double-circuit towers three ground cables are employed with two power circuits (Fig. 16) and two ground cables with one power circuit. The single-circuit towers are provided with a single ground cable.

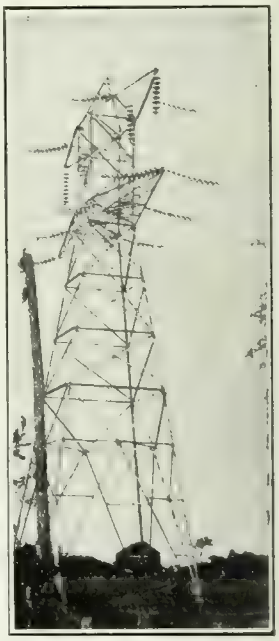


Fig. 16.—Standard Double-Circuit Anchor Tower.

Cable splicings (Fig. 17) were made by means of 18-inch and 22-inch aluminum McIntyre sleeves, the specifications called for sleeves providing for two and one-half complete turns. The ground cable splices were made by means of a specially designed connector. Cable sags were adjusted in the field according to sag tables which were compiled with reference to temperature and length of span. Calcula-

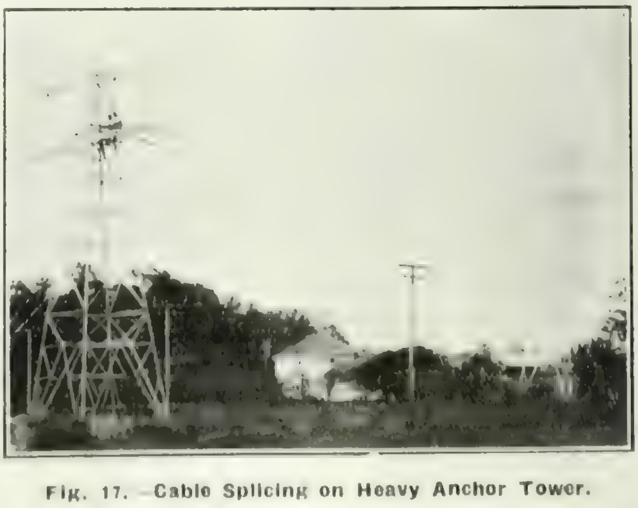


Fig. 17.—Cable Splicing on Heavy Anchor Tower.

tions were based on the assumption that the cables would be stressed to the elastic limit at 32 degrees Fahrenheit with a 3/8 inch coating of ice and a 65-mile gale. The minimum ground clearance allowed was 20 feet.

The rate of cable erection varied greatly, depending not only on weather conditions and topography, but upon the number of railways and transmission lines encountered. (Fig. 18). The erection of strain insulators and the forming and adjusting of loops on anchor and crossing towers seriously affected the progress of the work on some sections of the line. On double-circuit sections, where six power cables and three ground cables were erected, the average rate of erection was from ½ mile to 6/10 mile of the completed line a day. The labor cost varied from $110 to $215 a mile, the average being $130 for a mile of completed line. The rate of erection for three power cables and the ground cables was from ½ mile to ¾ mile of line a day, and the labor cost averaged about $80 for a mile.

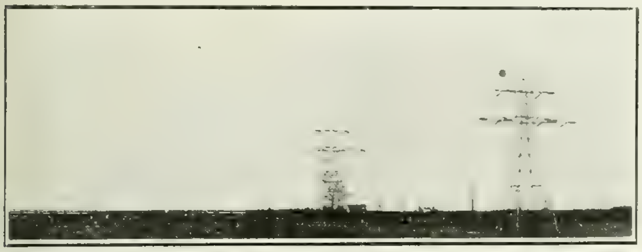


Fig. 18.—Typical Double-Circuit Transmission Line Railway Crossing.

Special Construction.—The most important special construction is located within the corporate limits of Toronto, where the high-tension line (Fig. 19) is carried to the Strachan Avenue station. This section of line is supported on towers giving 70-foot minimum ground clearance, and for a distance of about a mile the towers are located in Lake Ontario, 200 feet from the shore. Reinforced-concrete piers, cross-braced with steel girders 15-feet above water-level and protected at their bases by heavy hand-laid rip-rap support the tower bases.

Fig. 19.—High Tension Transmission Line in Humber Bay, Toronto Entrance.

Table IV.—Cable Diminsions and Characteristics.

	No. 0000.	No. 000.
Over-all diameter	.530 in.	.470 in.
Number of strands	7	7
Diameter of strands, average	.1756 in.	.1559 in.
Elastic limit, lbs. per sq. in.....	14,000-15,000	14,000-15,000
Ultimate strength, lbs. per sq. in..	24,000-27,000	24,000-27,000
Conductivity	61	61
Weight per mile	1050 lb.	816 lb.
Total miles single aluminum cable erected	312.2	673.8
Total weight of aluminum cable erected	164 tons	275 tons

HOW CITY PLANNING BILLS ARE TO BE PAID.*

By Nelson P. Lewis.†

In discussing city planning there is frequently a disposition to ignore such practical questions as that which is the subject of this paper. The writer recalls one occasion at a public dinner when a gentleman of distinguished reputation in the world of art expressed his sense of humiliation that one of the speakers, who was the chief financial officer of the city, should have introduced such sordid considerations as those of cost when the discussion up to that time had been confined to things of beauty. He assured his hearers that when, a few centuries ago, the men of Sienna or Florence wanted to do something to adorn their cities, they did not stop to consider the cost but went ahead and did it and thought about the expense afterward.

In contrast with this a prominent officer of a real estate holding company recently expressed his strong disapproval of any widening of streets or readjustment of street lines which was calculated to facilitate traffic, whether vehicular or pedestrian. He admitted that such changes might be advantageous to the city at large and would stimulate the development of outlying sections, but as his company owned a large amount of business property in the older part of the city, he believed that the rental value of that particular property for retail shops would be greater if the movement of the people were so obstructed that they would be compelled to loiter, to look into the shop windows and go in and buy.

We may have less patience with the latter than with the former point of view, yet both are inimical to real progress in city planning. He who scorns any consideration of cost may by his enthusiasm succeed in committing the city to projects which will seriously cripple its finances for years to come and render the public suspicious of any improvement, while he who openly avows his supreme selfishness may possibly arouse a feeling of indignation which will result in bringing about the very things he would like to prevent.

The question of how the bills are to be paid is not only a pertinent but a necessary one and cannot be avoided. To provide for a city of 100,000, with no apparent reason for exceptional growth, an ambitious scheme suited to a metropolis of several millions is to invite disaster; while to limit the plan of a large and rapidly growing city occupying a strategic position to one suited to its present size will seriously retard its future orderly development and may prevent it from realizing the growth and importance of which its natural advantages appear to give promise.

The feeling is common and not unnatural that if we are planning more for the future than the present, future generations which will reap the benefit should bear the greater part of the burden. It seems easy to pay with borrowed money, particularly when the money can be borrowed for fifty years or the span of two generations. The habit of paying in this way is easily acquired and is broken with difficulty. When anything is paid for with money borrowed for a period longer than the possible or even probable life of the article purchased, the city's credit is improperly used. A corporation which pays for its betterments from earnings is on a sound basis. When large earnings are used to pay excessive dividends and betterments and renewals are paid from borrowed money representing additional obligations, there is danger. When interest on existing debt is paid from funds raised by incurring more debt, disaster is imminent.

---

*Paper presented at the Fourth National Conference on City Planning, Boston, Mass., May 27-29, 1912.

†Chief Engineer, Board of Estimate and Apportionment, New York City.

The only source of revenue of the American city is its power to tax. Its credit is due to this same power plus the value of its own property. The larger the city's debt which has been incurred for projects which are not self-sustaining, the greater will be the demands upon its taxing power to meet interest and sinking fund charges due to such debt, and the less will be its ability to undertake new improvements and at the same time meet the enormous running expenses of the modern city. It might not be a forced comparison to say that the ordinary service which the city renders to the public through its administrative departments, the expenses of which are met by the regular tax levy, are the dividends which it pays to its stockholders, while for its betterments it must issue bonds or levy special assessments. Every bond issue requires an increase in the tax levy for a term of years in order to meet interest and amortization charges, curtailing by just so much the amount which can be expended upon municipal housekeeping expenses. In order to keep the tax rate within reasonable limits, expenses which should properly be met from the tax levy are often paid with borrowed money. Is not the city which adopts this policy actually doing the same thing as the business corporation which incurs additional debt in order to pay dividends?

The class of improvements which are commonly considered city planning projects are not self-sustaining. They consist for the most part in the correction of defects due to lack of proper planning. The property affected by them has presumably been already assessed for the acquisition and improvements of streets which were at the time considered adequate for its local needs. The widening and rearrangement of streets in built-up sections will, however, improve conditions and increase values, and a part of the expense should, therefore, be placed upon the property benefited.

In the more fundamental work of city planning, where unoccupied territory is being developed, the property will not have been assessed for improvements, and consequently the cost of the acquisition and construction of new streets can properly be assessed upon the adjoining property according to benefit, such benefit representing the entire cost in the case of local streets and a portion of the cost in the case of thoroughfares of metropolitan importance.

One principle should be invariably recognized, namely, where there is local benefit there should be local assessment. There can be no improvement which has been intelligently planned and executed without some local benefit, and it follows that there should always be some local assessment. No [illegible] to taxable val[illegible] the benefit. [illegible]

Perhaps this statement should be qualified [illegible] city planning. If so, the definition of city planning needs re-[illegible]

[illegible] The cost of that part of the subway passing through the districts where this rise in values took place was about $13,000,000, while the cost of the entire subway from the Battery north was $43,000,000. It is quite evident that if the $13,000,000 which was spent upon that part of the subway traversing the district so notably benefited had been assessed directly upon property, its owners would still have netted a neat profit of some $67,000,000, while had the cost of the entire subway been assessed upon the same limited district, the net profit to the land owners would have been $37,500,000. Was it quite fair that property in distant parts of the city, entirely unaffected by this great project, should bear the same proportion of the burden as that which was so conspicuously advantaged?

It is true that this improvement is entirely self-supporting, interest and amortization charges being provided from the rental paid by the operating company, but the local benefit was so clearly established that the rapid transit law was so amended as to permit the assessment of any part of the cost of future subways. Many new subways are now being planned, and some are being built, but it is doubtful if any of them will be self-supporting for years, the route furnishing the most intensive traffic having been followed by the line first built. The property owners along the present operating line having secured their benefit without direct tax, those along the proposed lines are not enthusiastic about being assessed for theirs, and there seems little prospect that the right to assess will be availed of.

To take another illustration from New York: Two new court houses are about to be built, one in New York County, the other in Kings County. In the former case a site has been selected to include a large area which will provide sites for still other public buildings and result in the creation of a real civic centre. What will be the effect upon the neighboring property of the expenditure of the millions required for this site and buildings? There is abundant evidence to justify the prediction that its value will be doubled, if not trebled, by the time the first building has been completed. Is is fair or just that the owners of this contiguous property should be enriched through no action of their own and that they should bear the same proportion of the expense, according to their taxable values, as will those owning property ten miles distant?

It needs no extended argument to prove the equity and wisdom of local assessment wherever there is local benefit. That it has been done to such a limited extent in the past is no reason why it should not be more generally done in the future. That certain property owners have heretofore been treated with such prodigal liberality is no good reason why others should fatten through a continuation of an irrational and essentially unfair policy. To the degree that the assessment plan is adopted, to that same degree will the city place itself upon a cash rather than upon a credit basis.

It may be urged that the adoption of such a policy would discourage the agitation for and execution of many desirable city planning projects, that American cities have been slow to appreciate the advantages of intelligent city planning, and now that there has been a marked awakening it would be unwise to suggest the adoption of a policy which might dampen this new born enthusiasm. A desire for something which involves no direct cost is not a sign of intelligent interest. We are learning that the improvement of our cities pays. That is a hopeful sign. If we have finally reached the stage where we want better conditions only if someone else is to pay the bills, the hope has not a very substantial basis. If we want them badly enough to pay for them ourselves in proportion to the benefit we feel sure will follow, we are making real progress.

Assuming that a case has been made in favor of assessing the cost of all improvements in accordance with prospective benefit, we are still confronted with a very difficult problem. The direct and indirect benefit must be estimated in advance. We cannot first carry out our city planning schemes and afterwards determine how the cost is to be met. Furthermore, we must determine to what extent the benefit will be strictly local, in what degree it will extend to a larger tributary area, and, again, how much it will mean to the entire city or metropolitan district.

In the case of residential streets, the purpose of which is to give light, air and access to the dwellings located upon them, the benefit will be entirely local, and the entire cost can properly be imposed upon the abutting property. When a highway is given a more generous width in the expectation that it will be called upon to accommodate a certain amount of through traffic, the benefit is more extended, and the assessment in such a case may be prolonged to a line midway between it and the next street of more than residential width. The major part of the cost should, however, be confined to the abutting property, so that the cost to it shall be somewhat more than that of the narrower street. In the case of arterial thoroughfares, or in that of the first street to be opened through an undeveloped territory the effect of which will be to give access to and stimulate the development of a large area, the district of benefit will be correspondingly enlarged. Again, in the case of thoroughfare of exceptional width, which it is proposed to treat as boulevards, the entire city or metropolitan district will be substantially benefited and should bear a portion of the expense. In fact, the state itself may derive an advantage which would justify its assumption of a portion of the cost, but the disposition to recognize such an obligation on the part of the commonwealth is exceedingly rare, even though a great city within its limits may, through its large taxable values, contribute the larger part of the state's revenues by which its rural highways are maintained.

In the case of parks this same principle might be applied. Some small parks are of strictly local benefit, and their cost could properly be placed upon the district in which they are located. Every park, whether small or large, is of some local benefit, even if such benefit were deemed to consist solely in unobstructed light and air to the property on the surrounding streets.

In the case of street widenings or the cutting through of new streets, the local advantage is less marked, though it will always follow. The mere fact that a widening or extension is required to accommodate traffic is conclusive evidence that the street has assumed more than local importance. The width of the roadway as widened is not an index of its local or general importance. There may be cases where the opening up of a new street of a width commonly given to local streets and extending for a very short distance would, on account of its strategic position, be of very great general and of little local benefit.

It is quite apparent that the relative local, district or general benefit of any street or other improvement can be determined neither by its dimensions nor its cost. An improvement involving an expenditure of $1,000,000 in one part of the city may be more distinctly local in its beneficial effect than one costing $5,000 in another section. No fixed rule can be established to govern the distribution of the expense. It must be determined in each case after a painstaking investigation. Such investigation should not be entrusted to a different individual, board or commission in each case. There should be a permanent body which should act in all cases. This body should not be large, and it should be so constituted that its entire personnel could not be changed at once, thus insuring continuity and consistency of policy. They should be broad men whose training should have fitted them for their difficult and delicate duties. The misleading evidence commonly called expert testimony as to existing and prospective values will be of little value to them. They should be capable by experience and intelligence of forming their own conclusions.

While no definite rule can be adopted to govern the distribution of assessments representing the district and general benefit, it should be possible to prescribe a method of determining the amount and extent of local benefit, particularly in the case of new streets, boulevards and parks. Let us assume that 60 ft. is the normal width required for a local street; then the entire cost of acquiring and improving all streets 60 ft. or less in width may properly be placed upon the property within half a block on either side of the street. In the case of wider streets that proportion of the cost represented by the ratio which 60 ft. plus 25 per cent. of the excess over 60 ft. bears to the width of the street would probably be an equitable proportion to assess upon the local district.

Inasmuch as property fronting a wide street is more valuable, it would be manifestly unfair to adopt a rule which would result in making the cost of a 70 or 80-ft. street less to the abutting owner than would have been the cost of a street 60 ft. wide. On the other hand, after a street reaches certain proportions, additional width will not involve additional benefit. It may be assumed that a share of the expense which would be equivalent to paving for a street 80 ft. wide should represent the limit of local assessment. This limit would be reached under the rule proposed when the street becomes 140 ft. wide. The percentage of cost which would be locally assessed would, therefore, be as follows for various street widths: 60 ft., 100 per cent.; 70 ft., 89.3 per cent.; 80 ft., 81.25 per cent., 90 ft., 75 per cent.; 100 ft., 70 per cent.; 120 ft., 62.5 per cent.; 140 ft., 57.1 per cent.; 150 ft., 53.3 per cent.; 200 ft., 40 per cent.

In the case of parks the problem is more difficult, the amount of local assessment and the extent of the area of local benefit being determined by the size and shape of the park and facility of access to it from other parts of the city. In any case, no rule should be adopted until it has been carefully tested and it has been demonstrated that the assessments levied in accordance with it will constantly decrease with the distance from the improvement. This decrease should not be directly in proportion to the distance, but in geometrical ratio.

A curve to determine the distribution of the assessments after the limits of the district have been decided has been proposed by Mr. Arthur S. Tuttle, Assistant Chief Engineer of the Board of Estimate and Apportionment of New York City, in accordance with which about 32.5 per cent. of the assessment would be placed upon the first 10 per cent. of the distance to the outer limit of the area of benefit, 55 per cent. upon the first 25 per cent. and 80 per cent. upon the district extending half way to the boundary of the assessment area.

In the case of street widening involving the destruction of buildings, it is suggested that the same general principles be adopted as in the case of new streets, but that they be applied to the land values only. If the street were less than 60 ft. wide, the proportion of the expense for additional land in order to make it 60 ft. would be assessed upon the half block on each side, while for all excess over 60 ft. the same rule already proposed could be adopted.

For instance, if a street 50 ft. wide were to be widened to 80 ft., involving the acquisition of 30 ft. of additional property, the first 10 ft. required to make it 60 ft. and 25 per cent. of the 20 ft. over 60 ft., a total of 15 ft. or one-half of the cost of the additional land to be taken, might be assessed locally, the expense involved in damage to buildings included in the district assessment, or in the general assessment if the improvement were of sufficient importance to involve general benefit. If the same street were to be widened to 100 ft., the local assessment under the same rule would be for 20 of the 50 ft. to be acquired, or 40 per cent. of the total land damage, the damage to buildings, as before, being included in the district or general assessment.

Special cases would undoubtedly arise which would require special treatment, but it is probable that in the great majority of improvements the method proposed would result in an equitable distribution of the burden. Those who are to pay the bills have a right to know in advance how the costs are to be apportioned, and the formulation of a policy which can be consistently followed is not only desirable but necessary.

The problem of determining whether or not there is general benefit and the proportion of the cost representing such benefit will be difficult. A typical case is that of a new boulevard recently laid out in the city of New York and now being acquired. It has been given a width of 200 ft. and extends from one of the great bridges over the East River directly across the Borough of Queens to Jamaica, and it is expected that it will ultimately be carried to the ocean front. It will afford ready access not only to the highway system of the Borough of Queens, but to all of Long Island. It includes within its lines an existing highway about 80 ft. in width.

Owing to its strategic position, this boulevard will be of more than local benefit. It was thought proper in this case to assess upon an area extending 800 ft. on each side that proportion of the cost of acquiring title represented by increasing the existing highway from 80 to 100 ft. Of the remaining 100 ft. it was decided to impose three-eighths upon the Borough of Queens and five-eighths upon the city at large. This division would have placed upon the local area, the borough and the city 16.7 per cent., 31.2 per cent and 52.1 per cent., respectively, but these were rounded off to 20 per cent., 30 per cent. and 50 per cent.

In the improvement of this highway it is proposed to construct one central driveway 41 ft. wide, with parking spaces [illegible] ft. wide on each side, and outside of these side roadways 28 ft. and sidewalks 20 ft. in width, the side roadways and walks to be treated strictly as local improvements and assessed directly upon the abutting property, and the central driveway and parking spaces to be treated as a part of the park system and to be built at the expense of the [illegible]. It is believed that such a distribution of the expense is just, but there has been a disposition to consider it a precedent for similar treatment in the case of other streets where the general public benefit would be far less, while in [illegible].

[illegible]

through recoupment by the exercise of the right of excess condemnation where this right exists, but this subject is to be treated in another paper, and is simply referred to in this connection.

Where the financial condition of the city will permit, the burdens of the property owner can be considerably lightened by the recognition of deferred benefit and a correspondingly deferred assessment. In this case the city would carry the amount until the benefit resulting from the improvement should have been fully realized, or, in other words, should have been reflected in actual increase in values. Similar relief could be given by permitting the payment of assessments in installments carrying a moderate rate of interest. Either plan would require larger capital to finance such improvements, and would to that extent impair the city's borrowing capacity for other purposes. These however, are matters of detail and have to do with the matter of collection of the assessments, rather than the distribution of the expense.

The general principles which should, in the writer's opinion, govern the distribution of the cost of city improvements, may be briefly summarized as follows:—

1. Where there is local benefit, there should always be local assessment.

2. The entire city or the metropolitan district should bear no part of the expense unless the improvement is in some degree of metropolitan importance and benefit.

3. Assessments should not be confined to the cost of acquiring and improving streets, but should extend to any improvement which will increase the value of the neighboring property, and should be apportioned as nearly as possible according to the probable benefit.

4. A workable policy once adopted should be consistently adhered to.

5. The determination of a policy and its application to each case should be entrusted to a board composed of men especially qualified, whose terms of office should so overlap as to insure continuity of policy and purpose.

◆

A LARGE REINFORCED CONCRETE BOAT.

A very large reinforced-concrete boat has recently been built for the use of the Manchester Ship Canal Company in England. This boat is described in the June 14, 1912, issue of London "Engineering." From that account we have made the following abstract:—

The boat in question is known as a sludge pumping pontoon. It has been built for the purpose of enabling dredged material to be deposited on low-lying land anywhere along either bank of the ship canal. The pontoon will be towed by steam tugs to selected points and there moored. The hopper barges will then be towed from the dredges as they are filled and moored alongside the pontoon. The suction pipe of the pontoon will be lowered into the barge to be discharged and the delivery pipe will deliver material upon the area selected for its reception. The pontoon is equipped with its own boilers and engine for the pumping operation described. It is 100 ft. long by 28 ft. wide, and [illegible] ft. 6 in. deep from the keels to the main deck, drawing about 6 ft. 6 in. of water when fully loaded. Its entire construction, including four water-tight bulk-heads and fittings for the boilers and engine, is of reinforced concrete. The pontoon was built according to the Hennebique system by the English agents of that system, Messrs. L. G. Mouchel & Partners.

A LARGE RETAINING WALL FOR THE CANADIAN PACIFIC RAILWAY IN TORONTO.

The Canadian Pacific Railway some time ago purchased from the Ontario Provincial Government the Government House property, located at the corner of King and Simcoe Streets, Toronto. This land is to be used for freight terminals and, therefore, had to be connected by track with the rest of the system lying south of Front Street. Two tracks of the Toronto Street Railway Company run along Front Street at an elevation of about twenty feet above the level of the tracks of the Grand Trunk Railway. It was, therefore, necessary, in order to connect the tracks at the lower level with the Government House property, to run along the south side of the street railway tracks on Front Street, and to protect these tracks by means of a retaining wall. Fig. 1 shows the location of the retaining wall along Front Street and an elevation of the wall itself. The wall at Bathurst Street is the highest section and at Spadina Avenue, about 2,100 feet east, the wall vanishes. Fig. 2 shows a typical section of the retaining wall at its greatest depth. Figs. 3 and 4 show the wall at different points. The wall is surmounted by an iron fence. Fig. 5 illustrates a typical detail of the fence posts used. The contractors were not allowed to interfere with the traffic on the Toronto Street Railway Company's line, nor to disarrange the north track of the Grand Trunk Railway. Excavation for the retaining wall was made with a Harris excavator. The excavator at work may be seen in Fig. 6. The

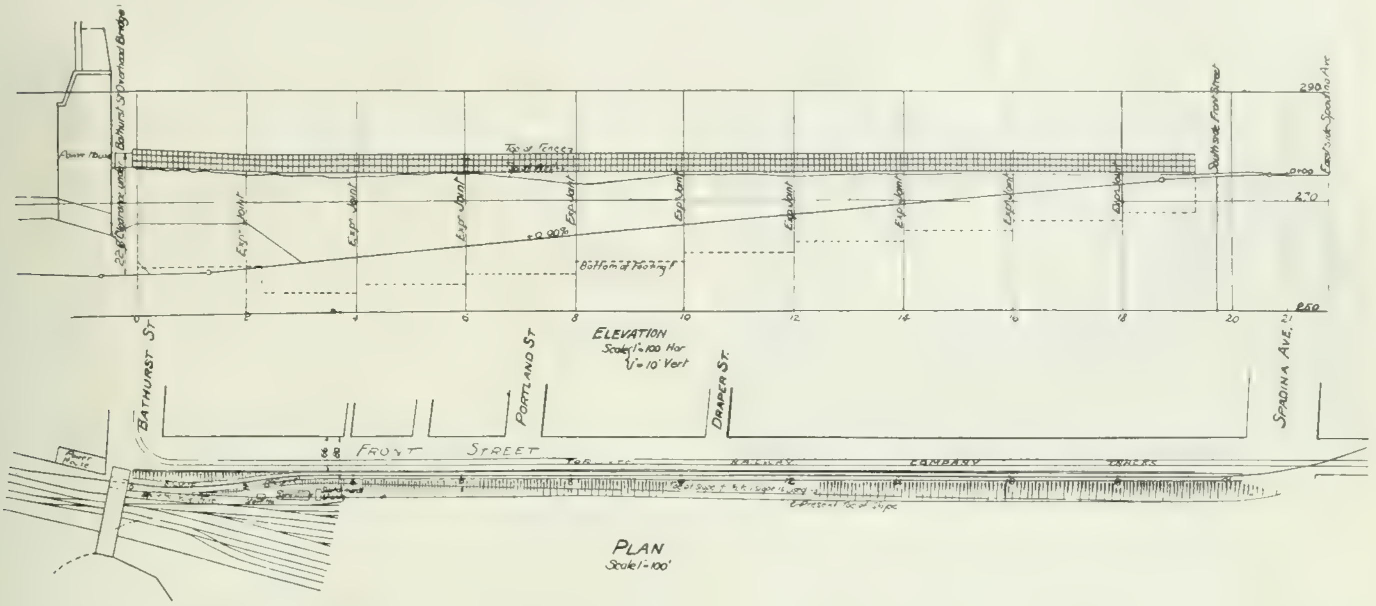


Fig. 1.—Location of New Retaining Wall for C.P.R. Along Front Street, Toronto.

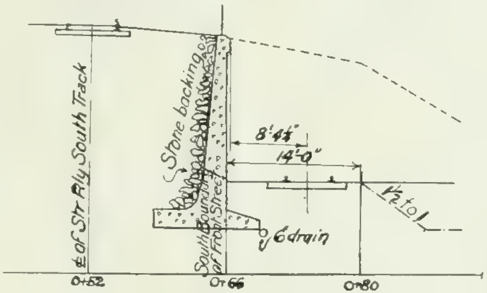


Fig. 3.—Typical Section of Retaining Wall at Station, 4 + 00.

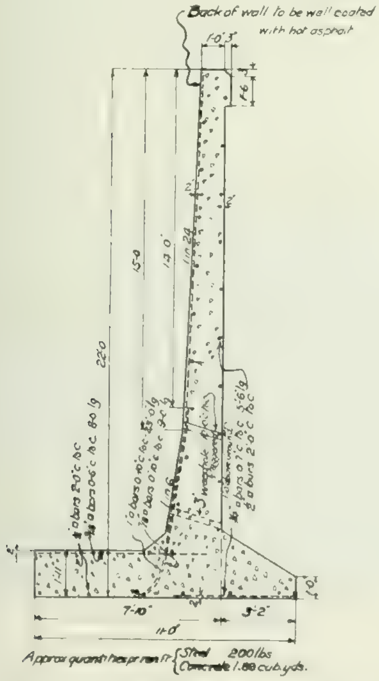

Back of wall to be well coated with hot asphalt
1'0"
1'6"
22'0"
15'0"
13'0"
1 in 24
7'-10"
3'-2"
11'0"
Approx quantities per run ft. Steel 200 lbs. Concrete 1.88 cub. yds.

Fig. 2—Typical Section of Retaining Wall at Deepest Point.

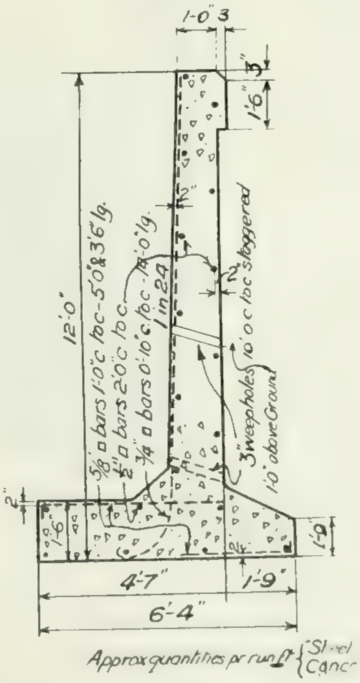

1'-0" 3
1'6"
3"
12'0"
⅝" ⌀ bars 1'-0" c. toc.-5'0" & 3'6" lg.
½" ⌀ bars 2'0" c. toc.
¾" ⌀ bars 0'-10" c. toc.-14'0" lg.
1 in 24
3" weepholes 10' o.c. toc. staggered
1'0" above Ground
1'6"
4'-7"
1'-9"
6'-4"
Approx quantities pr run ft. Steel 68 lbs. Concr. 0.84 cub. yds.

Fig. 4.—Typical Section of Retaining Wall at Intermediate Point.

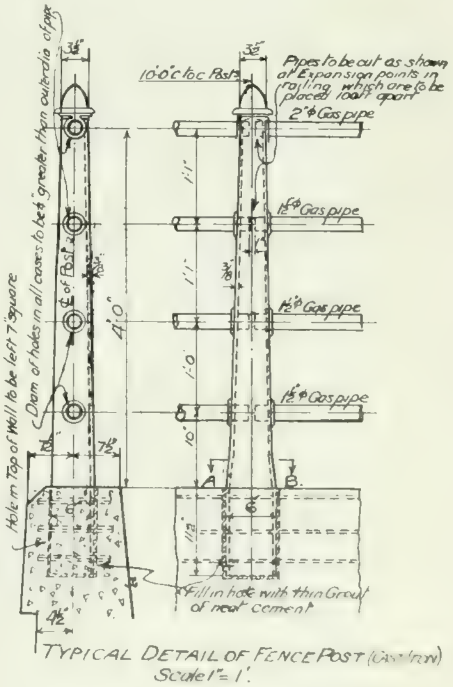

10'-0" c. to c. Posts
Pipes to be cut as shown at Expansion points in railing which are to be placed 100' apart
2" ⌀ Gas pipe
1½" ⌀ Gas pipe
1½" ⌀ Gas pipe
1½" ⌀ Gas pipe
4'0"
℄ of Post
Hole in Top of Wall to be left 7" square
Diam. of holes in all cases to be ⅛" greater than outside dia. of pipe
A
B
Fill in hole with thin Grout of neat cement
TYPICAL DETAIL OF FENCE POST (Cast Iron)
Scale 1" = 1'

Fig. 5.

forms were located, steel and concrete put in, and the backfill placed before the excavation was made on the south side, next the Grand Trunk track. Fig. 7 gives a general view of the location, showing the street railway tracks on the left.

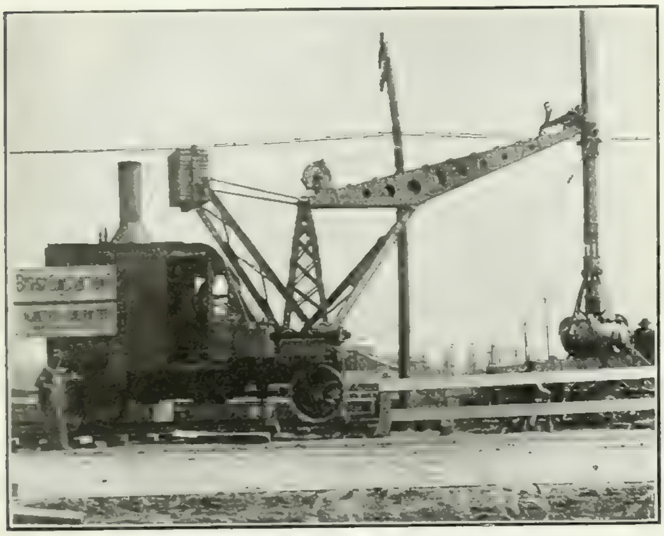


Fig. 6.

The foundations of the wall are carried to a depth sufficient to be absolutely free from frost, and stone backing was provided behind the wall. The contractors for the work are the Bishop Construction Company; the resident engineer in charge for the C.P.R. is Mr. C. S. Hertzberg. The wall was designed under the direction of Mr. P. B. Motler, engineer of bridges for the C.P.R.

FIXED AND TRAVELLING SEWAGE DISTRIBUTORS.

To determine the relative cost of sewage disposal with fixed sprays and with travelling sprinklers, Mr. Reginal Brown, engineer of the Southall-Norwood Works, England, prepared estimates for plants of both types. His findings, summarized below, were presented recently in a paper before the Association of Managers of Sewage Disposal Works.

The author decided to adopt a unit for comparison of eight 80-ft. diameter percolating filters, on which special revolving sprinklers were to be used, and an equal area of rectangular filters, on which fixed sprays were to be used, and to consider each installation to be working under the same conditions.

One of the great advantages attaching to the use of fixed sprays, and one which Mr. Brown has always advocated, is the complete breaking up and aëration of the liquid before it reaches the surface of the bed, which, without going into the chemical point of view, must be advantageous not only to the ultimate purification, but also to the life and work of the bed itself; hence, if revolving sprinklers are to be compared with fixed sprays they must be so arranged as to give the same effect, i.e., they must be subjected to a sufficient head and provided with a type of jet which will break up the liquid into a fine spray.

It is, of course, certain that the greater the head on the sprinklers the greater the distribution area per jet, and for comparative purposes a head of [illegible] ft. at the point of distribution was assumed. In most cases this would necessitate the lifting of the effluent water in the fixed spray type, but as this would also be the case in the revolving-sprinkler type, it is fair to assume that, in both cases, sufficient head is obtained without pumping. To get correct comparative results as to cost, each system of distribution should be provided with means of control into the same number of units; for the case under review this number would be eight.

Revolving Sprinklers.—The unit under discussion is eight 80-ft. circular beds. The ground is assumed to be level with the top of the carrier surrounding the beds. It has, therefore, been considered necessary that 6 in. of ground must be excavated over the whole area of the beds themselves, and 12 in. under the carrier. The base of the bed is constructed of concrete 6 in. thick at the periphery and 9 in. in the centre.

The beds are provided with 12 x 12-in. aërating and drainage tile. A ring of tiles is placed all round the outer edge of the circle, another and concentric ring is placed 20 ft. from the centre, while a third concentric ring is placed at 2 ft. 6 in. from the centre. The outer circle is divided into 3-ft. spaces, and at every fourth space lines of tiles are run to the inner circle, while at the intermediate spaces tiles are laid to the intermediate circle only.

The filtering medium is hard and well-burnt clinker, the outer walls being constructed of large lumps of clinker carefully bonded together and tied in to the filling. Over the drainage tiles a layer of large broken material is placed to a depth of 6 in., and the remainder for the whole height is filled with graded clinker and finished with a 3-in. layer of finer material over the whole surface.

The distributing system includes an 18-in. cast-iron pipe which commences at the boundary of the land occupied by the beds, and is carried to a brick control chamber constructed at the centre of the area. From this point 6-in. cast-iron pipes are carried under the beds and brought up through the concrete base by means of easy bends.

Each distributor is bolted to a concrete block 2 ft. square and 12 in. thick. The distributor consists of a central standard, a sealed top to utilize the full pressure due to the head, and to prevent overflow the mercury seal has been adopted. The distributing arms, four in number, are supported by means of strained guy ropes attached to a central tube carried up from and connected with the central standard, the top of the tube being pierced to allow for the escape of air. Each arm is pierced with thirty-five holes, spaced so as to give equal distribution and to permit of the breaking up of the liquid into a fine spray. Each hole is provided with a screw plug, pierced with two small holes inclined outwardly toward each other, so that two fine jets of water are discharged from each hole, and which meet at a short distance, thus creating a fine spray.

Fig. 7.

The cost of the sprinkler beds was $20,500. The area of land required is 6,525 sq. yds., which at $625 per acre is $815. The actual area covered by the eight beds is 5,044 sq. yds. The total external area of walls exposed to the air is 1,118 sq. yds.

Fixed Sprays.—To give a fair comparison, the area of the rectangular bed should be exactly similar to that of the eight circular beds; and, further, the means of distribution should be such as to control one-eighth of the whole area as a separate unit. The clinker area of the eight 80-ft. circular beds being 4,464 sq. yds., a square of 200-ft. sides has been selected, and a channel 3 ft. wide is constructed round the whole square. As in the case of the circular beds, the ground is assumed to be level with the top of the carrier. It has, therefore, been considered necessary that 6 in. of ground must be excavated over the whole area of the bed, and, to give about the same cross-fall to the concrete, the thickness of concrete at the centre will be 12 in. The carrier is, as before mentioned, 3 ft. wide inside, and its highest point is on the side opposite the outlet; this length is 400 ft., and to give the same fall as in the circular channels, commencing at a depth of 3 in. at the highest point, the depth of the carrier at the outlet will be, say, 12 in. Thus the depth of excavation for the carrier will be 1 ft. 6 in. The carrier has walls and bottom of concrete. The bed is covered with drainage tiles, arranged with a complete course round the exterior edge of the square, and straight lines of tiles are taken from this outer course towards the diagonals, drawn from each corner of the bed. The filtering media and external walls are similar to those described.

The following is a description of the distributing system. An 18-in. cast-iron pipe commences at the boundary area, and at the centre of one of the sides of the square a brick control chamber is constructed, as for the circular beds; 6-in. cast-iron pipes are taken from this control chamber to a point opposite to the centre of each unit, into which the whole bed is divided, and are continued upwards and over the drainage carriage, on to the edge of the bed. The bed is divided into eight units—seven being 24 ft. wide and one being 32 ft. wide.

The cost of the fixed spray system was $20,300 The area of land required is 4,922 sq. yds., which, at $605 per acre is $615. The total external area of walls exposed to the air is 445 sq. yds.

Annual Cost.—The total annual cost is made up of repayment of principal and interest on land and constructional work, and cost of labor and maintenance. For the land, in both cases it may be assumed that a loan would be granted for sixty years, and for the constructional works thirty years, but for the revolving sprinklers—as machinery—the loan would be for fifteen years only. For calculation these periods are taken, and the interest to be paid is 3½ per cent.

For the revolving sprinklers the capital cost is $21,330 and the annual cost $1,560. For the fixed sprays the capital cost is $20,900 and the cost per annum $1,440.

Effect of Spray.—In an 80-ft. revolving sprinkler Mr. Brown has found that with a head of 4 ft. there is a travel—at the periphery of the circle—of 8.4 ft. per second; there is, therefore, an intervening period of 7½ sec. before any part of the circumference of the circle receives a second dose of liquid. With the fixed sprays, however, the whole area of the bed is not, theoretically, covered by the spray, which takes a circular form. The area covered, however, depends upon whether the jets are spaced 8 ft. apart, vertically and horizontally (on plan), or whether they are spaced with the centres in the form of an equilateral triangle, each side of the triangle being 8 ft. In both cases, with a head of 4 ft. at the nozzle, the maximum diameter of the circle covered by the spray may be taken to be 8 ft., and the area of such a circle would be 5.58 sq. yds. If the sprays were spaced 8-ft. centres horizontally and vertically on plan, the total area per nozzle would be 7.11 sq. yds.; hence, an area of 1.53 sq. yd. is not covered. If spaced in the form of a triangle, the total area per nozzle would be 6.15 sq. yds.; hence, an area of .57 yd. would not be covered. Assuming the number of nozzles to be 625—arranged on the latter principle—the actual area covered by the nozzle would be 3,487½ yds., and, as the area of the bed is 4,464 yds., the area not actually covered is 976½ yds. super., or about 22 per cent. If spaced in triangular form, the actual number of sprays which could be fixed on the bed is 726, and the area not covered by the spray would be reduced to 10 per cent. of the whole area, but the cost of construction would be increased by $60 for nozzles only.

From Mr. Brown's figures it will be seen that a difference only of $120 per annum is in favor of the fixed-spray principle, but it must be borne in mind that this is obtained by the sacrifice of 22 per cent. area of bed not covered by sprays, no rest being given to the actual space covered by jet, if continually at work, and a very large reduction in area exposed to the air.

The chief reason for the excess of cost, although slight, of the revolving sprinklers over the cost of fixed sprays is due to the loan for the former being granted for fifteen years only. If the loan was for thirty years—as in the case of the fixed sprays—then the excess would be reduced to the infinitesimal sum of $25 per annum.

THE USE OF COPPER-SULPHATE IN PURIFYING WATER SUPPLIES.*

By Geo. Embrey, F.I.C., County Analyst, Gloucestershire.

In the year 1870 the author had frequent opportunities for observing the evil effects of plant growth in the artificial lakes of Sutton-Coldfield, Warwickshire. These were used as fishponds and for pleasure boats, but the growth of weeds was so extensive as to render them almost useless. Attempts were made to destroy the weeds by fixing scythes to the bottom of a punt and dragging this through the water, afterwards removing the weeds by means of rakes. This method was very costly, and not very effective, but in 1872, in the construction of a railway between Sutton-Coldfield and Walsall, an embankment which passed over the end of one of the lakes was constructed with ferruginous sand, and this, washing into the lake, effected in one season what the cutting method had failed to accomplish in seven; the vegetation was entirely destroyed, and this particular pool (Blackroot Pool) was effectually cleared of weeds.

On coming to reside in Gloucester in 1873, the author observed the bad odour and color of the drinking water, and on enquiry was informed that this was due to plants growing in the reservoir. He at once suggested the use of ferrous-sulphate to the city surveyor, Mr. R. Read, and an experiment was made on one of the reservoirs. About this time some trouble arose at a tannery due to oxide of iron from rusty pipes staining the skins red; this being wrongly attributed to the iron used in the reservoir, the experiment was discontinued, and for many years the weeds were removed by rakes at considerable expense without any satisfactory result.

The establishment of Bell's filters in 1901 to a considerable extent overcame the difficulty, but the author's attention was at that time directed to the reports of experiments made by the United States Department of Agriculture with copper-sulphate, which seemed to be an effective remedy. In the course of that year some watercress beds were treated with copper-sulphate, which was found to destroy the algæ, especially spirogyra, without injuring the watercress. In 1904 and 1905 numerous investigations were made to determine the amount which could be used for the destruction of the lower forms of plant life without destroying the fish or rendering the water toxic to human beings. It was found that quantities of 1 to 1,000,000 fulfilled these conditions, but quantities of 1 to 3,000,000 were sufficient to destroy the algæ, which were believed to cause the trouble.

---

* Paper read before Institution of Water Engineers of Great Britain.

In 1908 permission was given by the Sanitary Committee to carry out an experiment at Witcombe reservoirs, which were at the time choked with Chara Vulgaris. This plant is propagated by means of spores contained in an archegonium, and, fertilized by antheridia from an antheridium, the bursting of the archegonium sets free myriads of minute greenish cells, which, with the countless anthrozoids, give the water a distinct color and a fishy odour. In consequence of this odour it has been suggested that the particular chara was a new species named Chara Fœtida, but the author does not find that the plant differs in any material respect from the well-known Chara Vulgaris, except in regard to the odour. This, however, was removed by washing the plants, and an examination of the washing water revealed the presence of numerous Spongilla fluviatalis, which gave out a distinctly fishy odour. A portion of these was used to inoculate a nutrient agar medium, which, on incubation, yielded Proteus Vulgaris, a microbe well known to evolve a "fishy" odour, and the author, therefore, believes that this, and not the much-maligned chara, is the cause of the odour.

Method of Application.—The author's method of applying the copper-sulphate differs from that usually adopted, which is to place the crystals in a canvas bag and trail this at the stern of a moving boat. The defect of this method is that the copper-sulphate solution is very much diluted before reaching the bottom of the reservoir. This, however, is overcome by scattering the fine crystals over the surface of the water, as in sowing seed, the crystals falling rapidly to the bottom before dissolving. The sulphate is used in [illegible]

The three reservoirs have capacities, when filled, of 60,000,000 gallons (No. 1) and 30,000,000 gallons each (Nos. [illegible]

[illegible]

[illegible]

poisoned, but owing to the removal of the vegetable food on which they live, and this view is supported by the result of an experiment made at the end of last summer, when, No. 3 Reservoir being nearly empty, the rest of the water was, with the sanction of the city surveyor, drawn off, and, the trout having been removed to No. 2 Reservoir, only a few starved roach were found remaining.

As regards the question, What becomes of the copper-sulphate? it has been suggested that it unites with CO_2, and becomes carbonate, but the author has been unable to find this salt. He has, however, noticed that the stones with which the reservoirs are partly lined become coated with the two oxides of copper, bands of red cuprous oxide being traced, which, after exposure, becomes black by oxidation to cupric oxide. After four years' experience the author can confidently say that the odour and color so frequently met with in reservoirs containing water collected from the upper lias and inferior oolite can be perfectly removed by the use of sulphate of copper, and that no danger need be feared if the operation be performed with care and under proper supervision.

SOME NOTES ON BAND CONVEYORS.

By F. Tissington.

(THIRD ARTICLE.)

Belt Conveyors Capacities.—It is hardly possible to give any definite information as to the relative capacities of conveyors, as the figures are liable to change, even when considering the same class of material. This variation is due to a large extent to the feed, and also somewhat to the size of the material and the speed at which it is carried. Something has been said about these points before, and if the general practice laid down in Table I. is adopted so far as the two latter conditions are concerned good results should be obtained. Table II. has been compiled to give a general idea of the capacities of these belts for various classes of material and in a general way these figures should be obtained if a continuous feed can be arranged, as the estimate is by no means excessive. If, however, the material is being dumped in parcels with intervals between, an allowance must be made for this and a corresponding percentage of the values in the table taken.

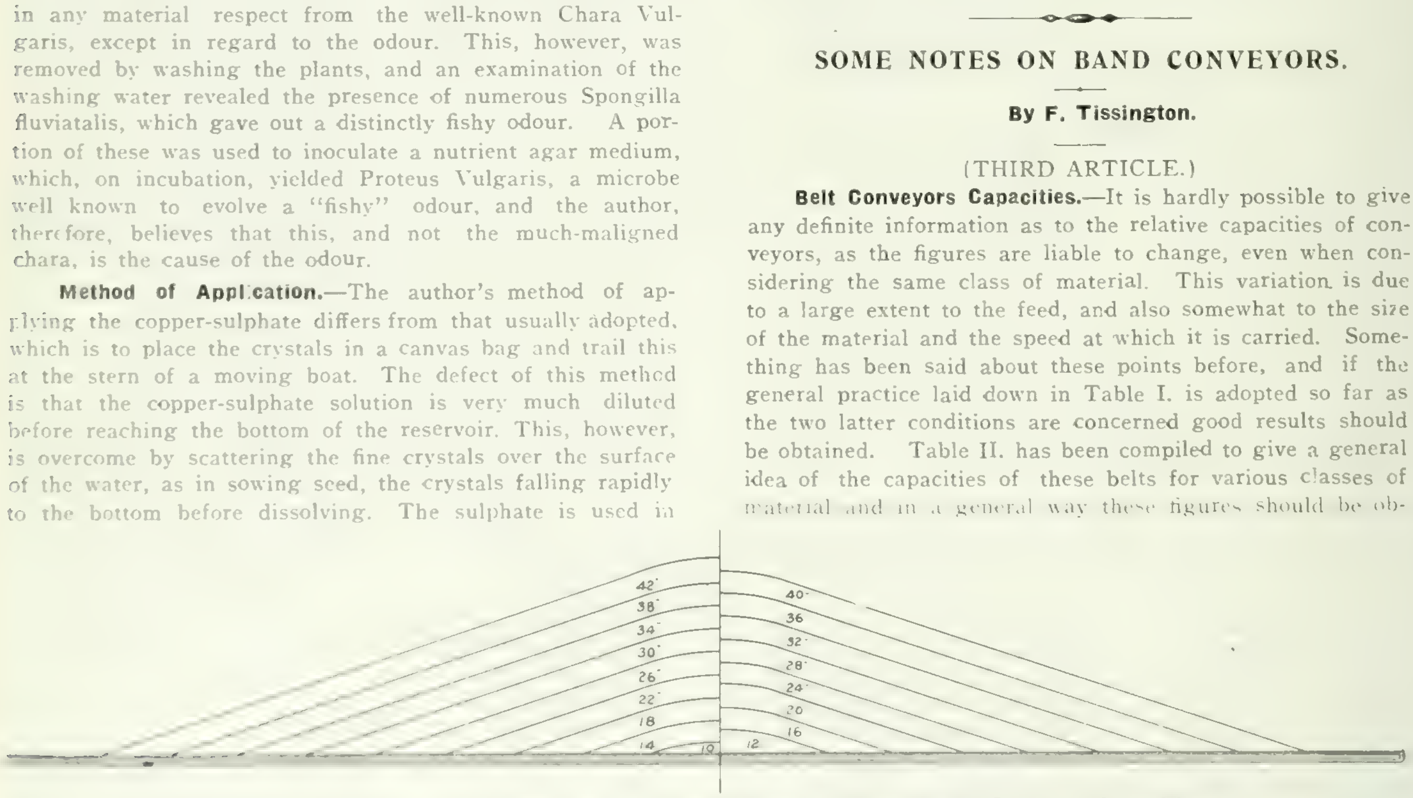


Fig. 16.—Cross Section of Belt Showing Approximate Carrying Capacities.

This table has been calculated on the assumption that the material loaded on the belt takes the form of a broad wedge in cross section with the two sloping sides at an angle of about twenty to twenty-five degrees with the horizontal. This will correspond roughly to the natural slope of the material, but naturally this varies with the different products carried. However, a clear edge distance of about three inches has been allowed for on each side of the belt which would prevent any spilling. The diagram given in Fig. 16 illustrates this, and in order to avoid confusion it has been laid out on a flat belt with a percentage added to allow for troughing.

Some further useful information is given in Table III., consisting of the weight in pounds per cubic foot and cubic inch, and also the amount of space occupied in cubic feet of one ton of material, and the number of cubic inches required to contain one pound weight of the same substance.

If any serious difficulty is experienced in obtaining the required capacity of a given belt it will be found that the addition of a special feeding apparatus suitable for the particular class will be necessary to increase same. In the case of large lumps, particularly if delivered onto a comparatively narrow band, some such arrangement will be necessary.

Horse-Power Required for Driving Band Conveyors.—It is a somewhat difficult matter to foretell exactly what will actually take place in any particular case, and why the only definite figures that can be obtained are those taken from an ammeter if the belt is driven by electric motor, and it therefore becomes a question for the designing engineer to estimate what power will be required from previous results.

A certain amount of power will be absorbed by the gearing and the belt itself when running light, and, as every engineer knows, the work on erection in setting all the parts up correctly and in alignment will have a great deal to do with the efficiency of the conveyor. In addition to this reverse bends in the band, such as are caused by the use of throw-off carriages, snub pulleys, etc., all require increased power over and above that necessary to drive a simple band of the same width and length, even if carrying the same material.

There are a number of different formulas, all claiming some particular advantage, some simple and some complex, and it appears to the writer that the only rational way of treating this problem is to select a set of rules that appear to be as near ordinary practice as possible and then make small allowances where necessary for special conditions.

The theoretical horse-power required to lift a given weight is $\text{H.P.} = \frac{W N}{33{,}000}$ where W = weight in pounds carried per minute and N = height in feet material is elevated.

Table IV. gives a series of values for this equation, the capacity ranging from 20 tons to 550 tons and the vertical life from 5 to 80 feet. These figures do not, of course, take into account any other factors, but simply represent the power necessary to elevate the load minus friction, efficiency of gearing, width of belt, etc.

For horizontal traction the force required must be some percentage of the figures given in Table IV. and the proportion will be regulated by the amount of friction to be overcome, both for the weight of the belt and for the full carrying capacity of same, the friction in the rollers and end gearing, etc.

Good average practice will be obtained if the percentage is taken at 20 per cent. on the maximum amount of the material which can be carried by the belt per minute. This allows for all losses for the moving parts of the conveyor itself except in the case of the smaller capacities, say from 150 tons per hour downwards, and for these an additional table giving values of the horse-power necessary for horizontal traction has been prepared. (See Table V.).

With the help of these two tables, it is now quite easy to estimate the power required to drive a belt conveyor of any ordinary type. If it is a horizontal one the figure can be taken at once from the table. Should there be any inclination in same all that is necessary is to add the figure for the latter to the former value and the sum is the total horsepower required. Note that the allowance for friction was made for horizontal traction and, therefore, in the case of an inclined conveyor no extra allowance for friction requires to be added to the figures in Table IV. for horse-power necessary to elevate the material.

TABLE II.—Table of Maximum Capacities for Troughed Band Conveyors.

Width of Band.	Cubic inches capacity per foot run.	Cubic feet capacity per foot run.	Number of Cubic Feet Capacity at a speed of				NUMBER OF TONS (2000 LBS.) PER HOUR FOR MATERIAL WEIGHING.																	
							25 lbs. per cubic ft.				50 lbs. per cubic ft				100 lbs. per cubic ft.				125 lbs. per cubic ft.	
							AT A SPEED IN FEET PER MINUTE OF													
			100	200	400	600	100	200	400	600	100	200	400	600	100	200	400	600	200	400
			feet per minute.																	
10"	26	.015	1.5	3.0	6.1	9.2	1.1	2.2	4.4	6.6	2.3	4.6	9.2	13	4.6	9.2	18	27	11	22
12"	39	.023	2.3	4.6	9.2	13.8	1.7	3.4	6.8	10	3.4	6.8	13	20	6.8	13	27	40	16	33
14"	66	.038	3.8	7.7	15.4	23.1	2.8	5.6	11	16	5.7	11	22	34	11.4	22	45	68	27	50
16"	105	.060	6.0	12.1	24.2	36.3	4.5	9.0	18	27	9.0	18	36	54	18.0	36	72	108	45	90
18"	158	.091	9.1	18.2	36.5	54.7	6.8	13	27	40	13.6	27	54	81	27.2	54	108	163	67	135
20"	184	.110	11.0	22.0	44.0	66.0	8.3	16	33	49	16.5	33	66	99	33.0	66	132	198	82	165
22"	264	.154	15.4	30.8	61.6	92.4	11.5	23	46	69	23.0	46	92	138	46.0	92	184	270	115	230
24"	316	.182	18.2	36.5	73.0	109.5	13.8	27	55	82	27.5	55	110	165	55.0	110	220	330	137	275
26"	396	.222	22.2	44.4	88.8	133.2	16.5	33	66	99	33.0	66	132	198	66.0	132	264	396	165	330
28"	475	.27	27.5	55.0	110.0	165.0	20.5	41	82	123	41.0	82	164	246	82.0	164	328	492	205	410
30"	554	.32	33.0	66.0	132.0	198.0	24.5	49	98	147	49.0	98	196	294	98	196	392	588	245	490
32"	686	.39	39.6	79.2	158.0	237.0	29.5	59	118	177	59.0	118	236	354	118	236	472	708	295	590
34"	811	.47	47.3	94.6	189.0	283.0	35.0	70	140	210	70.0	140	280	420	140	280	560	840	350	700
36"	924	[illegible]	55.0	110.0	220.0	330.0	41.0	82	164	246	82.0	164	328	492	164	328	656	984	410	820
38"	1056	.61	60.5	121.0	242.0	363.0	45.0	90	180	270	90	180	360	540	180	360	720	1080	450	900
40"	1120	[illegible]	66.0	132.0	264.0	396.0	50	100	200	300	99	198	396	594	198	396	792	1188	496	992
42"	1416	.82	82.5	165.0	330.0	495.0	56	112	224	336	112	224	448	672	224	448	896	1344	560	1120

TABLE III.—Weight in pounds and measure in cubic feet, and inches for various materials.

MATERIAL	Weight in Lbs. per Cubic feet.	Weight in Lbs. per Cubic inches.	Cubic Measure. Feet per ton.	Cubic Measure. Inches per lbs.
Ashes (coal)	45	.026	43	39
Ashes, pot and pearl	55	.032	34	31
Asphalte	140	.08	14	12.5
Ballast	103	.06	19	17
Bones	50	.029	39	34.5
Bones (calcined)	22	.013	85	76.5
Cement clinker	102	.06	19	17
Cement, Portland	79	.046	23	21.5
Chalk (solid)	122	.071	16	14
Clay	122	.071	16	14
Coal (slack)	52	.03	36	33
Coal (nuts)	43	.025	44	40
Coke	31	.018	60	54
Coprolites	103	.06	19	17
Concrete	122	.071	16	14
Cork dust	7	.004	254	230
Earth	79	.046	23	21.5
Earth (mould)	69	.04	28	25
Firewood	78	.004	247	221
Freestones	140	.08	14	125
Gravel (coarse)	97	.056	20	17.7
Gypsum	122	.071	16	14
Hay, compressed	21	.012	90	80.8
Hay, uncompressed	16	.009	120	10.78
Ice	58	.034	33	29.5
Limestone, broken	96	.053	21	19
Lime (quick)	53	.03	36	32.5
[illegible]	17	.01	106	96
Marl	79	.046	24	21.5
Mortar	[illegible]	.05	22	20
[illegible]	55	.032	34	30.5
Mud	104	.06	19	16.5
Ore (pulverized)	[illegible]	[illegible]	8	7.5
[illegible]	[illegible]	.034	[illegible]	[illegible]
Phosphate	103	.06	19	17
Plaster of Paris	[illegible]	.06	[illegible]	16.5
Pitch	[illegible]	[illegible]	[illegible]	34.5
Plumbago	[illegible]	.083	[illegible]	12
Sand	[illegible]	[illegible]	15	[illegible]
Sand (river)	[illegible]	[illegible]	[illegible]	15
Sand (moulding)	[illegible]	[illegible]	24	[illegible]
Sand (pit)	[illegible]	.06	19	17
[illegible]	[illegible]	[illegible]	[illegible]	216
[illegible]	[illegible]	[illegible]	12	[illegible]
Shingle	88	.051	21	19.5
Slag	86	.05	22	20.5
[illegible]	[illegible]	.102	11	[illegible]

MATERIAL	Weight in Lbs. per Cubic feet.	Weight in Lbs. per Cubic inches.	Cubic Measure. Feet per ton.	Cubic Measure. Inches per lbs.
Salt cake	69	.04	27	24.5
Salt	55	.032	34	30.5
Sugar (brown)	55	.032	34	30.5
Sugar (in bags)	57	.033	34	30
Sulphate of ammonia	55	.032	34	31
Trap	175	.101	11	9.85
Quartz	173	.1	11	10
Wood pulp (damp)	29.4	.017	64	57.5
Grain Seeds, Etc.				
Barley	38	.022	50	44
Barley (dried)	28	.016	69	61.5
Beans	50	.029	38	34.5
Bread (in bulk)	18	.01	106	95.5
Buckwheat	37	.021	52	47
Clover	47	.027	41	37
Coffee (in bag)	37	.021	52	47
Cotton (compressed)	45	.026	43	38.5
Cotton (seed)	23	.013	86	77
Flax	26	.014	75	67.7
Flour	43	.025	44	40
Flour (in barrels)	45	.026	43	38.5
Ginger	28	.016	70	61.6
Hemp	35	.02	55	49.3
Hemp (seed)	29.4	.017	63	57.5
Hides (well packed)	35	.02	55	49.3
Hides (loosely)	26	.015	72	64.7
Indian corn	45	.026	42	38
Indian meal	42	024	47	42
Indigo (in cases)	34	.02	57	50.8
Linseed	42	.024	47	42
Locust	22	.013	85	76.5
Malt	29.4	.017	64	58
Malt (green)	17	.009	112	101
Massecuite	95	.055	21	18.0
Molasses	37.5	.022	31	46.2
Oats	31	.018	61	55
Oats (in bulk)	37	.021	52	47
Oatmeal	38	.022	50	44
Peas	50	.029	38	34.5
Rape (seed)	37.5	.022	51	46
Rice (in bags)	50	.029	38	34.6
Rum (in casks)	37.5	.022	51	46.2
Rye	42	.024	46	42
Saltpetre	62.4	.036	31	27.7
Tea (in boxes)	16	.009	123	111
Wheat	47	.027	41	37

TABLE IV.—Table of Horse Powers for Inclined and Horizontal Conveyors.

Capacity		Horse Power Required to Lift to a Height of									
Tons per Hour.	Pounds per Minute.	5 ft.	10 ft.	15 ft.	20 ft.	30 ft.	40 ft.	50 ft.	60 ft.	70 ft.	80 ft.
20	660	.10	.20	.30	.40	.6	.8	1.0	1.2	1.4	1.6
30	1000	.15	.30	.45	.60	.9	1.2	1.5	1.8	2.1	2.4
40	1320	.20	.40	.60	.80	1.2	1.6	2.0	2.4	2.8	3.2
50	1660	.25	.50	.75	1.00	1.5	2.0	2.5	3.0	3.5	4.0
60	2000	.30	.60	.90	1.20	1.8	2.4	3.0	3.6	4.2	4.8
70	2320	.35	.70	1.05	1.40	2.1	2.8	3.5	4.2	4.9	5.6
80	2660	.40	.80	1.20	1.60	2.4	3.2	4.0	4.8	5.6	6.4
90	3000	.45	.90	1.35	1.80	2.7	3.6	4.5	5.4	6.3	7.2
100	3320	.50	1.00	1.50	2.00	3.0	4.0	5.0	6.0	7.0	8.0
110	3660	.55	1.10	1.65	2.20	3.3	4.4	5.5	6.6	7.7	8.8
120	4000	.60	1.20	1.8	2.40	3.6	4.8	6.0	7.2	8.4	9.6
130	4320	.65	1.30	1.95	2.60	3.9	5.2	6.5	7.8	9.1	10.4
140	4660	.70	1.40	2.10	2.80	4.2	5.6	7.0	8.4	9.8	11.2
		Horse-Power Required for Horizontal Belts.									
Length or height		25 ft. 5 ft.	50 ft. 10 ft.	75 ft. 15 ft.	100 ft. 20 ft.	150 ft. 30 ft.	200 ft. 40 ft.	250 ft. 50 ft.	300 ft 60 ft.	350 ft. 70 ft.	400 ft. 80 ft.
150	5000	.77	1.54	2.31	3.10	4.62	6.25	7.70	9.24	10.78	12.50
160	5320	.80	1.60	2.40	3.20	4.80	6.4	8.0	9.6	11.2	12.8
170	5660	.86	1.72	2.58	3.44	5.16	6.88	8.5	10.3	12.0	13.7
180	6000	.91	1.82	2.73	3.64	5.46	7.28	9.1	10.9	12.7	14.6
190	6320	.96	1.92	2.88	3.84	5.76	7.68	9.6	11.5	13.4	15.3
200	6660	1.01	2.02	3.03	4.04	6.06	8.08	10.1	12.1	14.1	16.1
220	7320	1.11	2.22	3.33	4.44	6.66	8.88	11.1	13.3	15.5	17.7
240	8000	1.21	2.42	3.63	4.84	7.26	9.68	12.1	14.5	16.9	19.4
260	8660	1.31	2.62	3.93	5.24	7.86	10.48	13.1	15.7	18.3	20.9
280	9320	1.41	2.82	4.23	5.64	8.46	11.28	14.1	16.9	19.7	22.5
300	10000	1.51	3.02	4.53	6.04	9.06	12.08	15.1	18.1	21.1	24.1
320	10660	1.61	3.22	4.83	6.44	9.66	12.88	16.1	19.3	22.5	25.7
340	11320	1.71	3.42	5.13	6.84	10.26	13.68	17.1	20.5	23.9	27.3
360	12000	1.81	3.62	5.43	7.24	10.86	14.48	18.1	21.7	25.3	28.9
380	12660	1.91	3.82	5.73	7.64	11.46	15.28	19.1	22.9	26.7	30.5
400	13320	2.01	4.02	6.03	8.04	12.06	16.08	20.1	24.1	28.1	32.1
420	14000	2.11	4.22	6.33	8.44	12.66	16.88	21.1	25.3	29.5	33.7
440	14660	2.21	4.42	6.63	8.84	13.26	17.68	22.1	26.5	30.9	35.3
460	15320	2.31	4.62	6.93	9.24	13.86	18.48	23.1	27.7	32.3	36.9
480	16000	2.41	4.82	7.23	9.64	14.46	19.28	24.1	28.9	33.7	38.5
500	16660	2.51	5.02	7.53	10.04	15.06	20.08	25.1	30.1	35.1	40.1
525	17500	2.65	5.30	7.95	10.60	15.90	21.20	26.5	31.8	37.1	42.4
550	18320	2.78	5.56	8.34	11.12	16.68	22.24	27.8	33.3	38.9	44.5

TABLE V.—Table of Horse Powers for Horizontal Conveyors.

Capacity		Horse-Power Required for Horizontal Conveyors of Various Lengths.									
Tons per Hour.	Pounds per Minute.	25 ft.	50 ft.	75 ft.	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.
20	660	.40	.80	1.20	1.60	2.40	3.2	4.0	4.8	5.6	6.4
30	1000	.43	.86	1.26	1.72	2.52	3.44	4.30	5.04	6.02	6.88
40	1320	.46	.92	1.38	1.84	2.76	3.68	4.60	5.52	6.44	7.36
50	1660	.49	.98	1.47	1.96	2.94	3.92	4.90	5.88	6.86	7.84
60	2000	.51	1.02	1.53	2.04	3.06	4.08	5.10	6.12	7.14	8.16
70	2320	.54	1.08	1.62	2.16	3.24	4.32	5.40	6.48	7.56	8.64
80	2660	.57	1.14	1.71	2.24	3.42	4.48	5.70	6.84	7.98	8.96
90	3000	.60	1.20	1.80	2.40	3.60	4.80	6.00	7.12	8.40	9.60
100	3320	.63	1.20	1.89	2.52	3.78	5.04	6.30	7.56	8.82	10.08
110	3660	.66	1.32	1.98	2.64	3.96	5.28	6.60	7.92	9.24	10.56
120	4000	.69	1.38	2.07	2.76	4.14	5.52	6.90	8.28	9.66	11.04
130	4320	.72	1.44	2.16	2.88	4.32	5.76	7.20	8.64	10.08	11.52
140	4660	.75	1.50	2.25	3.00	4.50	6.00	7.50	9.00	10.50	12.00

NEW SPECIFICATIONS FOR CREOSOTE WOOD BLOCK PAVEMENT.

The Board of Local Improvements of Chicago, Ill., has lately gotten out new specifications for the construction of creosoted wood block pavements in that city. The new specifications differ from the old ones in a number of the requirements. The method of treating the timber is specified more fully and provision is made for the use of oil which shall be a distillate obtained wholly from coal tar. In addition the new specifications provide that an asphaltic filler may be used. The following is an extract of the specifications as far as they relate to the creosoted wood block wearing surface:

Blocks.—The blocks shall be cut from southern....... ......yellow pine, tamarack or southern black gum timber. Only one kind of wood, however, shall be used on the work. The blocks shall be not less than 5 ins. in length, nor more than 10 ins. in length, but shall average 6 ins. in length. The depth shall be............ins., and the width shall be .. ins.

All blocks shall be made of sound timber and shall be free from any defects which will be detrimental to the life of the block or interfere with the proper laying of the same. Each block shall have at least 66 per cent. of heart wood.

The blocks shall be carefully protected from the effect of the sun and weather before and after treatment and until laid.

Timber.—The timber shall be that known to the trade as "prime" timber and of a texture permitting satisfactory treatment as hereinafter specified, and shall be subject to inspection at the works in the stick or at any time during the process of preparation or thereafter. The timber shall be sound, square-edged, free from bark, shakes, large or loose or rotten knots, red heart, worm or knot holes, or any other defects which will be detrimental to its strength or durability. No second growth timber or loblolly pine will be accepted.

With southern...........yellow pine timber, the annual rings in the 3 ins. measured radially from the centre of the heart shall average not less than 8 to the inch.

When the timber for the blocks is only partially seasoned, the Board of Local Improvements may require the same to be piled in such a manner and for such a length of time as will prepare it for the treatment herein specified.

The Board of Local Improvements may at any time reject in bulk all timber that does not fulfill the above requirements, and order same removed and properly culled before being returned to the mill.

Treatment.—The blocks shall be placed in an air-tight cylinder, where, by means of steam and the vacuum pump, the sap in the blocks will be vaporized and the moisture in them removed. During the process of steaming a vent shall be kept open in the cylinder to permit the escape of water, [illegible] the cylinder. After the heating or steaming period, the drain or vent in the bottom of the cylinder shall be opened and all moisture removed from the cylinder. During the vacuum period the temperature in the cylinder must be above the boiling point of [illegible]

[illegible]

After the blocks are [illegible] the cylinder shall be filled with oil [illegible] and pressure shall then be applied and [illegible] pounds of oil have been forced [illegible] to the satisfaction of the Board of Local Improvements. The pressure period on the oil shall be continuous and of a duration of not less than three hours. After the surrounding oil has been removed, the blocks shall remain in the closed cylinder for a period of 30 minutes to allow the excess oil on the surface of the blocks to drain off. The oil thus drained off shall be forced back into the treating tank in order to determine the amount of impregnation. In the process of treating the blocks, a correction must be made for any water contained in the cylinder. Compensation shall also be made for leaks and other wastes of oil that may occur during treatment.

If, in the treatment of the blocks, more oil is injected per cubic foot of timber than is called for in the specifications, such excess oil must not be removed. The temperature of the oil after entering the cylinder shall not be lower than 165° F. The cylinder shall be provided with sufficient steam coils to fully maintain this temperature throughout injection.

The oil tanks and cylinder in which the blocks are treated shall be equipped with the necessary gauges, thermometers and draw-cocks in order to facilitate a thorough inspection of the materials and treatments. The cylinder shall be equipped with the proper connections and apparatus for artificially seasoning timber before the impregnation with the creosote oil.

The plant shall be provided with proper means for obtaining the absolute measurement and weight of all oils entering the cylinder and the amount of oil absorbed by the blocks.

Oil.—1 The oil shall be distillate obtained wholly from coal tar.

2. It is required by this specification that the oil used shall be wholly a distillate oil obtained only by distillation from coal tar. No other material, of any kind, shall be mixed with it.

3. The oil shall contain not more than 1 per cent. of matter insoluble in hot benzol and chloroform.

4. Its specific gravity at 25° C. shall be not less than 1.08 and not more than 1.12.

5. The oil shall be subject to a distilling test as follows:—

The apparatus for distilling the creosote must consist of a stoppered glass retort having a capacity, as nearly as can be obtained, of 8 ozs. up to the bend of the neck, when the bottom of the retort and the mouth of the off-take are in the same plane. The bulb of the thermometer shall be placed ½ in. above the liquid in the retort at the beginning of the distillation, and this position must be maintained throughout the operation. The condensing tube shall be attached to the retort by a tight cork joint. The distance between the thermometer and the end of the condensing tube shall be 22 ins., and during the process of the distillation the tube may be heated to prevent the congealing of the distillates. The bulb of the retort and at least 2 ins. of the neck must be covered with a shield of heavy asbestos paper during the entire process of distillation, so as to prevent heat radiation, and between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20 mesh fine and at least [illegible] square must be placed. The flame must be protected against air currents.

The distillation shall be continuous and uniform, the heat being applied gradually. It shall be at a rate approximately one drop per second, and shall take from [illegible] to [illegible] minutes after the first drop of distillate passes into the receiving vessel. The distillates shall be collected in weighed bottles and all percentages determined by weight in comparison with dry oil. When 100 grams of the oil are placed in the retort and subjected to the above test, the amount of distillate shall not exceed the following:—

Up to 150° S., 2 per cent.
Up to 210° C., 10 per cent.
Op to 235° C., 20 per cent.
Up to 315° C., 40 per cent.

The distillation of the oil shall be carried to 355° C. The residue thus obtained when cooled to 15° C. shall not be brittle but shall be of a soft, waxylike nature, so that it can be readily indented with the finger. When a small portion of this residue is placed on white filter paper and warmed, the oil spot produced, when viewed by transmitted light, shall appear of an amber color.

The contractor shall deliver to the Board of Local Improvements an affidavit from the individual manufacturing the blocks (if manufactured by an individual), from the managing officer of the corporation manufacturing the blocks (if manufactured by a corporation) and by an active member of the firm manufacturing the blocks (if manufactured by a firm), setting forth that all oil used for treating the blocks for this contract is a distillate oil obtained wholly and entirely by distillation from coal tar, and that it is free from any adulteration.

Oil.—The oil shall be a pure coal tar product, free from any adulteration. It must not contain any petroleum oil or any product obtained from petroleum, and shall contain not more than 5 per cent. of matter insoluble in hot benzol and chloroform. No oil obtained wholly or in part from water gas tar or oil tar will be accepted.

The specific gravity of the oil shall not be less than 1.10 nor more than 1.13 at 25° C.

[This oil is subjected to a distilling test similar to that for the first mentioned oil.—Editors.]

Laying.—The blocks shall be laid in parallel courses across the roadway at an angle of approximately.......... degrees from the centre line thereof, except at the intersections of all alleys, where they shall be laid at right angles with the centre lines thereof. On intersections and junctions of lateral streets, the blocks shall be laid at an angle of 45° with the line of the street, unless otherwise ordered by the engineer. The blocks shall be laid with the fibre of the wood running in the direction of the depth. Gutters shall be constructed as directed by the engineer. The courses shall break joints alternately by a lap of not less than 2 ins., and the blocks shall be driven together except where joints for expansion are constructed as follows: On each side of the roadway a longitudinal joint shall be formed by placing a 1½ in. board on edge against the curb. The blocks shall be firmly laid against said boards. The boards shall remain in place until the blocks are rolled, and immediately preceding the application of the filler as hereinafter specified, they shall be carefully removed without disturbing the adjacent blocks.

The blocks, when set, shall be rolled with a steam roller weighing not less than five tons, until firmly bedded and brought to a uniformly even surface. After rolling, all imperfect blocks shall be removed and replaced by perfect blocks. Broken blocks shall not be used except to break joints in starting courses and in making closures. If the blocks that have been laid should become wet before the filler is applied, they must be taken up and reset at the contractor's expense, if the engineer so directs. In no case will teams be allowed on the work before the wearing surface is completed.

Asphaltic Filler.—After rolling, the surface of the pavement shall be swept clean and the joints between the blocks and expansion joints shall be filled with an asphaltic filler which shall be free from water, coal tar pitch, or any product of coal or water gas tar. It shall adhere firmly to the blocks, be pliable at all climatic conditions to which it will be subjected, and conform to the following requirements:—

It shall have a specific gravity of not less than 0.965 at 77° F.

It shall have a melting point of not less than 110 and not more than 160° F.

It shall have a penetration of not less than 20 nor more than 50.

The bitumen of the asphaltic filler shall be soluble in carbon tetra chloride to the extent of at least 98½ per cent.

The asphaltic filler shall be heated to a temperature of not less than 280° nor more than 350° F., and shall be applied in such a manner that all spaces between the blocks will be completely filled, the temperature of heating to be varied within these limits according to the nature of the asphaltic filler used and at the discretion of the Board of Local Improvements. In applying the asphaltic filler care must be taken to use the least amount necessary to properly fill the joints and hold the top dressing. The blocks must be dry at the time of the application of the filler.

The contractor shall provide the Board of Local Improvements with a duplicate delivery ticket for each and every consignment of asphaltic filler delivered on the work. This ticket must be signed by the consignor, and be of a form approved by the Board of Local Improvements.

Pitch Filler.—After rolling, the surface of the pavement shall be cleaned and the joints between the blocks and expansion joints shall be filled with a "straight run" paving pitch obtained from gas house tar. No pitch from coke oven tar shall be used. It shall be of such quality and consistency as will be approved by the Board of Local Improvements. The pitch shall contain not less than 28 per cent. nor more than 35 per cent. of free carbon, and shall have a melting point at a temperature of not less than 145° and not more than 155° F. The pitch must be used at a temperature of not less than 300° and not more than 350° F. In applying the pitch, care must be taken to use the least amount necessary to properly fill the joints and hold the top dressing.

The contractor shall provide the Board of Local Improvements with a duplicate delivery ticket for each and every load or tank of paving pitch delivered on the work. This ticket must be signed by the consignor and be of a form approved by the Board of Local Improvements.

Cement Grout Filler.—After rolling, the surface of the pavement shall be swept clean, and the joints, except as hereinafter provided, between the blocks shall be filled with a cement grout filler composed of equal parts by volume of clean, sharp, dry sand and Portland cement, the same to be thoroughly mixed dry, after which water shall be added, forming a liquid of the consistency of thin cream. From the time the water is added until the grout is floated into the joints of the pavement, the mixture must be kept in constant motion, and immediately after applying to the pavement it shall be thoroughly swept into all the joints. The grout or filler shall be applied in two or more courses. The first course shall fill the interstices between the blocks to within 2½ ins. of the top, the same to be left undisturbed and sufficient time allowed to elapse for the first application to stiffen. The following courses or applications shall be mixed in like manner, except that the mixture shall be slightly thicker than that of the first course. To avoid a possibility of the grout thickening at any point, water shall be applied ahead of the sweeping by spraying.

The expansion joints and points between the blocks in a space of 2 ft in width adjacent to the gutters and around all covers to sub-surface improvements shall be filled with a "straight run" paving pitch obtained from gas house tar. No pitch from coke oven tar shall be used. It shall be of such quality and consistency as will be approved by the Board of Local Improvements. The pitch must be used at a temperature of not less than 300° and not more than 350° F. The pitch shall contain not less than 28 per cent.

nor more than 35 per cent. of free carbon, and shall have a melting point at a temperature of not less than 145° and not more than 155° F.

Sand Filler.—After rolling, the surface of the pavement shall be swept clean and the joints, except as hereinafter provided, between the blocks shall be filled with clean, warm fine sand, which shall be swept into the joints until the same are completely filled.

The expansion joints and the joints between the blocks in a space 4 ft. wide in the middle of the roadway shall be filled with a "straight run" paving pitch obtained from gas house tar. No pitch from coke oven tar shall be used. It shall be of such quality and consistency as will be approved by the Board of Local Improvements. The pitch must be used at a temperature of not less than 300° and not more than 350° F. The pitch shall contain not less than 28 per cent. nor more than 35 per cent. of free carbon, and shall have a melting point at a temperature of not less than 145° and not more than 155° F.

Top Dressing.—Immediately after the filling of the joints, the surface of the pavement shall be covered to a depth of ¼ in. with screened, hot, torpedo sand.

◆

THE DESIGN OF REINFORCED CONCRETE GRAIN ELEVATORS.

Certain of the problems that enter into the design of reinforced concrete grain elevators were discussed by Mr. E. Lee Heidenreich, in a paper read before the eighth annual convention of the National Association of Cement Users, from which the following notes are taken:—

Mr. Heidenreich states that the design of such structures is dependent entirely upon the nature and value of the pressure exerted by grain while at rest and in motion. Experiments and calculations to determine these values have been made by a number of well-known engineers, among whom are Mr. Janssen, Mr. Wilford Airy, Mr. Tolz, Mr. Prante, Mr. Jameson, of Canada, and Professor Milo B. Ketchum.

The last named states that the flow of grain is more like that of a semi-liquid than a liquid, with the pressure line forming a curve. According to calculations of Mr. Janssen and Mr. Jameson the lateral pressure may be expressed as:—

$$L = \frac{w R}{u}\left(1 - e^{[illegible]}\right)$$

and the vertical pressure by

$$V = \frac{w R}{C u}\left(1 - e^{[illegible]}\right)$$

[illegible]

If the circular bin is empty and the two opposite interstices A and B are filled, we have a condition which necessitates reinforcement both at the intrados and extrados of the ring.

Compression in the direction $A B$ causes tension at the extrados at C and D and at the intrados at A and B. From experiments in loading culvert pipe firmly supported at the two lower quarter points, corresponding to E and F, the maximum moment at the section may appropriately be written

$$M = (D / \sqrt{2} - 6)\ L'\ D'/64.$$

Computing the resisting moment in the customary fashion, the stress in the concrete and in the steel may be determined from the expressions:—

$$f_c = \frac{M}{K/2\,(1 - K/3)\,b\,d^2}$$

and

$$f_s = \frac{M}{p\,(1 - K/3)\,b\,d^2}$$

By adding 1 in. to d_1 or d_2, the ring thickness is found.

A calculation of the external pressure shows that the stresses from the filled interstices are greater than those resulting from the filled circular bins. To provide for this some contractors using single reinforcement in the centre bins have rodded the interstices, while others increase the thickness of the bin walls and the connection between contiguous circular bins.

According to Mr. Heidenreich, the logical method seems to be to use double reinforcement.

The calculation of square bins, he states, is a simple matter, after the lateral pressure L has been found. The bending moment will be in inch pounds $M = 12\ L\ l^2/10$ where l = width of bin in feet.

Mr. Heidenreich states that interior bin walls having alternately pressure on either side should be reinforced on both sides. The connection of the reinforcements at the intersections and the corners of the bin walls in such cases becomes of the greatest importance. Where possible he recommends employing a strong wire fabric as a part of the reinforcement for the outer walls, running this reinforcement horizontally around the building.

◆

SERIOUS OUTBREAK OF TYPHOID FEVER OCCURS AGAIN IN OTTAWA.

The alarming increase in the number of typhoid cases in the city of Ottawa has called for the immediate action of the authorities and other business has been temporarily thrust to one side in order to give all concentrated energy to this pressing matter.

Dr. J. W. MacCullough, chief health officer of the Province of Ontario, has made a personal investigation of the district including an inspection of conditions along the water front.

The cause of the contamination is due to a leak in a concrete well through which the polluted water entered.

The Provincial Medical Health Officer has ordered the City Council to have plans prepared for a new system of water supply, to consist of a mechanical sand filtration plant on Lemieux Island in the Ottawa River, to be connected with the pumping station in the city by a tunnel under the bed of the river to carry the intake pipe and keep it free from contamination. The estimated cost of the tunnel is $[illegible], while the plant will cost about $750,000.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **60** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23 TORONTO, CANADA, AUGUST 1, 1912. No. 5

CONTENTS OF THIS ISSUE.

Editorial: PAGE

Railway Business for May 253
Ottawa Water Supply 253
Canadian Pacific Stock 254

Leading Articles:

The High Tension Transmission System of the Hydro-Electric Power Commission of Ontario (second article). 237
A Large Reinforced Concrete Boat 242
A Large Retaining Wall for the Canadian Pacific Railway in Toronto 243
Fixed and Travelling Sewage Distributors 244
The Use of Copper Sulphate in Purifying Water Supplies 245
Some Notes on Band Conveyors 246
New Specifications for Creosote Wood Block Pavement 250
The Design of Reinforced Concrete Grain Elevators 252
Serious Outbreak of Typhoid Fever Occurs Again in Ottawa 252
The Production of Chlorine for Water and Sewage Purification 255
Concrete Substructural Waterproofing 257
Hypochlorite Sterilization at Kansas City, Mo. 259
The Use of Charts in the Preparation of Estimates 261
Production in Canada of Structural Materials and Clay Products 264

Personals 267
Coming Meetings 268
Engineering Societies 268
Market Conditions 24-26
Construction News 67
Railway Orders 74

RAILWAY BUSINESS FOR MAY.

For the month of May the net operating revenue of the railways of the United States declined five and five-tenths per cent. per mile of line as compared with May, 1911, and that for May, 1911, was four and eight-tenths per cent. less than for May, 1910. This is the salient fact of the monthly summary of the Bureau of Railway Economics, compiled from the reports of the railways to the Interstate Commerce Commission, and embracing ninety per cent. of the steam railway mileage of the country.

The total operating revenues were $226,109,262, an increase of $7 per mile of line over May, 1911. The operating expenses were $161,368,677, an increase of $24.29 per mile of line, while the net operating revenue was $64,740,585, a decrease of $17.23 per mile of line. Taxes amounted for the month to $9,897,301, or $45 per mile, an increase of nine and two-tenths per cent.

The decrease in net operating revenue was most severe for the Eastern group of railways, amounting to eleven and nine-tenths per cent. For the Southern group it increased four-tenths of one per cent., and for the Western group less than one-tenth of one per cent. The aggregate of the net operating revenue for the eleven months of the fiscal year, and also for the five months of the calendar year, when measured per mile of line, shows a decrease in comparison with the corresponding periods of the previous year.

◆

OTTAWA WATER SUPPLY.

The water supply of the city of Ottawa has again been the subject of discussion, as a result of another outbreak of typhoid. The Provincial Medical Health Officer in no uncertain manner has impressed on the city council the necessity for immediate action with regard to improvements in the supply. For some time the city engineer has been preparing plans for a slow sand filtration plant. The council had decided on this method of purification, although the experts who were called to report on the method, and the source of supply, had decided against it. The city engineer himself had objected to slow sand filtration, but his objections were brushed aside by the council. The Provincial Health Officer, however, refused to sanction slow sand filtration, and demanded that immediate action be taken towards installing a mechanical filtration plant.

In the seventeenth annual report of the Board of Health of the Province of Quebec, Mr. James O. Meadows, the sanitary engineer for the board, gives a report on a sanitary survey of the Ottawa River. His report presents many matters of interest, and has been published in a pamphlet form recently by the Provincial Government for general distribution. This report of the sanitary condition of the Ottawa River was undertaken to study the river as a source of domestic water supply and its relations to public health, and the information contained is based upon results secured from analytical data recently completed and by analytical data which was available from previous local studies. These studies relate to the potability of the domestic water supplies in regard to their relation to sewage, refuse, and industrial wastes discharged into the river at points above those from which such water supplies are obtained. These questions have been further studied by the aid of vital statistics and typhoid fever data so as to obtain their relations to the public health. The work has been confined to a study of the main river from a point above Pembroke to Montreal, and the main object has been to determine to what extent the Ottawa River is used as a source of public water supply.

This study has shown that the Ottawa River above the city of Ottawa is in a very satisfactory condition as regards bacterial purity, except where polluted for a short distance by municipal sewers. It is not probable that the amount of pollution for this district will increase perceptibly for a considerable period of time. The report states that because of the high color content of the Ottawa River water, mechanical filtration will be found to be the most satisfactory method to be adopted to secure a purified water of satisfactory physical appearance and bacterial purity.

In the face of their experts' report and the above investigation, conducted by the Quebec Board of Health, the council showed poor taste, to put it mildly, to order plans prepared for slow sand filtration, and the rebuke administered by Dr. McCullough was well deserved. On last Friday night the Ottawa Council decided in favor of a mechanical filtration plant, to be established on Lemieux Island, in line with Dr. McCullough's recommendations. Ottawa's experience is one more instance of the result of interference on the part of the city council in matters of which they know nothing, and which should be decided by engineers.

CANADIAN PACIFIC STOCK.

Accumulating money at a rapid pace, making continued increases in earnings, always enlarging its programme of construction and improvement, the discussion of another issue of stock for the Canadian Pacific Railroad will not be silenced. A member of a New York banking house with London connections is the latest to re-echo the belief that when Parliament meets again at Ottawa, the railway will apply for authority to increase the amount of its authorized common stock capitalization.

The authorized common stock of the company is $200,000,000, it having been increased from $150,000,000 at the stockholders' meeting in October, 1908. Outstanding on June 30th, 1911, was $180,000,000. Shareholders of record of January 2nd, 1912, were privileged to subscribe at 150 for $18,000,000 of new common (ordinary) stock to the extent of 10 per cent. of their holdings. This is now being paid for, and will have yielded $27,000,000 by the time of the last payment, viz., October 18th.

In some quarters it is asserted that the next bonus to stockholders will take the form of an increase in the regular dividend rate to 12 per cent., which rate, in view of the rapidly expanding earnings, could be easily enough sustained. Others still seem to hold to the belief that a plan will be formulated whereby the large extraneous assets of the company will be segregated from the railroad assets proper and new securities created to represent them. But the majority is anticipating a new issue of common stock at 150 or 165, with accompanying valuable "rights" accruing to shareholders.

"The circumstances giving rise to this expectation of new financing," says the New York banker, "are the extraordinary expansion of earnings and the fast-rising [illegible] of land. It is apparent to those who have a reasonably good acquaintance with the vast scale upon which Canadian Pacific operates, that in a comparatively [illegible] [illegible] [illegible] or more of new cash capital must be provided. When the time comes, some of the new capital [illegible] be had, through the issuance and sale of more 4 per cent. debenture stock and perhaps 4 per cent. preferred stock. But the greater part of the requirement will be obtained by issuing additional common stock."

The earnings of the Canadian Pacific for several years have consistently made new records, and it looks as though the current year will make still another. While no official decision respecting the double-tracking of the system from coast to coast has been announced, observers see that such an enterprise will become necessary in a comparatively short time.

If another offering of stock is made, say, $40,000,000, at 150, which was the price of the $18,000,000 issue of last January, it would yield $60,000,000, but, as there is a likelihood of the next block being offered at a higher price, probably 165, an issue of $40,000,000 would bring $66,000,000. Such an amount would serve to carry the company's programme forward on an increased scale for another year. The company usually has on hand a working cash balance of $45,000,000 to $50,000,000, and this amount, coupled with the newly raised capital—$27,000,000 through sale of common stock and about £1,000,000 of preferred stock in London at the close of last year—the company could put about $80,000,000 into the construction work it has under way without issuing any new stock. Ample amounts, however, must be provided from time to time for the proper operation of the company's system, not only to-day, but in years to come.

EDITORIAL COMMENT.

We have had occasion several times of late to refer to the request of the Chicago Drainage Canal Sanitary District for permission to divert more water. We are glad to note that the United States Secretary of War has decided against allowing any increased diversion. The Canadian Commission of Conservation, and its able secretary, are to be congratulated on the able manner in which the objections of Canada were presented. It was largely due to this energetic protest that the increased amount was not granted.

* * * *

The judgment of the Privy Council, just delivered, awarding a decision in favor of the Niagara Falls Queen Victoria Park Commission against the Niagara power companies, in the matter of power rentals, means much to the Commission and its policy of beautifying the Niagara Peninsula. The question was whether the companies should pay rental on a peak basis or on the average load, and the decision of the Privy Council reverses the previous judgment of the Canadian courts. It is of interest to note that the opinion voiced by Dean Galbraith, of the University of Toronto, some years ago, when called as an expert by the Park Commission, has been sustained by the Privy Council.

LETTER TO THE EDITOR.

Sir,—In your leading editorial in your issue of July 25th you refer to a recent article of mine which you entitle "Mining and the University." The article referred to was one of a series being published in the Canadian Mining Journal, and in Applied Science, and the title was "The Mineral Industry and the University of Toronto." In this particular case, this is a distinction with a difference. The choice of terminology happens to be exceedingly vital.

H. E. T. HAULTAIN,

306 Stair Building, Toronto.

THE PRODUCTION OF CHLORINE FOR WATER AND SEWAGE STERILIZATION.

By Joseph Race, F.I.C., (Toronto Filtration Plant.)

Chlorine is being so largely used at the present time for the treatment of drinking water and sewage that a review of the different methods used in its production will be of general interest. Almost the entire quantity used at present is made either from bleach or by the electrolysis of brine solutions, and as the latter are becoming more prominent, they will be described first.

Electrolytic Methods.—When electricity is passed through a solution of common salt, the sodium chloride molecule is dissociated and the components liberated. If these are not separated, the chlorine combines with the sodium hydrate formed by the action of the sodium on the water present, to form sodium hypochlorite, a strong germicidal agent. There are two types of electrolysers used for the process . In one, the cathodic and anodic products are allowed to recombine in the main body of the electrolyte; and the other, the diaphragm process, the products are removed separately from the cell as produced. For the production of sodium hypochlorite, the non-diaphragm process has usually been adopted because it dispenses with the destructive diaphragms and the loss of energy that such diaphragms cause. Dr. Rideal of London, (England), has recently developed a cell of this type with an energy efficiency of 68 per cent., but as complete data are not available, the non-diaphragm process only will be dealt with.

The theoretical voltage required for the decomposition of sodium chloride is 2.3, but when the products recombine in the electrolyte, side reactions occur which raise the minimum voltage to 3.54. On this basis one kilowatt gives 272 amps., and as one amp. hour is theoretically capable of producing 1.28 grams of chlorine, 1.26 kilowatt hours are necessary for the production of 1lb. of chlorine by the decomposition of 1.65 lbs. of salt; this represents an energy efficient of 100 per cent.

Charles Watt (1851) was the first to patent this process and to recognize the necessary conditions, which are: (1) Insoluble electrodes; (2) Low temperature of electrolyte; (3) Rapid circulation of electrolyte from cathode towards anode. The temperature is very important, for, if it reaches over [illegible]° C, oxidation takes place, and the efficiency is lowered. The following types of electrolytic cells are now in use in various places:—

The Haas and Oettel Electrolyser.—The latest form of this electrolyser makes use of carbon as electrode material and of the liberation of hydrogen at the cathode to effect automatic circulation and mixing of the liquid in the cell. The inner or working cell is a rectangular stone-ware tank divided by the carbons into 30 narrow compartments or cells, each of which has one hole at the bottom and two others at the sides about two inches from the top. The first and last carbons of the set form the main electrodes of the cell; the intervening carbons act as secondary electrodes, i.e., as anodes on the one face and cathodes on the other. This inner cell is supported on a brick foundation within a stone-ware tank measuring 72 inches by 36 inches deep and is filled with a 15 per cent. solution of brine to within four inches of the top. The carbons are protected at their top and bottom edges with slips of glass of the same width as the carbons, which prevent short circuiting due to dirt and sludge, and also prolonging the life of the carbons. A continuous current of 80 amperes at 100 volts is employed to work the electrolyser, and as soon as the electrical connection is made the evolution of hydrogen at the negative or cathode surface of the electrodes causes the level of the liquid within the cells to rise above the overflow pipes, and a rapid circulation of the brine occurs, fresh liquid flowing in at the bottom of the cells. The liquid passing away at the top of the cells flows over cooling plate, and when necessary the heat produced by electrolysis is further dispersed by aid of cooling pipes placed in the layer containing tank.

The following figures give the yields of the industrial type TE/3 of this particular electrolyser:—

Capacity—165 gallons of brine. Strength 15 per cent. Salt required (112 kilos) 247.5 pounds.

Current—75 to 80 amperes at 110 volts for 10 hours equivalent to 88 B.T. units.

Yield—165 gallons hypochlorite solution containing 14 grms. of free chlorine per litre (1.4 per cent.) equivalent to (10.5 kilos) 23.1 pounds of chlorine.

The carbon electrodes are reported to have a life of 18 months for a 10-hour working day, and to cost for renewal £3-10c.-0 per set. The labor required for operating this type of electrolyser is about one hour per day, as when once charged with fresh brine is can be left for 10 hours but with slight attention. The current efficiency falls from 95 per cent. to 52.8 per cent. during the 10 hours required to produce a solution containing 14.0 grms. of chlorine per litre (1.4 per cent.) the highest efficiency being obtained with a concentration of 2.5 grms. of chlorine per litre (0.25 per cent).

The Kellner Electrolyser consists of a shallow stoneware tank divided into a large number of narrow cells by means of vertical glass plates so arranged that the electrolyte is obliged to take a zig-zag course in its passage through the electrolyser. The electrodes are formed of platinum-iridium gauze, and are arranged horizontally with anodes below the cathodes, so that the chlorine liberated at the former may be absorbed by the supernatant liquid. This electrolyser has only two terminal electrodes, and all the intervening electrodes function as secondary electrodes as in the Haas and Oettel apparatus. The electrolyser is constructed usually to take a current of 110 volts. Brine is passed continually through the apparatus until the desired concentration is obtained, a small centrifugal pump being employed to circulate the brine through the electrolyser and an external cooling vessel being used to keep down the temperature below 25° C. Using a 10 per cent. solution of salt, the current efficiency falls from 87.5 per cent. to 45.8 per cent. in 10 hours, the free chlorine rising from 0.309 to 1.295 per cent. during this period. The following figures give the yield of the industrial type (2 Esn. 60/9) of this apparatus.

Capacity—820 litres (180 gallons) of brine. Strength 15 per cent. Salt required 123 kilos (270 lbs.).

Current—90 amperes at 110 volts for 10 hours, equivalent to 99 B. T. Units.

Yield—820 litres (180 gallons) of hypochlorite solution, containing 20 grams free chlorine per litre (2 per cent.), equivalent to 16.4 kilos (36 lbs.) of chlorine.

The life of the platinum-iridium electrodes is, of course, much longer than that of the carbon electrodes employed in the Haas and Oettel electrolyser, and their scrap value is considerable; but, on the other hand, they are not indestructible, and if the brine contains magnesium salts, the deposit of these cause trouble.

The Hermite Electrolyser.—The distinctive features of this cell and process are the uses of a mixture of sodium and magnesium chloride as electrolyte, of magnesium hydrate as a preservative, and of zinc as negative element in the cells. The electrolyte is prepared in an elevated tank, and is allowed to flow by gravity through a series of four double troughs. These troughs were formerly made of slate, but are now constructed of glazed earthenware, and each is divided by a partition which causes the electrolyte to pass twice along the length. Each division of the trough contains five sets of electrodes, two negative electrodes of zinc, enclosing one positive electrode formed by winding thin platinum wire upon a perforated porcelain slab of the required shape. There are thus six separate cells containing 40 pairs of electrodes in the one unit of plant, and a current of 15 amperes at 230 volts is employed, the electrodes and cells all being connected electrically in series. The electrolyte passes between each of the electrodes in its passage from the inlet to the exit, the flow from one trough to the next being controlled by glass syphons and funnels. A small addition of sodium hydroxide solution is made to the liquid as it flows from the last trough, glass carboys being employed to receive the mixed solution of calcium and magnesium hypochlorites. The capacity of each unit of plant is 185-200 gallons of solution at a strength of 4 to 6 grams. of chlorine per litre (0.4 to 0.6 per cent.) per eight-hour day, the rate of flow of electrolyte being 3 1-3 pints per minute. The first unit of plant was erected at Poplar in 1906, and cost with all the necessary accessories £583 ($2,915), the second unit erected at the beginning of 1910 cost £501 ($2,505). The running cost—electricity, water, chemicals, supervision and testing—for the half-year ending September 30th, 1910, amounted to $500 (£100), but this total does not contain any allowance for interest, depreciation, rent, or distribution charges. The net cost of one electrolyser [illegible]

The Vogelsand Electrolyser.—The original form of Vogelsand electrolyser resembled in its main construction features of Hermite and Kellner electrolysers, the electrolyte being made to take a zig-zag (vertical) course through a trough filled with a large number of electrodes (secondary). Lead plates faced with platinum on the anode side were used as the intermediate electrodes, and by varying the number of these the electrolyser could be made to take a current of 85 amperes at 65 to 110 volts. An electrolyser of this type was said to have produced 20 kilos (44 lbs.) of active chlorine in a 10-hours working day, equivalent to a yield of 1 kilo of active chlorine (2.2 lbs.) per 6.6 E.H.P. hours, or an energy efficiency of 35.8 per cent. The use of lead for electrodes did not, however, prove satisfactory, and the Vogelsand cell has been considerably modified. The electrolyser now worked at Nottingham and other places abroad is constructed with composite electrodes. Narrow bars of slate extending the full width of the cell are wrapped with a sheet of platinum-iridium foil in zig-zag fashion, the result being an electrode of great strength, which can carry high current densities, and presents opposing surfaces of foil where required. The sectional area allowed for carrying the current through the electrode (from one face to the other) should be proportioned to the superficial electrode surface in contact with the electrode.

The Mather and Platt Electrolyser.—This resembles that of Kellner and is constructed with [illegible] electrodes made of a platinum-iridium alloy, and with two terminal electrodes for connection to the current mains. The 40 cells into which the electrolyser is divided by plate-glass strips and so arranged that the electrolyte takes a zig-zag course, and attains a [illegible] chlorine, equivalent to 6 K.W. hours per kilo, or 2.7 K.W. [illegible]

The Dayton Cell.—[illegible]

Rickard's quarterly bulletin, Ohio State Board of Health, Oct.-December, 1909, states that with this cell one pound of available chlorine could be produced by the consumption of 2.65 K.W. hours and 6.9 pounds of sodium chloride. This result was obtained by cooling with ice. Without the cooling process, 3.62 K.W. hours and 7.2 pounds of salt were necessary. Other results with this cell are to the effect that one pound of available chlorine can be produced by the consumption of 3.38 K.W. hours and 7.7 pounds of salt. The cell (model T N) using 20 gallons of 5 per cent. salt solution per hour gave a liquor containing 0.65 per cent. of available chlorine by the consumption of 40 amperes at 110 volts.

Taking the results given in the above descriptions of the various forms of electrolytic hypochlorite cells, we obtain the following figures for the relative yields:—

Type of Cell.	Salt used. lbs.	K.W. hours.	Active chlorine. lbs.
Haas and Oetell	247.5	80 x 110 x 10 88	23.1
Kellner	270.0	90 x 110 x 10 99	36.0
Hermite	78.5	15 x 230 x 8 27.6	9.57
Mather and Platt	....	19.33 x 220 x 10 42.52	7.0
Dayton	100	40 x 110 x 10	13.0
Theoretical	1.65	1.26	1.0

Efficiency.

	Salt used.		Power used.	
	lbs.	per cent.	K.W. hrs.	Efficiency.
Haas and Oettel	10.7	15.4	3.80	33.2
Kellner	7.5	22.0	2.75	45.8
Hermite	11.2	14.5	2.87	43.9
Mather and Platt		....	2.75	45.8
Dayton	7.7	21.4	3.38	37.3
Theory demands	1.65	100	1.26	100

The cost of production will depend upon local circumstances. If alternating current is available at $30 per horsepower per annum, the price per K.W. hour of direct current, assuming the efficiency of a motor generator set to be 88 per cent., will be 0.52 cent. With low-grade salt at $5 per ton, the cost of one pound of available chlorine would be as follows:—

Cost of Pound of Available Chlorine.

Type of cell.	Salt.	Current.	Total.
Haas and Oettel	2.67	1.97	4.64
Kellner	1.87	1.43	3.30
Hermite	2.80	1.49	4.29
Dayton	1.92	1.76	3.68

From these results it is evident that the most efficient cells are the Kellner and the Dayton, but as the former involves a much larger capital outlay owing to the high cost of the platinum-iridium electrodes, the latter is the most economical cell available. Low-grade salt is often unsuitable for use in the Kellner cell owing to the magnesium salts depositing on the electrodes and reducing the efficiency.

Chemical Methods.—

(a)—Bleaching powder.
(b)—Sodium hypochlorite.
(c)—Liquid chlorine.

Bleaching Powder.—Bleaching powder (commercial calcium hypochlorite) on addition to water yields chlorine in an active condition, and this constitutes one of the simplest and most economical methods of producing chlorine for sterilization purposes. Bleach usually contains 37-38 per cent. of available chlorine, and of this about 33 per cent. is easily obtained by solution in water. The product of the new plant at Windsor, the only bleach plant in operation in this country, is sold at $25 per ton, so that each pound of available chlorine costs 3.75 cents.

Sodium Hypochlorite.—This compound is sold by Brunner Mond & Co., Northwich, England, under the trade name of "Chloros." In this country it costs 25 cents per gallon, and as the solution contains about 12 per cent. of available chlorine, each pound of chlorine costs approximately 20 cents.

Liquid Chlorine.—Anhydrous liquid chlorine has recently come into use for sterilization purposes, and its introduction in 1910 was due to Major Darnall, M.D., of the Medical Corps of the United States Army. The method is very simple, being the addition of dry chlorine gas, evolved by releasing the pressure on the liquid chlorine, to the water to be treated. Chlorine is obtained as a by-product in the manufacture of caustic soda, and a portion of it is purified, dried, liquefied by pressure, and put on the market in steel drums or cylinders holding 100 to 140 lbs. each. The chlorine thus obtained is almost chemically pure, the impurities being traces of oxygen, carbon dioxide, and nitrogen. The pressure of the liquefied chlorine on the walls of the drum varies from 54 pounds per square inch at 32° F. to 216 pounds pressure at 122° F. The price is approximately 12 cents per pound, but there is doubt that this will be very materially reduced if the consumption materially increases.

Relative Sterilization Efficiencies of Chemical and Electrolytic Chlorine.—The claims made for the superior bleaching efficiency of chlorine produced by electrolytic methods have been modified by the results of recent independent research, and it is now generally accepted that there is but slight difference (not exceeding 5 per cent.) between the bleaching effects obtained, if the chlorine be present in the same form of combination and in the same degree of concentration in the various bleaching liquors. The disinfection and bleaching properties of chlorine are both due to the nascent oxygen liberated on solution, so that the above remarks apply equally well to chlorine for disinfection purposes. It is probable that the carbonic acid content of the water to be treated is a much more important factor than the form of combination of the chlorine, as this is the constituent of water that is mainly responsible for the decomposition of the hypochlorite into hypochlorous acid and free chlorine which in turn produce nascent oxygen.

Capital Outlay.—The capital outlay required for chlorine treatment depends so largely upon individual requirements that generalizations on this phase of the subject are practically of no value. Whilst chemical chlorine is undoubtedly the best in an emergency or for temporary use, the electrolytic method is deserving of full consideration, where chlorination is decided upon as a permanent measure. At Baltimore and Cincinnati the electrolytic process was probably installed on account of the extremely low cost of electrical current, and where even the same conditions obtain, this method is undoubtedly the most economical.

Resume of Costs.

Electrolytic—				
Haas and Oettel	4.64	cents per	pound of	available chlorine
Kellner	3.30	"	"	"
Hermite	4.20	"	"	"
Dayton	3.68	"	"	"
Chemical				
Bleach	3.75	"	"	"
Sodium				
Hypochlorite	20.0	"	"	"
Liquid Chlorine	12.0	"	"	"

CONCRETE SUBSTRUCTURAL WATERPROOFING.*

By J. R. Wickle.

The cost of the proper waterproofing of a building bears but a slight percentage of the total cost of the completed structure, and architects and engineers have recognized the fact that the use of good materials, giving permanent results, are the only ones which they can afford to employ, if only as a matter of good economy. The use of pitch and kindred products is gradually being abandoned for the reason that such materials disintegrate when in contact with moisture and are affected by alkalies and other substances in the soil which rapidly destroy them. Therefore, it must be apparent that such materials should be used which are unaffected by the conditions peculiar to the foundation.

Two methods are open to the architect preparing his waterproofing scheme. The first is the membraneous or seal method, which consists in surrounding the entire foundation with an impenetrable envelope interposed between the structure and the water or moisture to be kept out. The "integral" method is that by which the waterproof agent becomes absorbed into and integrated throughout the concrete mass, or through the cement plaster, or concrete so completely as to render the mass, or plaster, impregnable to the attacks or penetration of water or dampness.

For your consideration we will first take up the membraneous system. Where the term "foundation" is used, it is understood to be that of concrete in accordance with the general practice. The matter of heads pressure, and so forth, will be referred to only in a general way, as the object of this paper is not to dwell upon the engineering features of the substructure, but to discuss the waterproofing systems used and employed in this connection. The conditions under which the work is to be done will, to a large extent, determine the method to be used. In considering the membraneous treatment let us assume that our footing course has been placed. The next step is to lay the waterproofing over the footings, using no less than three ply of good felt bonded by means of a good bitumen. Bitumens which require heating are the ones used most advantageously in this connection. Binders of the sort will remain relatively tacky, and will not crack or break, due to any subsequent settling ot the foundation. Having laid this damp course, the waterproofing will be carried up the outside of the foundation wall to six inches above the grade line. Where only ordinary seepage exists, the use of a heavy asphaltum damp-proof paint applied on such walls will be sufficient, but should the walls be left in very rough shape, a bituminous plastic which is applied with a trowel should be substituted for the liquid damp-proof paint as suggested above. This last treatment dispenses with the safety coat of cement mortar which is necessary as a protection to the waterproofing in back-filling on completion of the work. In placing the waterproofing over footings the felt should project at least six inches on either side of same in order to make connection with the waterproofing to be carried over floors and the exterior side of the wall. The floor waterproofing is laid between upper and lower beds of concrete, the concrete being laid in such a manner that the top bed of same will resist any hydrostatic pressure which may develop from below. To illustrate: Supposing the total thickness of concrete to be placed for floors is seven inches, a three-inch bed would first be placed on which will be laid the waterproofing, the same number of plies being used as laid over footings. Upon this three inches of concrete will be put, as an upper bed, and a one-inch top dressing of cement and sand, say 1 to 2 mix, to provide a wearing surface for the floor. This floor waterproofing is made continuous by joining the felt with six inches of same projecting from the footings and up the walls. The method is simple, but is not always permanent, except that you employ such materials as will be unaffected by the expansion and contraction of the foundation. The architect or the contractor will see that the connections are properly made as between the wall waterproofing and the floor waterproofing, for it is at this point that trouble usually develops. Irish felt is considered one of the best reinforcing agents for substructural waterproofing, and, to-day, materials of this kind which are on the market compare very favorably in price with the domestic paper, in fact I believe a number of imported felts to be cheaper. Where considerable pressure is to be met with at least six ply of felt should be installed. In many cases automatic pumps or ejectors are erected in connection with a sump pit in order to keep the water around the foundation below the floor level. This installation, however, is optional, for waterproofing done in a careful manner as I have outlined, with an eye to the selection of proper materials on the part of the architect, will be reliable in the most acute cases. Where ordnary seepage occurs, a stratum of a plastic bitumen can be substituted for the felt. If the foundation adjoins that of another structure it is evident that the felt cannot be placed on the outside of the foundation walls, without first laying up a brick wall on the outside of the bearing wall to sustain the waterproofing. In instances of this kind, it depends upon the conditions whether this scheme should be preferred to the integral method.

---

* Paper read before a meeting of Architects in Winnipeg.

Coming to the integral method, it is perhaps, well to touch upon the character of materials now largely in use. In the laboratory or in very careful practice, it is possible to obtain a voidless concrete by using properly graded aggregates with the cement. A concrete thus obtained is waterproof, but in every-day work, taking into consideration the human equation, the probabilities of securing an absolutely dense concrete, are too utopian for consideration in this paper. Owing to the porous nature of concrete, many tests have been conducted with the object of securing a medium to overcome this porosity with an absolutely voidless concrete at the ultimate. Some materials on the market are liquid in form, and we are advised they do not act as void fillers, but simply increase the cementative properties of the cement without affecting the volume of concrete and have for their object a closer relation between the cement and the aggregate. This is explained as bringing into service the full colloidal possibilities of the cement. Frequently hydrate of lime is used for the purpose of waterproofing concrete. It is my opinion that this is not a successful agent, unless the lime can absorb oxygen or slack. In plastering, for instance, the object of using three coats of lime mortar is to give the lime sufficient surface to take up oxygen and fulfil its purpose. Take a sixteen-inch wall, for instance, waterproofed by the use of lime; it will only be waterproof on or near the surface where the lime has the opportunity of becoming active. In the interior of such wall we find this agent in an unslacked state, having absolutely no chance to assist the cement, and is a loafer on the job. It will be seen that unless all parts of the mass can receive the full [illegible] of the [illegible] [illegible] that the purpose of the agent cannot be attained.

Experiments have been conducted in the laboratories of several of the large universities of the United States which [illegible] [illegible]. Other materials now in use act as [illegible] [illegible] [illegible] of [illegible] [illegible] and water- [illegible] [illegible] affecting the strength of the concrete, they [illegible] [illegible] [illegible]. Materials of this kind are [illegible] [illegible] [illegible] and are extensively used. A concrete mass so waterproofed will lose its capillary value for attracting water. Having selected the material, the next question to decide is, shall we incorporate it throughout the entire concrete body, or use it in an interior plaster coating? If we decide the former, all that is necessary is to put in the waterproofing when mixing the concrete, and the other details of construction can be carried on without further regard to the waterproofing except to observe the manufacturer's directions as to mixing and so forth, and leaving no part of the substructure untreated. The question is often brought up as to what assurance we have that the material be properly mixed. If the workman is not careful in mixing his concrete he will not secure a good concrete, and by the same token he will not secure a waterproof concrete. On the other hand, a careful workman will be as careful in adding his waterproof compound as he will in mixing his concrete. The fact that many perfect jobs executed by following manufacturer's directions and without his supervision, is a test to the merit of these waterproofing factors. The advantages of the integral method are quite apparent. No need to build a retaining wall to receive the waterproofing when building against an adjoining wall. Another service, and a great one, which the integral method performs is exemplified when trouble develops in a foundation. Excavating around the outside of foundation walls, and applying asphaltum, serves only to keep the water from the structure at that point, while it is a natural course for the water to find its way through the footings and floors. The best that we can expect from such a treatment is a waterproof wall down to the footings, and water will come up through the footings and floors. In other words, we must secure continuity of the waterproof course. The solution of the problem and the only practical way of obtaining such a continuous surface is an interior application whereby the waterproofing can be placed over all walls and floors, and thus successfully resist the penetration of water at all points.

In discussing the membraneous method I mentioned that the waterproofing would need to be placed between the water to be combatted and the structure, but in the application of the integral method as a plaster coating, this is not necessary. For the purpose of explanation, let us consider a concrete foundation with seepage occurring at different points. It is not possible to apply the waterproof coating as described, on a surface continuously wet and by water under pressure, so as in all problems in waterproofing, the first step will be to keep the water below the floor level during the process of waterproofing. One of the methods commonly employed for this purpose is known as "bleeding the wall"—that is, inserting iron pipes in the wall at points where the entrance of water is most apparent, these bleeders being placed so as to permit the pumping of the water from the outside wall to a point below the level of the surface to be waterproofed. Having done this, the next step is to make all surfaces to be treated sufficiently rough to receive the plaster coating. This can be done by hacking, followed by an acid wash, which, in turn, is washed off with clean water after the effervescence ceases. The use of acid (common muriatic acid) or acids in powder form used for this purpose act upon the lime in the cement and expose the silicate particles of the concrete. Then we apply our waterproof plaster coating, which is a coat of either 1 to 2 or 1 to 3 mixture of cement and sand, having the waterproof agent mixed in. This applied on the walls in a three-quarter inch coating and on the floors in a coating at least one inch in thickness, will accomplish the result after the waterproofing is set up; then it is possible to seal the bleeders. As to the adhesion between the waterproof coating and the concrete, this bond will resist any pressure which may develop. Many large jobs have been waterproofed by such a scheme as I have described. The waterproofing is ever in sight and the installation can be made on a brick foundation wall, with practically as good results as can be obtained on a concrete wall.

In conclusion, you yourselves can best determine the method to be employed based upon the local conditions. A suitable caption would be, suit methods to conditions and material to methods, and with this ever in mind, and without pre-supposing the nicety of workmanship guaranteed in ordinary labor, we are able to get good results.

HYPOCHLORITE STERILIZATION AT KANSAS CITY, MO.

By S. Y. High, Chief Superintendent of Water Works.

The water supply of Kansas City, Mo., is taken from the Missouri River about five miles above Kansas City, at the Quindaro station in Kansas. The water is pumped directly from the river into settling basins. The water is then treated with lime and sulphate of alumina. After leaving the basins through the back flow or suction pipe, the hypochlorite solution is introduced before the water gets to the pump, the pump agitation making a thorough mixture of the hypochlorite with the water.

From the Quindaro station the water is pumped to the Turkey Creek station twelve-million-gallon reservoir, and from this reservoir to the service mains.

Since the demonstration at Boonton, N.J., in 1909, of the reduction of bacteria by the introduction of minute quantities of "available chlorine" with water more or less polluted, and the acceptance of the process by the courts as a proper method to be employed in connection with a municipal water supply, the question of the efficient introduction of hypochlorite of lime solution and the mechanical appliances suitable for the purpose engaged the attention of the fire and water commissioners of this city. They ordered the city chemist, Dr. W. M. Cross, to make a trip of inspection of several cities known to have the hypochlorite sterilization system in satisfactory operation.

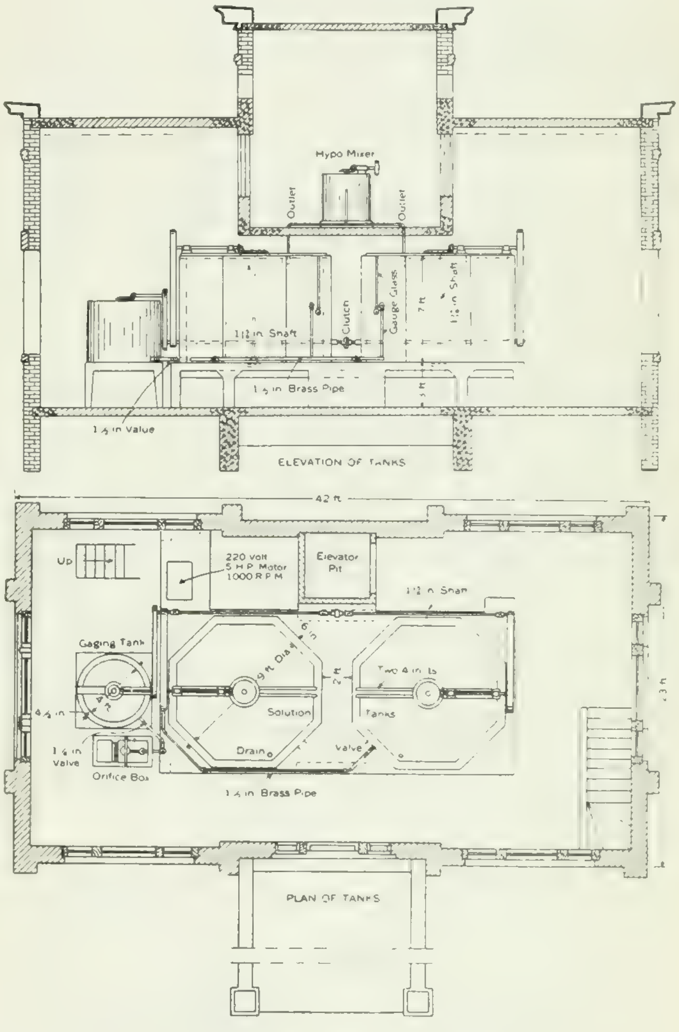
Dr. Cross found the method of installation of the system easy, cheap and satisfactory. During the year 1911 an experimental installation of the hypochlorite process for the approximate sterilization of the entire municipal water supply of Kansas City was so successful that the Kansas City fire and water commissioners undertook the construction of a permanent building and apparatus for the application of this purification process to the entire water supply.

A separate building was constructed to make possible the satisfactory storage, handling and making of the solution of hypochlorite ready for mixing with the sedimented water. The building itself was designed by W. C. Root, an architect, and the apparatus for use in connection with the sterilization process was installed under the direction and supervision of Burton Lowther, engineer in charge.

The apparatus for the handling of the hypochlorite and the supports for it are of reinforced concrete. It is to be observed that no other material is so well suited for use in connection with this sterilizing agent as good concrete, for the reason that all other materials that are capable of oxidation are promptly attacked by the hypochlorite solution and become rapidly deteriorated. The prime consideration with regard to this class of installation is to employ methods of construction and to use material that is so permanent in character as to obviate the necessity of repairs which would force the discontinuance of the application of the sterilizing agent, even for an hour.

The basement of the building is used for storage of the reagent that is kept in reserve. The main floor is used to house the dilution tanks and the feeding devices, while on the floor above is placed the tank in which the hypochlorite is reduced to paste of a creamy consistency before being delivered to the dilution tanks beneath. This pasting tank, three feet in diameter and four feet high, is provided with a stirring device carrying two rather heavy rollers disposed horizontally at its lower end.

The rollers clear the bottom of the concrete tank only by a fraction of an inch, thus insuring the mashing and disintegration of all of the small lumps that are invariably present in commercial calcium hypochlorite. Owing to the fact that the action of the reagent on bronze is to form on the surface of it a fairly insoluble and protective coating of metallic carbonate and oxychloride, that metal appears to be the most available for use on all bearings and stirring or disintegrating devices that come in contact with the solution. Leading from the concrete pasting tank are pipes so arranged that the contents of the tank may be discharged into either of the large dilution tanks on the floor beneath. The outlet of the pasting tank is placed at a considerable distance from its bottom, so as to avoid the possibility of drawing off with the paste any fragments of considerable size. The pipes carrying the paste are so arranged as to be readily cleaned in a few minutes in the event that they become clogged. Ultimately, they are sure to become clogged if they are not occasionally cleared, because of the formation in them of carbonate from carbon dioxide absorbed from the air.



Hypochlorite Sterilization Plant at Kansas City, Mo.

---

* Paper read before American Waterworks Association.

The dilution tanks are hexagonal in form, nine feet in maximum diameter and seven feet high. Their walls are six inches thick. Although the difficulty experienced in properly disposing the reinforcing iron in the construction of a hexagonal tank is much greater than is the case in the building of a round one, the hexagonal tank is to be preferred on account of the fact that in a round tank a rotary stirrer does not produce nearly such thorough agitation and mixing of the solution of hypochlorite as the same stirrer can do in the hexagonal tank. The paste is mixed with water in the dilution tanks until a uniform solution of a strength of 2 per cent. occurs. The use of two tanks makes it possible to accurately adjust the strength of the solution in one solution tank while the contents of the other are being utilized. The dilution tanks are placed on supports high enough to permit the use of a gravity feed to the orifice box, which is placed on the floor of the room housing the big tanks.

Bronze pipes, 1½ inches in size, so arranged as to be readily cleaned in the event of stoppage, connect the dilution tanks with a gaging tank four feet in diameter. This gaging tank contains a float, scale and pointer so arranged that the man in charge can accurately check the speed of outflow of solution from his orifice box into the big water main carrying the entire city water supply from the settling basins to the pumps. The solution passes through the gaging tank to the orifice box. Each division on the gage represents one gallon of the hypochlorite solution.

The orifice box is oblong in shape and carries a float of about 250 cubic inches displacement. The float operates a valve which, by either opening slightly or closing, maintains the hypochlorite solution in the orifice box to a constant level. One end of the orifice box is of plate glass to enable the operator to see at a glance that the solution is filling the box to the proper height. Attached to the plate glass and covering a hole in it is a hard rubber disc having near its periphery several slits, the adjustment of which fixes the size of stream of the 2 per cent. hypochlorite solution that will be the proper amount to treat the quantity of water passing through the main. All movements of the hypochlorite solution after its preparation are by gravity. Ample opportunity for the hypochlorite, after its addition to the water, to react with the putrescible organic matter and germs is afforded during the time in which the water passes through the centrifugal pump, the flow line and a small storage basin at Turkey Creek, where it is pumped to the domestic water mains.

All stirring devices are run by an electric motor belted to a line shaft carrying pulleys so placed as to make possible the turning of any one of the stirrers, whether or not [illegible].

[illegible] municipal water supplies is substantially the same as that in [illegible]

[illegible]

cents per million gallons, so that it probably will not exceed that amount, including interest and depreciation, as the pumpage during the hot and cold months averages over forty million gallons.

In view of the fact that a great many cases of typhoid fever are imported and that there are still open and being constantly used numerous springs, wells and cisterns, known to be contaminated with sewage, the result has been all that could have been anticipated. During the year 1910 no specific attempt was made to destroy pathogenic germs in the municipal water supply. During the year 1911 the hypochlorite process was used throughout the year.

The following tabulation, showing the number of deaths from typhoid fever, month by month, during those years, is illuminating:

Month.	**Deaths.**	
	1910.	1911.
January	17	6
February	21	6
March	10	4
April	8	3
May	3	4
June	7	1
July	9	5
August	8	6
September	6	3
October	6	8
November	4	6
December	8	9
Totals	107	61

Now, with this great source of danger from infection by the municipal water supply removed, it is possible for the health commissioner to so enforce the abandonment of questionable sources of water supply and regulate sanitary conditions as to make the occurrence of typhoid fever and most intestinal diseases an uncommon thing in Kansas City.

The following are some germ counts on the city water supply, showing the improvement of the water by the hypochlorite process:

Germs in one Cubic Centimeter of Water.

Date.	Quindaro, Missouri River Before Treatment.	Clear Basin Before Treatment.	City Hall Hydrant After Treatment.	B. Coli After Treatment.
March 20	10,000	1,200	75	0
March 21	8,000	1,800	70	0
March 22	4,000	800	100	0
March 24	10,000	500	55	0
March 25	8,000	600	90	0
March 27	8,000	400	25	0
March 28	5,000	260	20	0

The accompanying cut will give a fairly good idea of the disposition of the various parts of the purification installation.

A NEW USE FOR THE SULPHUR LIQUOR DISCHARGE OF GAS WORKS.

A French investigator, A. Demolon, found that when the soil was given a quantity of flowers of sulphur, the growth of roots and leaves was invariably hastened and the plants took on a deeper green. The investigation was suggested by the common use in northern France of gas works waste as manure. Analyses showed 30 per cent. of sulphur in this waste, and the growth stimulation was traced to this ingredient.

THE USE OF CHARTS IN THE PREPARATION OF ESTIMATES.

The following article by Mr. Edward G. Fiegehen, published recently in London "Engineering," contains material of so valuable a nature that we have reproduced it in full.

In the preparation of estimates of all kinds, time enters as a most important factor. It may become necessary, for instance, in order to take advantage of an unexpected opportunity of quoting, to compile a specification and estimate at the shortest possible notice, whilst, on the other hand, as in the case of tenders to public bodies, a definite date, generally two or three weeks ahead, is announced up to which tenders will be received; and since the tenders sent in remain unopened until after that date, no benefit is to be gained by posting them in advance. The bulk of inquirers, however, are content to receive tenders at the "early convenience" of the manufacturers concerned, and although the majority of firms will submit their proposals in the course of a few days, there are notable exceptions where the estimating departments appear to be constantly in arrears.

Without discussing, on the one hand, the advantages to be gained by being first in the field with a complete and attractive proposal, or, on the other hand, the risk thereby incurred of having one's price divulged for the guidance of a competitor, there can be no question that any method that will lighten the labor involved in preparing a tender by reducing the time absorbed by the merely mechanical portion of the work will thereby enable the estimator to give greater attention to the special features of each case, and will tend to prevent his work getting behindhand during those periods when inquiries are exceptionally numerous; furthermore, it will enable him in many cases to submit alternative proposals, for which, in the ordinary way, no time could be spared. We shall confine our remarks in what follows more especially to the preparation of estimates for electric-crane work; but it will be obvious that the methods advocated can be applied with equal facility to other branches of manufacture.

An advantage of such time-saving devices that appeals with special force to the estimator for crane-work is the ability thus secured to determine quickly the type, leading dimensions, approximate weight, electrical equipment, etc., appropriate to the crane he intends to offer, thus enabling him to get an estimate-drawing put in hand in ample time to allow the draughtsman to produce a satisfactory design.

By way of illustration, the charts described below will refer chiefly to the specific case of electric overhead traveling cranes. The number of types of cranes regularly manufactured is now very great, but perhaps no other is so popular, or exhibits more variation in its essential features, than that selected; for whilst it will frequently be possible to quote for a steam or electric jib-crane or winch directly from a standard price-list, with overhead cranes this is rarely the case, and each inquiry must be considered upon its merits to enable the most suitable offer to be put forward. In tackling such problems, it is found to be a good rule to deal with the known factors first, afterwards deciding the various points upon which the exercise of judgment is permitted.

In the case of established buildings the space available for the crane, and the nature of the current supply, are usually definitely stated by the customer; but since inquiries are frequently ambiguous even upon such essential points, it should be the rule to state definitely in the specification the basis upon which the estimate has been prepared, and to show clearly upon the drawing the space required for the satisfactory operation of the crane, indicating also any projections that would be likely to foul existing fixtures in the building, and also the position suggested for the main trolley-wires.

Such information is invariably of far greater service to the engineer than fullness of constructional details, which are far better indicated by photographs of similar jobs.

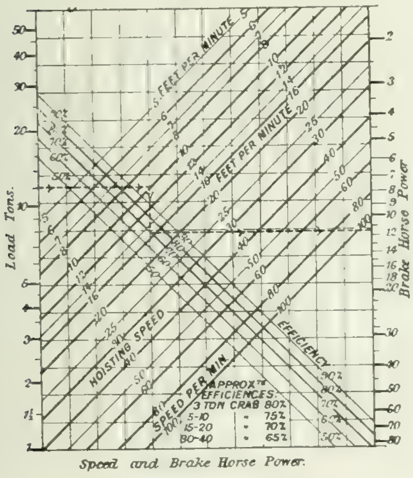


Fig. 1.

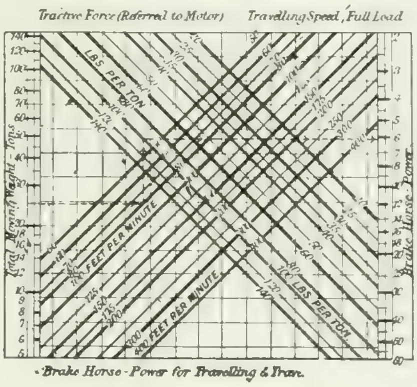


Fig. 2.

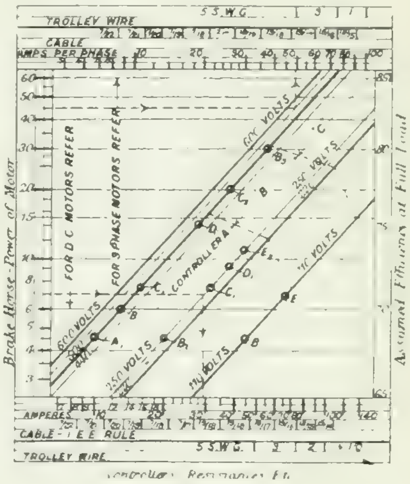


Fig. 3.

The speeds of the various motions under full load are sometimes specified by the customer, although in many instances these details are left to the judgment of the maker. In any case, however, it is generally open to the latter to submit speeds in accordance with his standard practice as an alternative, if by so doing he can quote a reduced price, or, perhaps more acceptable, earlier delivery, due to the use of stock patterns and parts. The first chart, Fig. 1, which is based upon the formula:—

$$\text{B.H.P.} = \frac{0.068 \times \text{load (tons)} \times \text{speed (f.p.m.)}}{\text{Efficiency}}$$

shows the connection between hoisting speed and brake horse-power for various loads, taking into account, of course, the mechanical efficiency of the crab-gearing under full load, which will vary both with the size of the crane and the type of gearing employed. The estimator will usually have access to test records for his guidance upon this point, but the approximate values given may be taken as typical of machine-cut spur-geared crabs under favorable conditions.

The next chart (Fig. 2) will, in a similar way, facilitate the calculation of the brake horse-power required for the traversing and traveling motions, and is based upon the formula:—

$$\text{B.H.P.} = \text{total moving load (tons)} \times \frac{\text{tractive effort} \times \text{speed (f.p.m.)}}{33{,}000}.$$

In working out test records of overhead cranes it is usual to express the "tractive effort" in pounds per ton as exerted at the motor thus:

$$\text{Tractive effort (pounds per ton)} = \frac{\text{Motor B.H.P.} \times 33{,}000}{\text{Traveling speed} \times \text{tons moved}}.$$

It will be noticed that the figure thus obtained contains an allowance for the transmission losses between the motor and the track-wheel treads, and is thus in the most convenient form for use, provided that the above qualification is not lost sight of.

To secure simplicity and, where possible, interchangeability of parts it is the commendable practice of many firms to confine themselves to a few standard powers and speeds of motors for use upon their cranes, and thus, in quoting, they will put forward the nearest standard motor that will be suitable for each motion.

This involves sometimes, it is true, offering a 10-brake horse-power motor where only 8½ brake horse-power to 9 brake horse-power is actually indicated; but the difference in cost is inappreciable, and in such cases the offer of increased speed that will thus be obtainable may sometimes be made available as a selling point.

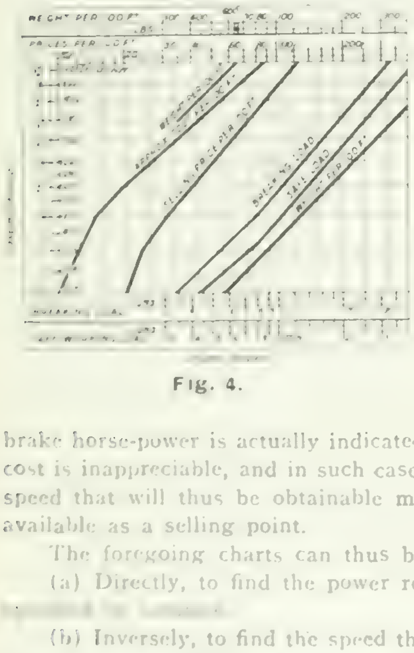


Fig. 4.

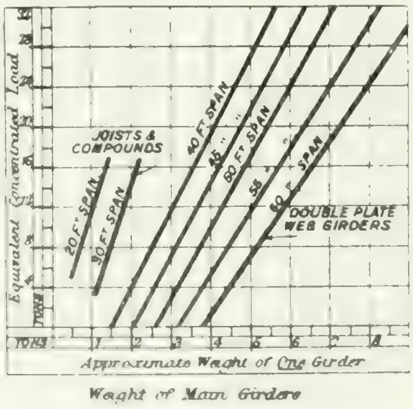


Fig. 5.

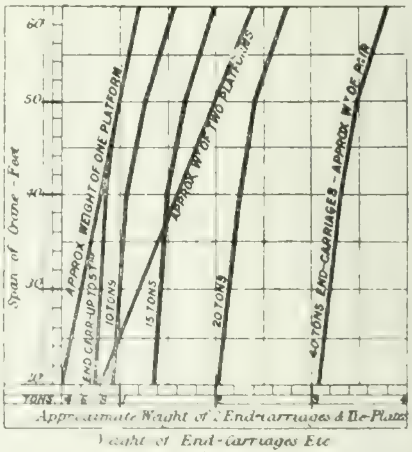


Fig. 6.

The foregoing charts can thus be used in two ways:—

(a) Directly, to find the power required from the speed [illegible]

(b) Inversely, to find the speed that the nearest standard motor, when applied to the motion, will give.

Having fixed the size of the motors to be employed, the next chart (Fig. 3) will enable us to determine approximately the current consumption of each at full load, and can be used both for continuous current and three-phase induction-motors, the current in the latter case being, of course, the [illegible] throughout.

From the same chart, and upon the basis of current and voltage, the most suitable sizes of controllers, resistances, cables, and trolley-wire can be ascertained for normal cases. [illegible] to agree with [illegible] In Fig. 3 the lines and circles, indicating respectively the capacity of controllers and resistances, refer only to a certain make by way of illustration, and will have to be modified to suit the limits of the controlling apparatus actually put forward.

Turning now to the mechanical features of the crane, we have the chart (Fig. 4) giving the leading particulars of lifting-ropes.

Here, again, the prices shown refer only to a particular case, and the user would modify them to suit his requirements. The grade of rope covered is of 100 to 110-ton wire, up to 1¾-in. circumference, and of 90 to 100-ton wire for the larger sizes, and a variable factor of safety, from 8 in the smallest size to 6 for the 3-in. rope, has been introduced.

In the preparation of such estimates as we are now considering the greatest variant, perhaps, at least in cranes of medium and long spans, is the weight and type of the main girders.

With the exception, perhaps, of deflection, it is rare for any stipulation to be made in the inquiry concerning these, and consequently it is not surprising that the offers submitted in any particular case differ materially in many respects, having regard to the difference of opinion that is bound to exist as to the most suitable type, depth, and working stress.

This discrepancy is generally most marked at those spans and loads where the carrying capacity and stiffness of joists and compounds reaches a limit, and it becomes, therefore, a matter of judgment or policy whether riveted girders should be put forward.

The calculation of the approximate weight of a girder for a given duty involves of necessity a provisional estimate of this weight in order that the bending tendency of this can be duly allowed for. Upon short spans the accuracy of this preliminary estimate is of small importance, but upon long spans, especially when associated with the smaller lifting capacities, it becomes the paramount item of the loading, and it will, therefore, be necessary to exercise the greatest care in its determination.

The chart, Fig. 5, is intended to facilitate the estimation of the weight of main girders of normal construction.

To ascertain the "equivalent concentrated load" upon each girder, we must add to half the weight of the crab and of the maximum load half the estimated weight of the girder itself and its platform, if any.

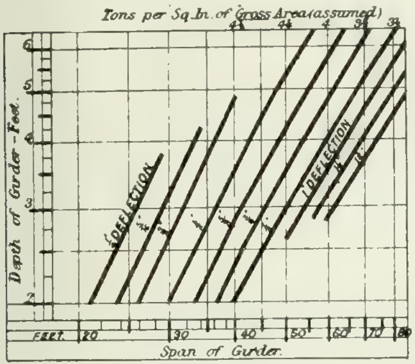
By reference to the chart we can now find the approximate weight of the girder required; but should our first attempt indicate that our provisional estimate of this weight was incorrect, the "equivalent concentrated load" assumed must be modified, and a second reading taken.

It will be noticed that the curves upon this chart, from 40-ft. span upwards, refer to double-plate web girders only.

Lattice-braced girders may be expected to show a slight saving in weight at this span, increasing to, say, 25 per cent. saving upon the longer spans and heavier loads. Since, however, it is usual to give the customer the option of plate-web or lattice-girders at the same price, the basis of plate-web weights for estimating is usually the safest.

The estimation of the structural weight of end-carriages cannot be systematized to any extent owing to the variation in their design due to different modes of attachment to the main girders, governed mainly by the amount of head-room available for the crane. The chart, Fig. 6, may, however, be taken as a rough guide in the absence of more definite data or of detailed calculation, the weights given referring to a pair of end-carriages with their appropriate tie-plates for attachment to the main girders in each case.

The chart also indicates the approximate weight of the usual timber platform with its hand-railing and brackets.



Deflection of Girders

Fig. 7.

In the case of girders the estimator is frequently required either to work to a given maximum deflection, or to specify what maximum deflection he is prepared to guarantee under test.

To the case of a built-up beam of varying depth, such as the typical crane-girder, the ordinary theoretical formula cannot be conveniently applied. The chart, Fig. 7, has therefore been based upon an empirical rule, recommended by Thorpe, as follows:—

$$\text{Deflection (inches)} = \frac{(\text{span in feet})^2 \times \text{stress on gross flange area}}{4000 \times \text{depth in feet}}$$

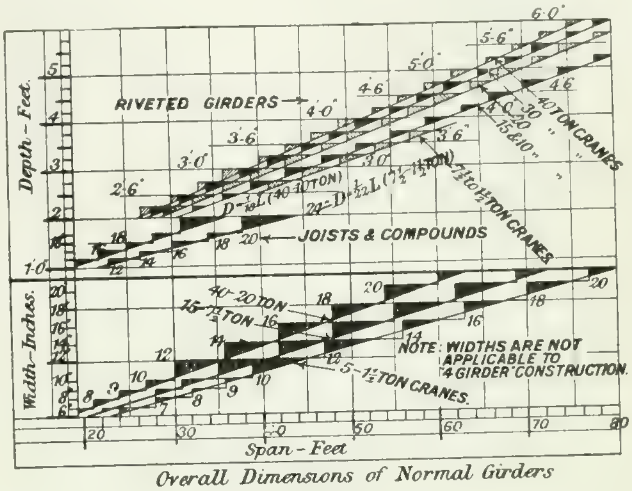
This represents the results of experience with riveted girders, and accords fairly well with practice. It should be noted particularly that the stress in the present instance is the mean stress taken over the gross area of the flange, no deduction being made for rivet-holes.

In preparing the chart, a stress of 4½ tons per sq. in. of gross flange area has been assumed up to 40 ft. span. Beyond this, some provision will be required upon the flange area of the girders to supply the necessary lateral strength, and to allow for this upon the chart the direct stress due to vertical loading only, and taken over the gross area, has been assumed to diminish uniformly from this value to 3½ tons per sq. in. only at 80 ft. span. By the use of this chart it can be readily seen whether the girder proposed will be stiff enough to comply with the specification, and, if not, to what extent the stress or depth must be modified to secure the desired result.

It is often desirable to specify the depth and width of the girders proposed, and although the designer's judgment will not mislead him greatly in this matter, a chart such as that shown in Fig. 8 tends to uniformity in this respect and prevents overlapping. It will be noticed that the depths and widths advance by steps at definite spans to correspond to market sizes or level figures, and that the proportion of both width to span and depth to span varies slightly according to the capacity of the crane.

It is fairly safe to assert that the bête noir of the average estimator is the preparation of the detailed shipping specification that must accompany all quotations for export trade. In the compilation of such sheets guessing plays an altogether too conspicuous part.

If, on the one hand, the result errs upon the side of too great weight and bulk, the tender may be ruled out at once on that account alone; whilst should a "light" specification assist in securing the order, the firm run the risk of losing the confidence of its client, who will not relish having to pay any unexpected additional freight.

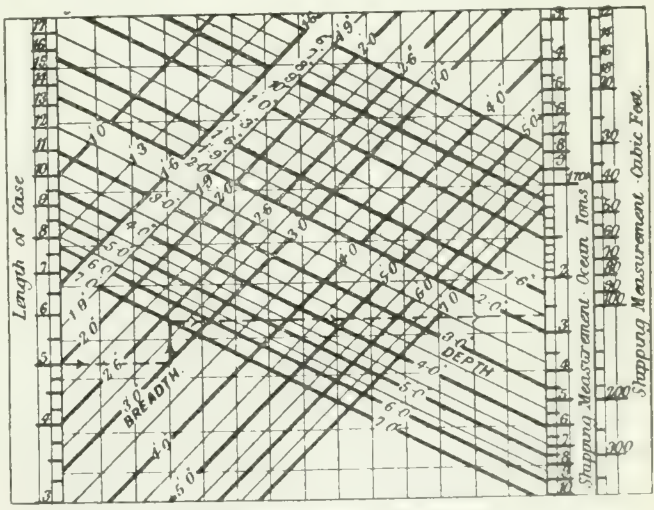


Overall Dimensions of Normal Girders

Fig. 8.

Any means, therefore, that will reduce the uncertainty and labor of the process is a step in the right direction. For standard cranes a form of specification should be decided upon and adhered to, and it will generally be found that many of the items remain unaffected by changes in span, etc.

For reducing the shipping measurements of the various items to cubic feet or ocean tons, as may be preferred, Fig. 9 will be found of great service, the accuracy obtainable being quite sufficient for all ordinary purposes.



Shipping Measurement of Packages

Fig. 9.

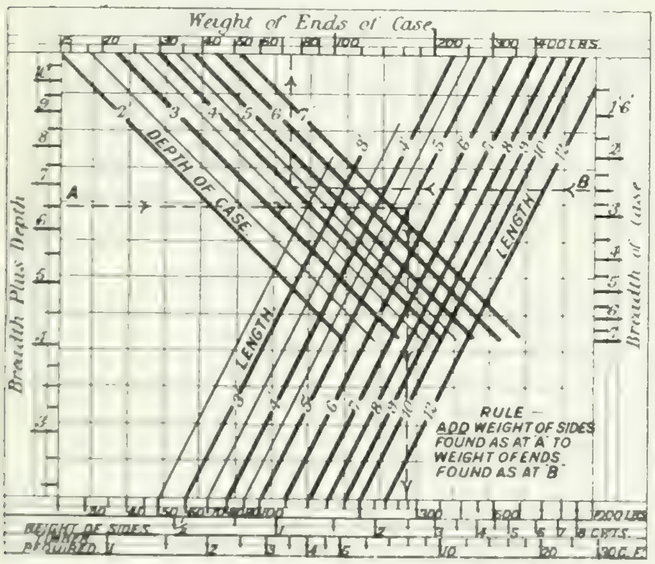
Clients frequently ask for both gross and net weights of packages to be stated. Owing to the time involved in looking up previous packing-lists of similar work, the weights of the various packing-cases are frequently guessed at, a process that can hardly be considered satisfactory. Our last chart, Fig. 10, is intended to show the approximate weight of ordinary unlined cases of 1¼ in. deal, and by its use consistent results of reasonable accuracy can be obtained with great rapidity.

By the use of the bottom scale in conjunction with those immediately above it the number of cubic feet of timber used in the construction of the case can be estimated.

In the foregoing we have endeavored to indicate briefly some methods of economizing time and labor in the preparation of estimates. Our examples have necessarily been confined to one type of crane only, but other applications will readily occur to the reader.

It is desirable that such charts should be boldly and clearly constructed to facilitate ready reference, to prevent mistakes, and, above all, to avoid that appearance of great accuracy that fine lines and close divisions always tend to produce.

It is quite possible to obtain great accuracy by the use of such charts, but for our present purpose such accuracy is not only unnecessary, but inconsistent with the data available. Charts for estimating purposes should be drawn to a liberal scale, upon tough paper or tracing-linen, and arranged in a binder with a suitable thumb index.



Approximate Weight of Packing Cases 1¼ In. Deal

Fig. 10.

For the greatest utility their scope should not be too ambitious, and they should be so clear that in the majority of [illegible] the results can be read without the aid of a pointer to trace them from one set of lines to the next.

By the use of logarithmically-divided base-lines almost any ordinary formula can be represented by parallel straight lines, [illegible] eliminating the labor and likelihood of error introduced when [illegible] further, the parallel lines facilitate the reading of the chart.

The foregoing remarks and illustrations touch, of course, [illegible]

◆

GRAPHITE FOR GERMANY.

[illegible]

PRODUCTION IN CANADA OF STRUCTURAL MATERIALS AND CLAY PRODUCTS.

The value of the production of mineral water in 1910 for which returns were received by the Department of Mines, Ottawa, was $199,563, as compared with a value of $175,173 in 1909. The imports of mineral and ærated waters in 1910 were valued at $202,306, as against a value of $184,071 in 1909.

The value of the production of natural gas in 1910 was $1,346,471, as compared with a value of $1,207,029 in 1909 and $1,012,660 in 1908. Shipments of peat for fuel purposes in 1910 were 841 tons valued at $2,604, as compared with 60 tons valued at $240 in 1909.

The production of crude petroleum shows another large falling off in 1910, the production being only 315,895 barrels or 11,056,337 gallons valued at $388,550; as compared with 420,755 barrels or 14,726,433 gallons valued at $559,604 in 1909. Exports of refined oil in 1910 were 2,818 gallons valued at $462, and 7,768 gallons valued at $934 in 1909.

While the production has been decreasing the imports have been increasing; the total output of the petroleum oils, crude and refined, in 1910 was 84,629,334 gallons valued at $4,826,763, in addition to 1,362,235 pounds of wax and candles valued at $80,106. The oil imports included: crude oil, 53,604,053 gallons valued at $1,639,358; refined and illuminating oils, 7,656,727 gallons valued at $502,364; gasoline, 16,679,691 gallons valued at $1,693,296; lubricating oils, 4,081,257 gallons valued at $718,381, and other petroleum products, 2,607,606 gallons valued at $273,364.

The total imports in 1909 were 58,317,101 gallons, valued at $3,353,311, in addition to 467,731 pounds of wax and candles valued at $40,689. The oil imports in 1909 included: crude oil, 35,884,103 gallons, valued at $1,186,400; refined and illuminating oils, 9,632,595 gallons, valued at $705,971; gasoline, 7,452,762 gallons, valued at $706,994; lubricating oils, 3,909,117 gallons, valued at $558,632, and other petroleum products 2,038,524 gallons valued at $195,314.

Phosphate, Pyrites and Quartz.

Shipments of phosphate or apatite in 1910 were 1,478 tons valued at $12,578, as compared with 998 tons valued at $8,054 in 1909. There were no exports reported in 1910, as against 895 tons valued at $15,735 in 1909. The imports of phosphate rock (fertilizer) in 1910 were valued at $72,950; phosphorus, 6,752 pounds valued at $2,065, and manufactured fertilizers valued at $388,467.

The production of pyrites in 1910 was 53,870 tons valued at $187,064, as compared with 64,644 tons valued at $222,812 in 1909. The exports of pyrites in 1910 were 30,434 tons valued at $110,071, as against exports of 35,798 tons valued at $156,644 in 1909. The imports of brimstone or sulphur in 1910 were 22,835 tons valued at $474,619, as against 22,887 tons valued at $458,061 in 1909.

The quartz production in 1910 was reported as 88,205 tons valued at $91,051, compared with a production in 1909 of 56,924 tons valued at $71,285. There were imported during 1910, 628 tons of silex or crystalized quartz, valued at $11,996, and, in 1909, 559 tons valued at $8,733.

Production of Salt, Talc and Tripolite.

The total sales of salt in 1910 were 84,092 tons valued at $409,624 (exclusive of packages). The value of the packages used was $173,446. In 1909 the sales were 84,037 tons valued at $415,219, and value of packages used, $175,612.

Exports of salt in 1910 were [illegible] pounds, valued at [illegible], and, in 1909, [illegible] pounds valued at $2,488. The total imports of salt in 1910 were valued at $462,061, and included: 20,174 tons valued at $97,326, subject to duty; and [illegible] tons valued at [illegible], duty free. The 1909 imports were valued at $431,221 and comprised: 112,554 tons of salt subject to duty, valued at $352,165; and 16,857 tons duty free, valued at $79,056.

The imports of soda products in 1910 included: soda ash or barilla 35,596,006 pounds, valued at $306,167; soda bichromate 878,777 pounds, valued at $32,842; caustic soda in packages of 25 pounds or more 13,848,170 pounds, valued at $260,938; sal soda 9,715,272 pounds, valued at $72,845, and sulphate of soda 17,728,543 pounds, valued at $95,054.

The production of talc increased from 4,350 tons, valued at $10,300, in 1909, to 7,112 tons, valued at $22,308, in 1910.

There was a production of 22 tons of tripolite, valued at $134, reported for 1910 and no production in 1909.

Structural Materials and Clay Products.

The total sales of cement in 1910 were 4,753,975 barrels, valued at $6,412,215, as against 4,067,709 barrels, valued at $5,345,802, sold in 1909, showing an increase of 686,266 barrels. The exports of cement in 1910 were valued at $12,914, compared with exports valued at $113,362 in 1909.

The imports of cement in 1910 included: manufactures of cement, valued at $7,718; hydraulic cement, 365 hundredweight, valued at $349; and Portland cement, 1,222,586 hundredweight (349,310 barrels) valued at $468,046. The imports in 1909 were: manufactures of cement, valued at $6,374; hydraulic cement, 682 hundredweight, valued at $614; and Portland cement, 497,678 hundredweight (142,194 barrels) valued at $166,669.

The consumption of Portland cement in Canada in 1910 was approximately 5,103,285 barrels, as compared with 4,209,903 barrels in 1909.

The total value of the production of clay products in Canada in 1910 was $7,629,956, as compared with a total value of $6,450,840 in 1909. Brick and tile products alone were valued in 1910 at $6,377,728, as against $5,327,815 in 1909. The value of sewerpipe production in 1910 was $774,110, as compared with $645,722 in 1909. The only clay products exported in 1910 were: 390,000 building brick, valued at $2,762, and the manufactures of clay valued at $9,061; against 365,000, valued at $2,255, in 1909, and manufactures valued at $979. The total imports of clay products in 1910 were valued at $4,331,397, and included: brick and tile valued at $1,755,773; earthenware and chinaware, $2,283,116, and clays valued at $292,508. The total imports in 1909 were valued at $3,247,539, comprising: brick and tile, $1,249,450; earthenware and chinaware, $1,781,759, and clays, $216,330.

Lime, Sand Lime Brick and Slate.

The total production of lime in 1910 was 5,848,146 bushels, valued at $1,137,079, as compared with 5,592,924 bushels, valued at $1,132,756, in 1909. The exports of lime in 1910 were valued at $44,762, as against exports valued at $48,821 in 1909. The imports of lime in 1910 were 212,502 barrels, valued at $138,847, and in 1909, 168,357 barrels, valued at $118,239.

The total sales of sand-lime brick in 1910 by 13 firms reporting were 44,593,541, valued at $371,857, an average value of $8.34 per thousand. The sales in 1909 by 9 firms reporting were 27,052,864 brick valued at $201,650, an average of $7.45 per thousand.

The production of slate in 1910 was 3,959 squares valued at $18,492, and 4,000 squares, valued at $19,000, in 1909.

The imports of slate in 1910 were valued at $142,285, and included: roofing slate, valued at $67,063; school writing slate, $31,397; slate pencils, $6,948, and manufactures of slate, $36,877.

The imports in 1909 were valued at $135,221, comprising: roofing slate, $71,914; school writing slate, $34,085; slate pencils, $6,154, and manufactures of slate, $23,068.

Stone Production of all Kinds.

The total value of the production of stone of all kinds, in 1910, was $3,650,019, as compared with a value of $3,127,135 in 1909. The value of stone exports in 1910 was $27,471, as against $59,370 in 1909; and the total value of stone imported in 1910 was $845,123, as against imports valued at $683,801 in 1909.

The production in 1910 included: granite valued at $739,516; limestone, $2,249,576; marble, $158,779, and sandstone, $502,148. In 1909 the production of granite was valued at $454,824; limestone, $2,139,691; marble, $158,441, and sandstone, $374,179.

Classifying the output according to the purposes for which the stone was used, the production in 1910 comprised: building stone, valued at $1,504,001; ornamental and monumental stone, $147,421; paving and curbstone, $239,668; rubble, $352,000; crushed stone, $975,379; and furnace flux, $431,550; while in 1909 the production included: building stone, valued at $1,170,550; ornamental and monumental stone, $306,338; paving and curbstone, $279,227; rubble, $303,120; crushed stone, $664,287, and furnace flux, $403,613.

◆

NEW RAILWAY FOR NORTH-WESTERN CANADA.

Forty survey parties, consisting of 800 men with teams and pack horses, will be sent into the field at once from Edmonton to make preliminary surveys for the Northern Territorial Railway company's line from Edmonton to tidewater at Fort Churchill on Hudson's Bay. This is to be part of a system of 1,450 miles, from the Hudson's Bay country to Port Essington on the Pacific Coast, connecting Edmonton with Lac La Biche, Fort McMurray and Lake Athabasca.

H. G. H. Neville, C.E., chief engineer for the company, which is financed by a British syndicate and capitalized at $40,000,000, has covered every portion of the proposed route and is fully satisfied upon the engineering problems presented in the construction of the system.

The route is from a point at or near Fort Churchill or Fort Nelson on the Hudson's Bay, thence westerly to a point at or near the south shore of Lake Athabasca, in the province of Alberta, thence westerly and north of the Peace River block, thence southwesterly by the nearest possible route through the Rocky Mountains to a point on the Pacific Coast at or near Port Essington at or near the Portland Canal and from a point on the said railway near the crossing of the Athabasca River, in the province of Alberta, southerly to a point at or near Fort McMurray, thence southerly to a point at or near Lac La Biche, thence by the most feasible route to the city of Edmonton.

Plans are under way to begin grading work early next season, when the laying of rails will also be carried on, and in two years, according to present calculations, the line is to be in operation from Edmonton to the shore of Lake Athabasca, opening to commercial development the vast mineral and timber wealth of Alberta's farthest north. The company will then proceed with the construction of the line in the province of Saskatchewan. The Edmonton cut-off will be built later. The line from Lake Athabasca westerly will tap the rich agricultural resources of the newest north, continuing thence to the Pacific Coast.

The Northern Territorial Railway Company will operate a line of steamships from its Hudson's Bay terminal to a British port. Engineers in the employ of the corporation have made a study of the construction of ice-breakers in the Baltic and are now working on designs of vessels capable of meeting the abnormal conditions which prevail in Hudson's Bay.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended July 7th:—

	1911.	1912.	Increase or decrease.
C. P. R.	$2,096,000	$2,571,000	+ $475,000
G. T. R.	943,095	1,012,051	+ 68,956
C. N. R.	346,500	391,900	+ 45,400
T. & N. O. R.	28,547	28,272	— 275
Halifax Electric	5,696	5,808	+ 112

The following are the railroad earnings for the week ended July 14:—

	1911.	1912.	Increase or decrease.
C. P. R.	$2,170,000	$2,701,000	+ $531,000
G. T. R.	994,800	1,037,863	+ 430,063
C. N. R.	364,700	436,700	+ 72,000
T. & N. O. R.	28,241	26,699	— 1,542
Halifax Electric	5,270	5,686	+ 416

The Grand Trunk Railway has issued its statement of earnings and expenses for May and for the five months of the fiscal year. Taken altogether, the results are favorable, notwithstanding the fact that the revenue for this has been largely cut into owing to extraordinary outlays for extensions and improvements all over the system.

The roads in the Grand Trunk system report for May and five months as follows:—

Grand Trunk of Canada.

	1912.	1911.	Increase or decrease.
May gross	£691,700	£628,800	+ £62,900
Net	207,000	206,500	+ 500
Five months' gross	691,700	2,831,000	+ 221,500
Net	696,400	724,800	— 28,400

Canada Atlantic.

	1912.	1911.	
May gross	£ 41,500	£ 38,100	+ £ 3,400
Net	def 450	4,700	+ 3,250
Five months' gross	172,750	163,600	+ 9,150
Net	3,900	18,900	— 15,000

Grand Trunk Western

	1912.	1911.	
May gross	£114,500	£108,550	+ £ 5,950
Net	23,800	def. 150	+ 23,950
Five months' gross	549,600	552,350	— 2,750
Net	[illegible]	48,050	+ 12,050

Detroit, Grand Haven and Milwaukee.

	1912.	1911.	
May gross	[illegible]	£ 34,500	+ £ 2,000
Net	[illegible]	def. 850	+ 1,650
Five months' gross	[illegible]	177,950	+ 2,050
Net	[illegible]	[illegible]	+ 5,700

While the annual statement of the Canadian Northern Railway is not yet prepared for publication, it will be shown that the gross earnings for the year ended June 7, will be approximately $21,000,000 compared with $16,360,000 for the [illegible]

The general increase in business through the West is reflected in the fact that this increase of 29 per cent. in earnings [illegible] per cent. over last [illegible] At present the [illegible] miles last year

Particularly in the movement of grain have traffic con- [illegible] Canadian Northern [illegible] per cent.

Two hundred and sixty miles of track have now been completed west of Cochrane, Ont., on the National Transcontinental Railway, according to latest reports, and an average of a mile a day is being laid. Rails have been laid from Superior Junction to Winnipeg, leaving a distance of 184 miles yet to be covered with steel between the former point and the present rail-head west of Cochrane. Those in charge of the work expect to have the entire line between Cochrane and Winnipeg finished by the end of September.

◆

EXPERT WOODSMAN REPORTS ON FOREST CONDITIONS.

The timber of the Hudson Bay region (the southern part of the old district of Keewatin) is a topic that has lately become of considerable interest. Interesting observations with regard to it are found in the 1911 report of the Director of Forestry, published as part of the annual report of the Department of the Interior for 1911. These are in continuation of the report on the timber along the proposed line of the Hudson Bay Railway, published as Bulletin No. 17 of the Forestry Branch.

Mr. J. T. Blackford, an experienced woodsman, acquainted with the conditions in the north, reports on the conditions of the forest around Oxford House, his explorations covering some 5,400 square miles of country. Of this only about 1,600 square miles bears merchantable timber; on the remaining 3,800 miles the timber has been burned. There is abundant evidence that the whole country was originally forested with spruce, tamarack, jack pine, balsam fir, birch and poplar, and on islands which have by their position been protected from fire are dense stands of trees two to three feet in diameter.

The areas, after the first burning, have usually been covered with dense growth of trees, but the debris left after the first almost invites a second fire. In many places fire has swept the country many times, impoverishing the soil, destroying all seed-trees, and with them all hope of a second forest. "During the summer," the report states, "Mr. Blackford found no commercial timber of any quantity, but he states that, except for fire, the country would be covered with timber two or three feet in diameter."

◆

THE HOLDING POWER OF SPIKES.

Tests of the holding power of spikes in railroad ties and of the resistance of the wood fibre to indentation by tie-plates have been made during the past year at the Armour Institute by the Board of Supervising Engineers of the Chicago Traction lines. The results are presented in a recent report. The principal object of the spike tests was to determine the comparative holding power of the standard track spike and the screw spike. It was found that though the holding power of the screw spike is approximately three times that of the square spike, the relative holding powers in different timbers is such as to make the screw spike in treated pine fully equivalent to the standard spike in white oak. The tests of indentation of the tie plates showed that the ratio of resistance of a flat-bottom plate to that of a corrugated-bottom plate is much greater than the ratio of the bearing areas. The indentation of the corrugated plate is considerably greater for the same load per unit of surface contact. The tests also showed that chloride-of-zinc treatment of loblolly and short leaf yellow pine increases the fibre strength to an extent making them compare favorably with the long leaf yellow pine in resisting the indentation of tie plates.

PERSONAL.

MR. M. K. ALLEN has resigned from the position of city engineer of Regina, Sask.

ALD. CHISHOLM has resigned his position as chairman of the Board of Works, Toronto, to become property commissioner of the same city.

MR. G. A. DUDLEY, of Windsor, N.S., has been appointed to a position on the engineering staff of the St. John Valley Railroad.

MR. A. S. RUNCIMAN, who was with the Canadian Westinghouse Company, at Calgary, is now assistant superintendent of the electric light department of Prince Albert, Sask.

MR. FRANK E. BELFRY, of the firm of Thomson and Belfry, has been selected for the position of architect assistant superintendent of buildings under the Board of Education for the city of Toronto.

MR. R. S. LEA, Mem. Can. Soc. C.E., Mem. Am. Soc. C.E., M.I.C.E., has recently removed his office from 405 Dorchester Street West, to Room 820 New Birks Building, Montreal. Besides conducting a consulting practice of his own, Mr. Lea is associated with H. C. Ferguson, 200 Fifth Avenue, New York City, under the name of Lea and Ferguson, consulting engineers for paper and pulp mill equipment and hydraulic developments.

MR. ALEXANDER LESLIE BLACK has recently joined the firm of Ford, Bacon and Davis, 115 Broadway, New York, as engineer in charge of southern properties. Mr. Black graduated from the School of Mines, Columbia College, in 1890, leaving the college to go into mining work in Mexico. In 1894-5 he had charge of the reconstruction for electric operation of the St. Charles Street Railway, New Orleans, remaining with that company until 1901. Since that time he has been the engineer for the New Orleans Railway and Light Company.

◆

OBITUARY.

MR. H. J. BEEMER is dead in England, according to a cable despatch. Mr. Beemer was born at Holmesdale, Pennsylvania, in 1848. He began business in New York with Smith and Ripley, who brought him to Canada over twenty years ago. His first work as a contractor was on the Ottawa Railway bridge, followed by portions of the Dufferin improvements at Quebec. Later, he constructed a number of railways, bridges and waterworks. He built the Canadian Pacific Railway bridge at Ottawa, the Ottawa and Gatineau Valley Railway, the Pontiac and Pacific Junction Railway, the Quebec and Lake St. John Railway, the Quebec and Montmorency Railway, now the St. Anne division of the Quebec Railway, the Light, Heat and Power Company's system in Quebec, a new water main for the city of Quebec, and the new St. Louis and Kent gates, also in Quebec.

◆

MEETINGS.

The twelfth annual meeting of the Union of Canadian Municipalities will be held at Windsor, Ont., on August 27th, 28th and 29th. Among the speakers and their subjects are the president, Mr. J. W. McCready, Fredericton; Ald. Harris, Halifax, "Capital Cities"; City Engineer Doarn, Halifax, "The Cleaning of Water Mains"; Ald. Cannon, Quebec, "Electric Franchises"; Mayor Hebert, Sherbrooke, "The Operation of Public Utilities in Sherbrooke"; Ald. Boyd, Montreal, "Metropolitan Parks"; Mayor Hopewell, Ottawa, "The Georgian Bay Canal Water Powers"; S. Morley Wickett, Toronto, "Municipal Government by Commission"; G. A. Walters, Detroit, "Motion Pictures"; Controller Harvey, Winnipeg, "The Price of Cement"; Controller Cockburn, Winnipeg, "Winnipeg's Hydro-Electric Power Plant"; J. N. Bayne, Regina, "Municipal Progress in the West"; Mayor Spencer, Medicine Hat, "Good Roads and Their Effect Upon Rural Life"; Ald. Clarke, Edmonton, "Equable Municipal Taxation"; Ald. Hepburn, Vancouver, "Municipal Taxation"; Councillor Richardson, Point Gray, B.C., "Point Gray as a Model City."

◆

CANADIAN FORESTRY ASSOCIATION CONVENTION.

Mr. James Lawler, of Ottawa, secretary of the Canadian Forestry Association, has just returned from Montreal and the city of Quebec, where he was making arrangements for the Dominion Forestry Convention to be held upon the invitation of the government of British Columbia, in Victoria, B.C., on September 4, 5 and 6. He found great interest being taken in this convention, in which Sir Richard McBride and Hon. W. R. Ross will personally take part, and which will be held in the best time to see the Pacific Coast and the prairies. Hon. Jules Allard, Minister of Lands and Forests for Quebec, has consented to attend and he will be accompanied by some of the officers of his department. Eastern lumbermen and forest engineers will also be well represented. The railways have granted greatly reduced rates for the return trip to Victoria to delegates. Mr. Lawler, who is looking after the arrangements, states that everything is looking well for one of the largest conventions ever held on the coast.

◆

AMERICAN ROAD BUILDERS' ASSOCIATION CONVENTION.

The invitation extended by the mayor and the Commercial Association of the city of Cincinnati to the American Road Builders' Association to hold its ninth annual convention in that city has been accepted. The convention of the American Good Roads Congress, which is always held in connection with the convention, will, therefore, be held in Music Hall, Cincinnati, December 3, 4, 5 and 6.

In connection with the annual convention of the association, there will be held, as usual, an exhibition of machinery, materials and methods of road construction in Music Hall in space which has been set aside for the purpose. The building has a floor space of over 50,000 square feet and it is expected that all this space will be required for the exhibits. Not only will the manufacturers of material and machinery be represented in this exhibition, but the several states will have booths set aside for them in which they will exhibit models of roads, photographs, drawings, road materials, etc. This feature will be especially attractive to road builders. It is proposed, in fact, to make the exhibition practically an exposition of everything that pertains to road building and street paving in all their phases.

The American Road Builders' Association was organized in 1902. The president of the association is Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment of New York city; first vice-president, Harold Parker, ex-chairman of the Massachusetts State Highway Commission; treasurer, Major W. W. Crosby, consulting engineer of the Maryland State Highway Commission; secretary, E. L. Powers, editor and publisher of "Good Roads." Among the directors of the association are: W. A. McLean, provincial engineer of highways of Ontario; Arthur W. Dean, chief engineer, Massachusetts Highway Commission; S. D. Foster, chief engineer, State Highway Department of Pennsylvania; W. J. Roberts, State Highway Commissioner, of Washington; James H. MacDonald, State Highway Commissioner, of Connecticut; Austin B. Fletcher, State Highway Engineer, of California; John R. Rablin, chief engineer, Metropolitan Park Commission, of Boston; R. A. Meeker, State Highway Engineer, of New Jersey, and Wm. H. Connell, chief of the Bureau of Highways and Street Cleaning, of Philadelphia.

While the association is made up primarily of technical men, everyone interested in street and highway improvement is made welcome at its meetings.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention at Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address, P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton, Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, [illegible] Indian Head, Sask.; Secy-Treasurer, E. Hingley, [illegible]

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; Secy-Treasurer, [illegible], Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, [illegible]; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, [illegible]; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, [illegible] Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, [illegible], Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. R. Ross, Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phoenix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-5	—Electric Generating Machinery, Canora, Sask (S.)	7-18

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Canora, Ont., electric generating machinery	Aug. 5.	July 18.	78
Cobourg Harbor, Ont., breakwater	Aug. 14.	July 25.	68
Edmonton, Alta., gas holder and tank	Aug. 9.	July 4.	67
Edmonton, Alta., gas plant	Aug. 23.	July 18.	67
Kirkfield Park, Man., incinerator	Aug. 8.	July 18.	78
Northern Ont., right to cut pine.	Oct. 1.	July 25.	68
Norway House, Man., school and hospital	Aug. 19.	July 11.	68
Norwood, Ont., drill hall	Aug. 6.	July 25.	(2) 68
Omemee, Ont., drill hall	Aug. 6.	July 25.	68
Ottawa, Ont., design for monument	Oct. 1.	Apr. 18.	60
Ottawa, Ont., supply of coal	Aug. 28.	July 25.	67
Pas Reserve, Sask., school building	Aug. 19.	July 11.	68
Regina, Sask., electrical plant.	Aug. 14.	July 25.	68
Toronto, Ont., drip guards	Aug. 13.	July 25.	68
Winnipeg, Man., 36-inch pipe	Aug. 28.	July 25.	68
York Township, concrete sidewalks	Aug. 5.	July 25.	68

TENDERS.

County of York, Ont.—Sealed tenders will be received by Frank Barber, county engineer, 57 Adelaide Street East, Toronto, up to noon Saturday, August 10th, for the construction of concrete bridges in this county. (See advt. in this issue of the Canadian Engineer.)

Dorval, P.Q.—Separate sealed tenders endorsed "Tender" will be received by A. Decary, town secretary, up to 4 o'clock p.m., August 15th, 1912, for the construction of water works, sewage system, and electric light installation. Plans and specifications may be seen at the office of the Town Engineer, Mr. V. H. Dupont, 62 St. James Street, Montreal.

Edmonton, Alta.—Sealed tenders marked "Tenders for steam heating, plumbing and sheet metal work in the Government House," will be received by John Stocks, Deputy Minister of Public Works, until noon August 7th, 1912. Plans, etc., may be seen at the structural engineer's office, New Parliament Buildings, Edmonton.

Lethbridge, Alta.—Tenders are asked for the erection and completion of St. Patrick's Church in accordance with plans and specifications prepared by E. C. Hopkins, Edmonton, and to be delivered to him on or before Wednesday the 7th of August next. Drawings and specifications can be obtained from H. M. and W. A. Whiddington, architects, Lethbridge.

Moose Jaw, Sask.—Tealed tenders marked "Tenders for Switchboard," addressed to the City Commissioners, Moose Jaw, will be received up to 12 o'clock noon on Friday, August 9th, 1912, for the supply and erection of one twelve panel switchboard.

Moose Jaw, Sask.—Sealed tenders marked "Tenders for reinforced concrete dam and highway bridge," addressed to the City Commissioners, Moose Jaw, will be received up till twelve o'clock noon on Friday, Aug. 9th, 1912, for the construction of one concrete dam and highway bridge across the Moose Jaw River. Plans, specifications and all information may be obtained from J. Antonison, City Engineer.

Niagara Falls, Ont.—Sealed tenders will be received by the National Trust Company, Toronto, up to and including the fifteenth day of September, 1912, for the purchase of the property heretofore owned and operated by the Canadian Ethinite Company, Limited, and by the Canadian Calcium Carbide, Limited, and also for the purchase of certain patents owned by the Canadian Ethinite Company, Limited.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, secretary Department Public Works, and endorsed "Tender for wharf at Kempenfeldt Bay, Ont.," will be received at this office until 4 p.m. on Wednesday, August 21, 1912, for the construction of a wharf and approach at Kempenfeldt Bay, on Lake Simcoe. Plans, specifications, etc., can be seen at this department and at the offices of J. G. Sing, Confederation Life Building, Toronto; and at the post office at Painswick, Ont.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, secretary Department of Public Works, and endorsed "Tender for the repair of headblock at Port Colborne, Ont.," will be received at this office until 4 p.m., on Wednesday, August 21, 1912, for the repair of the headblock of the east breakwater, at Port Colborne, County of Welland, Ont. Plans may be seen at the office of J. G. Sing, Confederation Life Building, Toronto, and at this department.

Ottawa, Ont.—Sealed tenders addressed to J. D. McLean, assistant deputy and secretary Department of Indian Affairs, and marked on the envelope, "Tender for school building, Cape Croker Indian Reserve," will be received up to noon of August 26, 1912, for the erection of a stone school house and teacher's residence combined on the Cape Croker Indian Reserve.

Ottawa, Ont.—Tenders addressed to W. W. Cory, deputy minister of the Department of the Interior, Ottawa, Ont., marked "Tender for wire fence," will be received up to 12 o'clock noon of the 20th August, 1912, for the construction of a wire fence around Moose Mountain Buffalo Reserve.

Ottawa, Ont.—An extension of time for the sending in of the sketch models for the competition for the memorial to his late Majesty King Edward VII., has been granted. The designs must be delivered at the National Art Gallery of Canada, Victoria Museum, Ottawa, before the 1st day of November, 1912.

Ottawa, Ont.—Sealed tenders, addressed to R. C. Desrochers, secretary Department Public Works, and endorsed "Tender for breakwater, sheet piling and dredging at Beaverton, Ont.," will be received at this office until 4 p.m. on Monday, August 26, 1912. (See advt. in Canadian Engineer.)

Ottawa, Ont.—Tenders addressed to John McDougald, Commissioner of Customs, will be received up to noon of the second day of September, 1912, for the construction of a twin screw steel steamer for Customs service on the Atlantic coast, to be delivered at the port of Quebec.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, secretary department of public works, and endorsed "Tender for addition to wharf at Murray Bay, P.Q.", will be received until 4 p.m., on Wednesday, August 7, 1912, for the construction of an addition to the wharf at Murray Bay, County of Charlevoix, P.Q.

Port Arthur, Ont.—Messrs. Hood and Scott, architects, are calling for tenders for the construction of the new public library. The estimated cost of this work is $35,000.

Toronto, Ont.—Sealed tenders endorsed "Tenders for Dormitory," addressed to H. F. McNaughten, secretary Department of Public Works, Ontario, will be received at this department up to noon on Thursday, the 8th day of August, for the erection of dormitory buildings on the grounds of the Institution for the Blind, Brantford. Plans and specifications can be seen at this department and at the above institution.

Streetsville, Ont.—Tenders will be received by S. P. Smith, town clerk, up to Aug. 5th, 1912, for the following:

(a) For excavating, laying and back filling of 4,115 ft. of 6-inch water pipe; top of pipe to be 4½ ft. from ground level, the packing of joints, attaching hydrants and T. Tenders to state price per running foot for the same.

(b) Twenty hydrants, complete, f.o.b., Streetsville. Hydrants to be similar to one in use at present.

(c) Excavating and back filling for 4,115 feet; depth 5 feet.

(d) Packing of joints, laying pipe, attaching necessary hydrants and T.

(e) For 4,115 feet of cast iron pipe, 6-inch; weight not less than 30 lbs. to foot; also two T's with cap, to be tapped for 4-inch pipe. All f.o.b. Streetsville.

(f) Tenders will also be received for the work complete.

Toronto, Ont. — Tenders will be received by W. H. Hearst, Minister of Lands, Forests and Mines, up to and including the 15th day of August next, for the right to cut pulpwood on a certain area situated on the Abitibi Lakes and River, tributary to the Grand Trunk Pacific Railway, and the Temiskaming and Northern Ontario Railway, in the District of Temiskaming.

Victoria, B.C.—Sealed tenders will be received by W. Galt, municipal purchasing agent, up to 3 p.m. on Monday, Aug. 5, 1912, for the supply of 12,000 feet; 10 pair No. 16 electric cable; 2,000 feet No. 16 Duplex cable; 10 miles No. 12 W.P.B. and S. gauge steel wire.

Winnipeg, Man.—Sealed tenders addressed to the chairman, Board of Control, will be received by M. Peterson, secretary, up to 11 a.m. on Monday, August 5th, 1912, for supply of 5,000 Tobin bronze bolts, ⅞-inch diameter and 3¼-inch in length.

◆

CONTRACTS AWARDED.

Brandon, Man.—The contract for the structural steel work of the new arena of the Brandon Winter Fair was let to the Wisconsin Steel and Iron Company of Chicago, and the contract for the completion of the work has just been given to C. W. Hall, of Brandon.

Brockville, Ont.—The Board of Works has awarded the contract for the paving of King Street to the Godson Contracting Company of Toronto, on the following terms:

Asphalt pavement, [illegible] per square yard.

Concrete curb and gutter, 70c. per foot.

Earth excavation, [illegible] per cubic yard.

Rock excavation, [illegible] per cubic yard.

Dutton, Ont.—The section of the main line from the [illegible] on the south side of the town hall lot, [illegible] feet, has been given to [illegible] for [illegible]. The village will provide the material.

Guelph, Ont.—Messrs. P. H. Secord and Sons have been awarded the contract for excavating and the concrete base, [illegible] per square yard. The city engineer will lay the Tarvia wearing service at [illegible] cents per square yard.

Fort William, Ont.—The contract was awarded to Barrett and McQueen of this city for the construction of the new Fort William Elevator Company grain house. The contract price was close to [illegible].

Fort William, Ont. — The Canadian Stewart Company have been awarded the contract calling for the erection of a grain elevator for the Superior Elevator Company of Winnipeg, Man.

Port Arthur, Ont.—The contract for the paving of Cumberland Street has been awarded to the Warren Bituminus Paving Company and the National Paving Company of Winnipeg have been awarded the contract to lay a coating of asphaltic concrete on Algoma Street.

Port Arthur, Ont. — Barrett and McQueen have been awarded the contract for construction of grain elevator for the Fort William Elevator Co.; capacity, 3,000,000 bushels. Approximate amount of contract, $700,000.

Port Colborne, Ont.—The contract for the extension of the piers to provide additional docking facilities has been awarded to M. J. Hogan at a price of $213,000.

Regina, Sask.—Messrs. Wilson and Wilson have been awarded the contract for erecting the addition to the collegiate institute. This is to be a ten-roomed structure and the price agreed upon is $88,500. Other bidders and their prices were: R. J. Lecky and Co., $109,962; Parsons Building Co., $95,580; Smith Bros. and Wilson, $90,000; Wilson and Wilson, $88,500.

Sherbrooke, P.Q.—Messrs. Lefebore and Bonin, architects and builders, have been awarded the contract to erect a convent 132 x 50, brick stone foundation. The price for this work is $37,000.

Sherbrooke, P.Q.—Messrs. Loomis Dackin, Ltd., have been awarded the contract to erect a building, excluding the steel work, for the Bank of Montreal. The price for this work is placed at $40,000. The steel work has been awarded to MacKinnon, Holmes and Company, Ltd.

St. Catharines, Ont.—Thos. E. Riloy has been awarded the contract for the construction of the new trunk sewer.

Vancouver, B.C.—The Board of School Trustees awarded the contract for the erection of the Dawson School to the Canadian Ferro Concrete Company at a price of $121,913.

Vancouver, B.C.—D. Matheson has been awarded the contract calling for the erection of a set of stone steps at the King Edward High School. The price for this work is $3,397.

Winnipeg, Man.—The G. M. Gest Company have been awarded a contract to construct an electric cable conduit on Portage Avenue from Carlton Street to Sherbrooke Street.

◆

RAILWAYS—STEAM AND ELECTRIC.

Fredericton, N.B.—The Minister of Railways and Canals has concluded the purchase of several pieces of property with the intention of starting work on an improved station yard for the Intercolonial Railway.

St. Thomas, Ont.—The deficit in the street railway in 1910 was $12,044.44 and in 1911 $10,537.48, a decrease of $2,406.96.

◆

LIGHT, HEAT AND POWER.

Edmonton, Alta.—The municipal council will discuss a communication received from the provincial authorities regarding an application of The Western Power Joint Stock Company, Ltd., to erect poles and offer power for sale in opposition to the municipal plant in this city.

Kingston, Ont.—The Seymour Power Company purposes making another proposal to supply power to Kingston and it has had experts here looking over the ground, so that the offer will be as fine as can be drawn.

Moncton, N.B.—The Board of School Trustees has entered into an agreement with Moncton Tramways, Electricity and Gas Company to heat two schools with gas. The agreement contains a clause providing that should the expense of this be higher than the cost of similar heating with coal the company will reimburse the Board.

Barrett Specification Roofs

The Place to Break the Pen!

The building shall be covered with a Barrett Specification Roof or

IN writing your roofing specifications it is especially important not to add "or equal thereto."

You need precision in dealing with a roof more than with any other part of the structure for the reason that in laying a roof there are many opportunities for "skinning the job."

Further, you put the honest, reliable contractor at a great disadvantage when you ask him to bid on an indefinite or vague specification, and such specifications usually mean poor workmanship and cheap materials with subsequent leaks and trouble.

There are various ways of constructing gravel and slag roofs, but if The Barrett Specification is followed, there is no chance for mistakes or slipshod workmanship.

It describes in a practical way how to use Specification Felt and Specification Pitch to make a first-class roof—one that will always give maximum service.

The Barrett Specification embodies the best experience of the roofing industry and is designed for the benefit of architects, engineers and owners.

Incorporate it in full into your own building specification and you will be ordering a roof that has shown a lower cost per foot per year of service than any other type of roofing ever made.

We know that if all buildings were covered with Barrett Specification Roofs, roof troubles would be practically nil.

Copy of the Barrett Specification ready for incorporation into building specifications free on request.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If an abbreviated form is desired, however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Orillia, Ont.—The Town Council have re-leased the Ragged Rapids from the Department of Lands, Forests and Mines for a period of ten years. The town is to pay the government a rental of fifty cents per horse power per year on a basis of 1,600 h.p.

Regina, Sask.—The municipal engineer has reported to the council that the recent cyclone caused $9,775.85 damage to the electric light plant.

Vancouver, B.C.—The municipal council have received the following tenders for the installation of electric or steam equipment for the rock and gravel bunkers at Bridge Street: B.C. Equipment Company, $2,086, $5,156 and $5,198; R. Hamilton and Company, $2,936 and $3,010; Pacific Machinery and Supply Company, Limited, $9,869; Mussens Limited, $6,876 and $6,047; Vancouver Machinery Depot, $3,380 and $4,220.

Victoria, B.C.—The municipal council have opened the following tenders for the installation of an arc light system: Hinton and Company, $13,195; Messrs. Hutchison Bros., $10,350; Electrical Construction Company, $10,500.

Winnipeg, Man.—A report states that the new conduits to be laid on Portage Avenue will contain accommodation for all the wires now carried on poles.

◆

GARBAGE, SEWAGE AND WATER.

Galt, Ont.—The municipal council have received a notice from the provincial authorities which will call for considerable work in connection with the treatment of the town's sewage discharge. They will have to abandon the present method of utilizing the river for this purpose and erect sewage tanks, etc., that have the approval of the board.

Imperial, Sask.—This place intends to proceed with installation of water works. J. G. Hobman, secretary-treasurer.

Ingersoll, Ont.—A by-law calling for the expenditure of $57,000 on a sewerage system was defeated by the ratepayers with a majority of 390.

Lacombe, Alta.—A petition made by the council shows that 80% of the ratepayers are in favor of the installation of a waterworks system.

Medicine Hat, Alta.—The ratepayers will vote on August 18th next on the matter of spending $300,000 on a new system of water works.

St. Thomas, Ont.—The water commission has a surplus revenue of $[illegible].

Winnipeg, Man.—The chairman of the Provincial Board of Health, Dr. R. M. Simpson, has warned the municipal council regarding the evident signs of failure on the part of the water supply of this city.

Winnipeg, Man.—Dr. Simpson, chairman of the provincial health board, has condemned Winnipeg's present water supply, both in quality and quantity. He advised against an extension of the present artesian well supply and for a visible supply.

Yorkton, Sask.—Mr. R. O. Wynne-Roberts, Regina, has made a report for this municipality regarding the future source of supply and intimates that the ratepayers need not feel anxiety as an abundant supply is available from certain springs in the vicinity of the town.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Canning, N.S.—The management of the Cornwallis [illegible] Company will [illegible] [illegible] building [illegible] feet.

Edmonton, Alta.—Plans are prepared for the erection of [illegible] for the Grand Trunk Pacific Railway call for an expenditure of $[illegible]. [illegible]

Fredericton, N.B.—Messrs. W. M. Jones, Thomas Mc[illegible] [illegible] and Charles S. [illegible] are seeking incorporation as The New Brunswick [illegible] Co., Ltd., with a capital of $[illegible]. [illegible]

Fredericton, N.B.—The municipal council will consider plans for the erection of a new fire hall. Ald. Cruikshank is chairman of a committee dealing with the matter.

Fort William, Ont.—A permit has been issued to the Canadian Pacific Railway for the erection of a gas plant to supply illuminating gas to the cars.

Guelph, Ont.—The management of the Guelph Carpet Mills Company will again enlarge their plant. This time a brick building, 130 x 50 feet, will be located in the rear of the present plant.

Medicine Hat, Alta.—Mr. F. P. Jones, of the Canada Cement Works, is considering the establishment of a cement works in this city.

Medicine Hat, Alta.—Mr. W. J. Christie, of Winnipeg, Man., is making arrangements for the erection of a glass plant in this city.

Montreal, P.Q.—Plans are now being prepared under the supervision of Mr. R. L. Deschamps, of the Public Works Department, for a new terminal warehouse for the Customs Department. It will be seven stories high and will cost at least $750,000. Tenders for the construction of the building will be called in a few days.

Moose Jaw, Sask.—The Minister of Militia has signified his intention of erecting a $100,000 armory in this city.

Provnce of British Columbia.—The Cowichan Lake Lumber Company is planning to erect a sawmill at the lake and another one later on at a site already secured in the vicinity of Port Moody.

Quebec, P.Q.—Arrangements are under way for the erection of an arena in this city. In size it will be 268′ x 162′. The architects are Messrs. Ross and MacFarlane, Montreal.

Regina, Sask.—The Loyal Order of the Moose have purchased a plot of ground in this city with the intention of erecting a seven story building. A building committee has been formed with Mr. R. P. Allen, of the Western Construction Company, as chairman.

Stratford, Ont.—The International Mausoleum Company of Toronto have purchased a perpetual lease of one acre of land in the local cemetery and will start work on a stone and marble mausoleum similar to the one recently constructed in Toronto, but on a smaller scale. The cost of this work is estimated at $125,000.

Victoria, B.C.—A report is in circulation to the effect that Maclaren cheese manufacturers are considering the location of dairying plants in the vicinity of this city.

Victoria, B.C.—A new block is projected for the corner of Hillside Avenue and Douglas Street, having a frontage of 144 feet on Douglas Street and 120 on Hillside Avenue, for R. Scott. L. W. Hargreaves being the architect.

Welland, Ont.—A report states that the Northern Steel Company will erect a rolling mill 150 by 600 feet and 85 feet high, to roll black plate and sheets, and other smaller buildings will be erected. Construction work is to be started at once and the plant will open early next year with 500 employes, running eight-hour shifts, 24 hours daily.

◆

BRIDGES, ROADS AND PAVEMENTS.

Guelph, Ont. — The commissioners have recommended that paving be commenced on Wilson and Sandiland Streets and the space in front of the fire hall. The city will put the surface of tar macadam on.

Locust Hill, Ont.—The bridge crossing the Little Rouge was demolished by an overload.

Moose Jaw, Sask.—The members of the Railway Commission have given a decision which calls for the construction of a bridge over the Canadian Pacific Railway tracks. The city are to pay $[illegible] towards the cost and maintain the road.

New Westminster, B.C.—The municipal council are considering by-laws, amounting to $[illegible], for additional street paving, grading and widening.

Ottawa, Ont.—A report states that there is a likelihood of a bridge being constructed over the Rideau at Gladstone Avenue.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

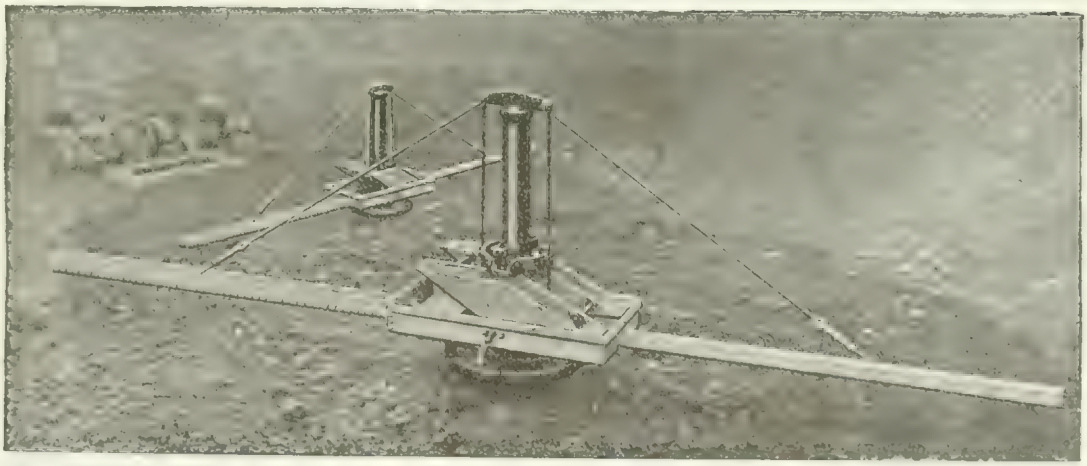
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

THE "IDEAL" DISTRIBUTOR
FOR BACTERIAL SEWAGE FILTERS

Just
a
Moment
Please
!
FACTS
Prove Them



AS A DISTRIBUTOR, gives an even and gentle distribution from the serrated edges of the arms.
AS A MOTOR, obtains greater power from the liquid head for propulsion than any other type of machine, and will revolve in any wind.
AS AN AUTOMATIC MACHINE, having no orifices to choke, does work for weeks without attention.

SEWAGE LIFTS & EJECTORS

WRITE NOW FOR OUR NEW 140 PAGE CATALOGUE OF SEWAGE FITTINGS

PATENTEES & MANUFACTURERS TUKE & BELL LTD., 69 LEADENHALL ST. LONDON, ENGLAND.
AGENTS FOR CANADA LAURIE & LAMB, ENGINEERS, MONTREAL

Peterboro, Ont.—A conference has been held in connection with the matter of erecting a bridge across Pigeon Creek. This is between the counties of Peterboro and Victoria and it is probable that government aid will be asked in the project.

Province of Alberta.—The Privy Council has decided a suit regarding the building of bridges over the irrigation canal in favor of the province.

Ottawa, Ont.—It is the intention of the city engineer to carry the garbage to the new incinerator by the cars of the Grand Trunk Railway.

St. Catharines, Ont.—The council have passed a by-law calling for the erection of a concrete bridge across the Welland Canal at a cost of $75,000.

Vancouver, B.C.—The municipal council have received the following tenders for the creosoted wood block pavement of Broadway: Laplaca Brothers, $47,636; Romano Pinto and Company, $47,800; and Bruce and Ford, $49,500. For resurfacing Main Street with wood blocks and stone in the track, the following were the tenders: T. R. Nickson and Company, $12965; Romano Pinto and Company, $12,700; and Laplaca Brothers, $10,349.

Victoria, B.C.—The municipal council have sent out notices of their intention to grade, drain and pave a number of streets.

◆

FIRES.

Dundas, Ont.—The factory and plant of Messrs. Jones Brothers was destroyed by fire with a loss of about $25,000. The firm manufactures dental and barbers' supplies, bar fixtures and interior shop and office fittings.

Montreal P.Q.—The mattress factory of B. Simon and [illegible] was damaged by fire to the extent of $2,000.

Montreal, P.Q.—The plant and stock of the Sovereign Lime Works was destroyed by fire with an estimated loss of $80,000. Mr. A. N. Tessier is the managing director.

◆

CURRENT NEWS.

Fort William, Ont.—The city engineer, Mr. John Wilson, has been given permission to engage an assistant and pay up to $150 per month for a suitable man. It is probable that this will be a temporary appointment.

Hamilton, Ont.—A survey of this port will be made by the Harbor Commission. The municipal council will defray the expense and a surveyor will be appointed at once, and make a grant of $500 toward office expenses and the engagement [illegible]

Ingersoll, Ont.—A by-law to vote a sum of money to assist a local manufacturing concern and a by-law to erect certain local improvements were defeated by the ratepayers.

Norwood, Man.—The Consumers Ice Company has been organized with the intention of erecting a plant in this place. Many Winnipeg men are interested in the project. Among the [illegible] W. S. Thomson, president [illegible] A. J. Andrews, vice-president; F. E. Cryder, managing director; J. R. Forman, secretary-treasurer; Dr. E. A. Jones. The pro- [illegible] tural artesian water under the Harrison process which is in [illegible] United States. [illegible]

Ottawa, Ont.—[illegible]

[illegible]

Ottawa, Ont.—The government has invited tenders for the construction of the new car ferry, which will be plied in the service between the mainland and Prince Edward Island. Tenders have been invited in Canada, the United States, Great Britain, Germany and Denmark. Specifications for the ferry are to be furnished and tenders will close August 15th. It is to be hoped to have the new ferry in operation this winter, if at all possible.

Quebec, P.Q.—The Federal Government has given up the idea of piercing a tunnel under Cape Diamond in order to have a union station in the Palace Ward, and its decision is to build the Transcontinental terminals, elevators and car ferry service on the water front, together with the station, on the old site of the Champlain market.

Regina, Sask.—The municipal commissioners are making preliminary plans for the erection of a gas plant next year.

Toronto, Ont.—There is a probability of friction arising between the gas company in this city and the Municipal Parks Department owing to the alleged destruction of some fine elm trees by the laying of gas mains.

Toronto, Ont.—The directors of the university have recently awarded a contract for 9,000 tons of soft coal to be used in the boilers of the heating plant during the coming winter. It is the intention of the directors to install proper smoke consuming appliances as the Queen's Park, where the university is located, is also the residence of many wealthy citizens.

Toronto, Ont.—The yards of the Polson Iron Works present a busy aspect at the present time; several tugs and some larger vessels are under construction.

Vancouver, B.C. — The municipal council has ordered that all sawmills be equipped with proper saw dust burners by January 1st next. This is the outcome of an action on the part of the council to lessen the smoke nuisance.

Winnipeg, Man.—The Board of Control invites architects resident in Canada to submit designs from which a selection may be made of a plan for the erection of a new City Hall for the city of Winnipeg (estimated cost $3,000,000). A copy of the regulations and conditions embodied in the programme governing the competition may be obtained from M. Peterson, secretary, Board of Control.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada 17 Victoria Street, London, S.W., during the week ending July 15th, 1912:—

A London firm is in the market for supplies of Canadian three-ply veneer.

A Welsh firm of bituminous paint manufacturers desire to get into touch with Canadian importers.

A London firm are in the market for Canadian mica. and would like to hear from actual mine owners in the Dominion.

The commercial manager of an English firm manufacturing a patent lighting system is about to visit Canada with a view to appointing agents in each province.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:

A firm of commission merchants in Johannesburg wish to get into communication with Canadian shippers of planks and other lumber suitable for South African markets.

A London firm would be pleased to hear from Canadian manufacturers of fence wire, wire netting, and also wire nails, who are in a position to undertake export trade.

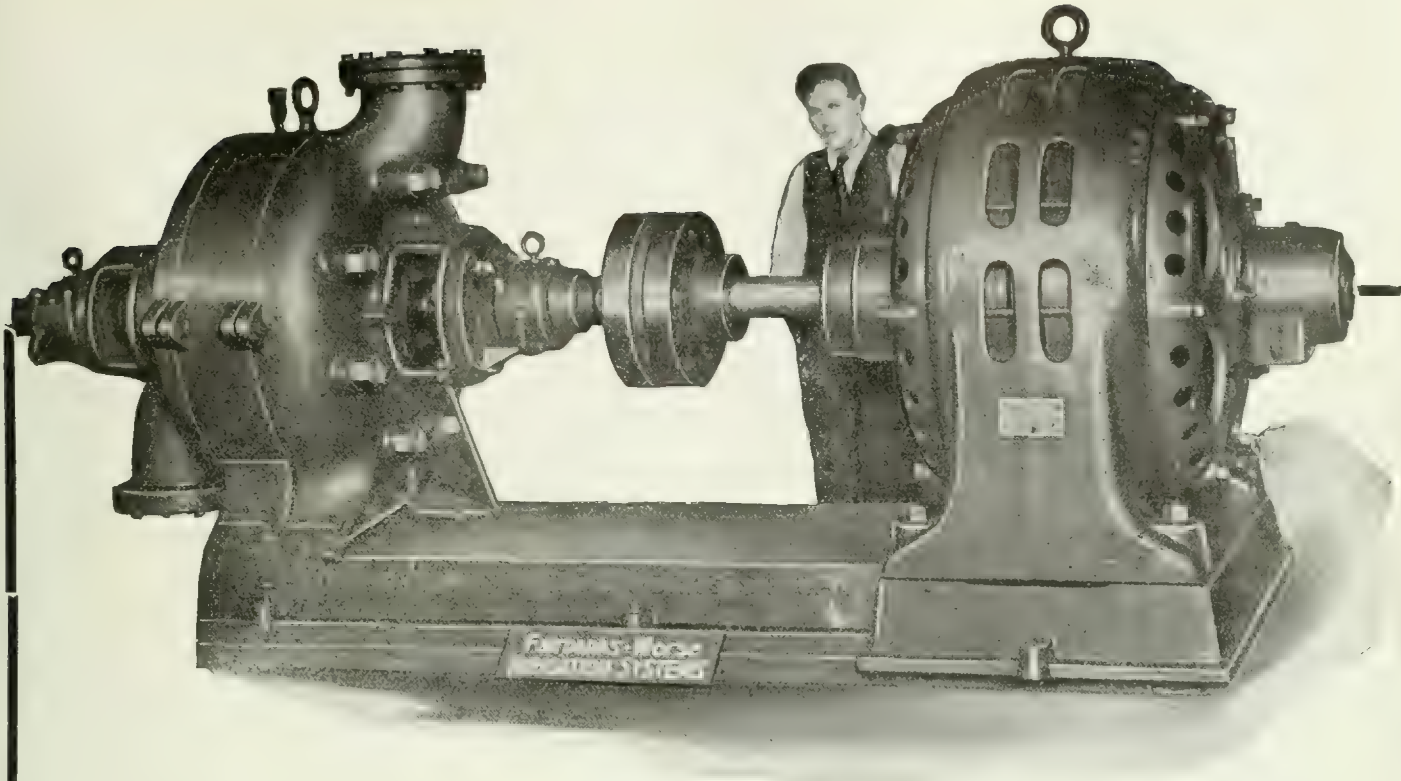
A French firm wish to arrange for the sale in Canada of a patented automatic machine for making bottles.

A Glasgow engineering firm who are sending out a representative to Canada next month would like to hear from United Kingdom machinery manufacturers seeking Canadian representation.

◆

COPIES OF CANADIAN ENGINEER WANTED.

One copy each of our issues of July 4th and 11th are required at once. The usual extension of the sender's subscription will apply in this case.



The Largest Direct Connected Centrifugal Pumping Unit in British Columbia.

The Vancouver Power Company have recently installed at their works at Coquitlam Dam, B.C., the largest direct connected centrifugal pumping unit in British Columbia. This outfit is to operate in parallel with a number of other pumps that are to furnish water under pressure for sluicing into place the material for their new dam.

This pump is a 10-inch, class "F," two-stage centrifugal, with bronze inpellers and renewable bronze diffusion vanes. It has a normal capacity of 1833 imperial gallons per minute when operating at 1160 r.p.m. against a total head of 355 feet or an equivalent pressure of 154 lbs. per square inch. It is mounted on a common sub-base with a 300 h.p. type "B," Fairbanks-Morse squirrel cage, induction motor, 2200 volts, 60-cycle, 3-phase, 1160 r.p.m. at full load, being direct connected thereto by means of a flexible leather link coupling.

The motor possesses a feature in rotor construction that is unique. The end rings are welded on to the rotor bars by a new process, making a perfect joint, free from the troubles common to the purely mechanical or riveted joint, such as oxidation, working loose, and solder-throwing. This improvement marks a long step forward in the elimination of rotor trouble.

Our Vancouver Branch supplied and assembled this complete pumping unit. We are in a position to quote on the necessary equipment for any pumping requirements on receipt of specifications.

The Canadian Fairbanks-Morse Co., Limited

Fairbanks Standard Scales, Fairbanks-Morse Gas Engines
Pumps Safes Vaults

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

NEW BATHS IN CONNECTION WITH THE CANADIAN PACIFIC RAILWAY HOTEL AT BANFF.

There has recently been opened two new baths or swimming pools in connection with the hotel at this point. One fed by the sulphur springs is 24 feet wide by 75 feet long, while the fresh water pool is 90 feet across, receiving its supply from the mountain springs. There are 72 dressing rooms in connection with the pools. In addition, Turkish and Russian baths have been provided to which are attached 24 dressing rooms, containing every up-to-date appointment.

The swimming baths are constructed of reinforced concrete, and lined with white enamel tiles. The fittings are of the latest and most modern pattern every convenience having been provided. The sulphur pool is protected by a screen of plate glass with reinforced pillars, at the top of which have been arranged boxes containing mountain flowers. The fresh water pool is on a lower terrace, and above the sulphur pool is a fine promenade terrace connecting with the hotel.

* * *

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible] Board of Railway Commissioners to date. [illegible] orders [illegible] Copies of these orders may be secured from The Canadian Engineer for [illegible]

[illegible] Ottawa to Express [illegible]

[illegible] Grand Trunk Railway to construct siding [illegible] Brothers [illegible] Humberstone, County of Welland, Ontario.

16968—July 10—16969—July 11—Authorizing Grand Trunk Railway to use and operate interlocking plant at drawbridges constructed over St [illegible] Bridge No. [illegible] across Grand River on its Holmedale Branch, twelve inches.

16970—July 6—Authorizing Grand Trunk Pacific Railway to cross highway [illegible] District of North Alberta, Alberta.

16971—July 6—Authorizing Canadian Northen Ontario Railway and approving [illegible] Twp. of [illegible], Ontario.

[illegible] Canadian Northern Ontario Railway to cross public road between Concessions 2 and 3, in Twp. of Whitby East, County Ontario, Ontario.

[illegible] Canadian Northern Ontario Railway to cross Montreal, Park and I. Railway at Sault au Recollect, Que., room to [illegible]

16974-5—July 10—Authorizing Canadian Northern Quebec Railway to extend its existing siding on Prince Albert Ave., Tetreaultville, now in Montreal, crossing Laurier and Azilo Streets and to construct spur for American Canning Company, Maisonneuve, Quebec.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

16990—July 12—Approving plan of G.T.R. cross-over switch east end of Cardinal Yard, Ontario.

[illegible]—July 11—Authorizing G.T.P. B.L. Co. to construct industrial spur in Yorkton, Saskatchewan.

16998—July 13—Authorizing C.P.R. to construct spur near Longue Pointe, Que., and granting certificate of correction.

16999—July 15—17000—July 8—Authorizing C.P.R. to construct spur for Saskatoon Public School District Board, Saskatoon, Sask., and for Ogilvie Flour Mills Co., Ltd., Fort William, Ontario.

17001—July 8—Authorizing C.P.R. to construct spur for Messrs. McGregor & McIntyre, Lot 28, Con. 2, from Bay, Twp. of York, Ont.

17002—July 8—Authorizing Campbellford, Lake Ont., and Western Ry. to join its tracks at mileage 183.51 from Glen Tay with C.P.R. (O. & Q. Ry.) at mileage 87.41, westerly from Havelock, Ont.

17003—July 13—Authorizing Gedeon Mailloux to construct farm crossing on his farm across G.T.R. near mile-post [illegible] from Windsor, Ontario.

17004—July 13—Directing G.T.R. to install gates at crossing main street, Victoriaville, Que.,. within 60 days.

17005—July 13—Approving change in C.P.R. station building at St. Augustin, Que., County of Two Mountains.

17006—July 8—Authorizing C.N.O. Ry. to construct across public road in Parish of St. Genevieve, County Jacques Cartier, Que.

17007—July 13—Authorizing Empire Limestone Co., Ltd., to construct tunnel or cut under Carroll Brothers' siding in Lot 5, 1st Con. Twp. of Humberstone, County Welland, Ontario.

17008-9—July 8—Approving revised location Canadian Northern Ontario Railway through Twps. of Boulter, Lauder, Pentland, and Master, Stratton and Barron in District of Nipissing, Ontario.

17010—July 8—Authorizing Canadian Northern Ontario Railway to cross with its line public road between lots 5 and 6, Twp. of Ross, Ct. Renfrew, Ontario.

17011—July 8—Approving revised location Canadian Northern Ontario Railway in Twp. of Beaucage, District of Nipissing, Ontario.

17012—July 13—Authorizing Campbellford, Lake Ont. and W. Ry., (C.P.R.) to make changes in its line and cross Bay of Quinte Railway at mileage [illegible] in Twp. of Camden, Ct. Addington, Ontario.

17013—July 15—Approving changes in location Canadian Pacific Railway station at North Wakefield, Quebec.

17014-15-16—July [illegible]—Authorizing Canadian Northern Ontario Railway to cross public roads in Twps. of Bristol, Pontiac Ct., Quebec, and in Twp. Westmeath, Ct. Renfrew and in Twp. Torbolton, County of Carleton, Ontario.

17017—July [illegible]—Authorizing Grand Trunk Railway to construct spur for John Duff and Son, Hamilton, Ontario.

17018—July 16—Approving revised location of G.T.P.B.L. Co., mileage 26.26 to 38.74 Saskatchewan (Cutknife Branch).

17019-20—July 16—Authorizing G.T.P.B.L. Co., to construct spur for McLeod Collieries, Ltd., from its Alberta Coal Branch and Grand Trunk Pacific Railway to construct spur for Jasper Park Colliers, District of North Alberta, Alberta.

17021—July 16—Approving location Montreal and Southern Counties Ry. from Ranlagh to boundary between Parish of Longueuil and Parish of Laprairie, Quebec 4,500 feet.

17022—July 13—Directing Canadian Pacific Railway to within 90 days install electric bell at Queen Street, Woodstock, N.B., 20 per cent. from Grade Crossing Fund.

17023—Juy 16—Directing Temiscouata Railway to within 30 days remove cattle guard and earth at crossing of Grand Falls Road, under penalty of $25.00 per day.

[illegible]—Approving revised location Campbellford, Lake Ont. and W. Railway, mileage 155.13 (from Glen Tay) to mileage 157 and approving location through town of Whitby, Ont., and authorizing crossing of main line track and two additional tracks in 1st Con. of Twp. East Whitby, Ct. Ontario, Ontario.

[illegible]—Authorizing Canadian Pacific Railway to construct spurs for Fitzsimmons Fruit Co., Ltd., at Port Arthur, Ont. For Crow's Nest Pass Lumber Co., Ltd., at Calgary, Alta., for Rocky Mountains Cement Co., Ltd., at Blairmore, Alberta.

[illegible]—Approving Canadian Pacific Railway plans for span at eastbound hump, new yard, East Winnipeg, Man., and bridge 132.3 Brandon, S.D.

[illegible] Grand Trunk Railway and Canadian Pacific Railway to operate trains over interlocker at West of Fergus, Ont., without stopping.

[illegible]

[illegible] September, 1912, [illegible] new Union Station, Toronto, Ont., same to be commenced forthwith and [illegible] per day.

[illegible]

17036—July 11—Reserving for further consideration of Board approval [illegible] and author- [illegible] C.N.O. Ry.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Volume 23 Toronto, August 8, 1912

Contents of this issue on page 287

The Canadian Engineer

An Engineering Weekly

THE HIGH TENSION TRANSMISSION SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

THIRD ARTICLE.

Telephone System.

A private telephone system connects and provides a means of instant communication between the transforming stations of the system. The Niagara, Dundas, Toronto and London stations are what might be termed "terminal stations," since the telephone lines terminate on the individual drops in these exchanges, while Port Credit, Guelph, Preston, Berlin, Stratford, St. Marys, Woodstock and St. Thomas are through stations with exchanges bridged across the the main line and operated as party-line stations. All exchanges are located on a loop circuit and can be sectionalized without interfering with other exchanges by means of specially installed switches in case of trouble. The telephone circuits are erected on separate poles paralleling the high-tension system. Considerable inconvenience was at first experienced from induced potential on the telephone circuits, which was found to be sufficiently high to strain the insulation of the standard potential equipment beyond safe limits. Various types of protective equipment were at first employed, but were unsatisfactory. After careful consideration and study of the conditions and requirements, an entirely original equipment, designed by the engineers of the commission, was installed and the operation of the telephone system since then has been entirely satisfactory. The equipments (Fig. 21) are mounted on special slate panels and consist of indicating fuses, vacuum type lightning arresters, auxiliary gap arresters, specially wound open-core choke coils, accurately balanced bleeding inductances and condensers.

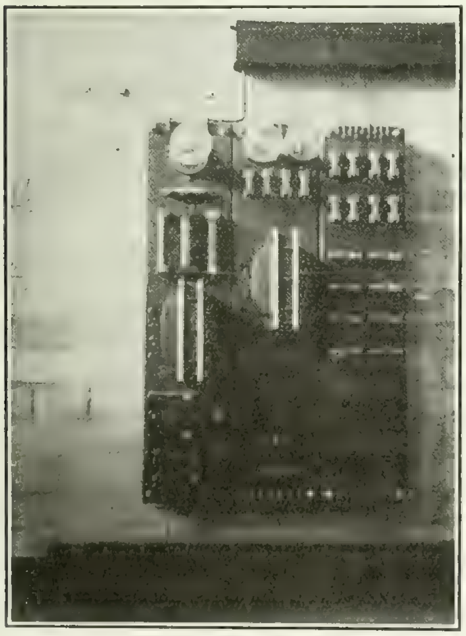


Fig. 21.—Telephone Protective Equipment Panel.

Description of Stations.

Niagara Falls Station.—Power is received at the Niagara Falls station (Fig. 22) from the Ontario Power Company's distributing station at a potential of 12,000 volts over three conductor, 300,000 cm., paper-insulated, lead-sheathed cables 2,200 feet in length, placed in tile conduits. Each cable has a carrying capacity of 4,500 kw., and since the individual transformer banks have a rating of 9,000 kw., the incoming power cables feeding these banks are connected in parallel. The ends of each pair of cables are protected by automatic oil circuit breakers connected to auxiliary buses, which in turn, are connected by similar breakers to the main buses, or directly to banks of transformers as desired.

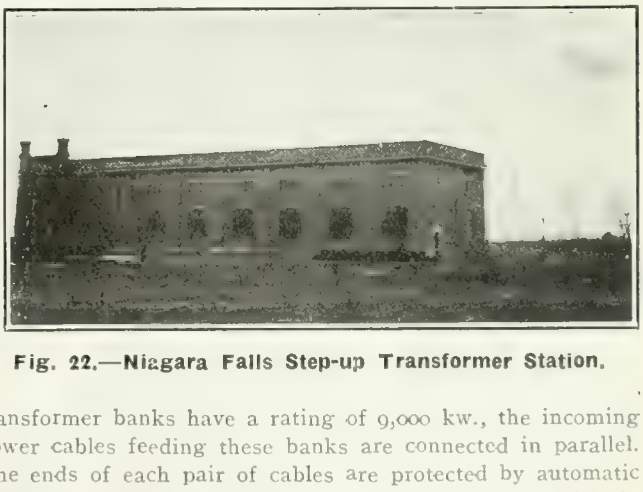


Fig. 22.—Niagara Falls Step-up Transformer Station.

At present there are nine 3,000 kv-a. single-phase transformers installed, although the building has been made sufficiently large to contain an additional bank of three.

From the high-tension side of the transformers the current is carried through disconnecting switches, and high-tension oil switches to the high-tension busbars, here it passes again through disconnecting switches and oil circuit breakers to the line outlets of the two 110,000 outgoing lines, and thence through choke coils and electrolytic arresters, provided with horn gaps placed outside, on to the line. (Fig. 23).

The 12,000-volt switches, busbars and accessories are located in the basement, and incoming feeder cables are laid in ducts beneath the basement floor, the necessary number terminating at the terminal compartment opposite each feeder switch. The heating boilers, oil tanks, storage battery, pumps and air compressor are situated in other parts of the basement. The cables feeding the switches terminate in terminal rooms with standards and bells, above which the feeders are tied together in pairs. The leads from the transformer oil switches pass up through the floor to the transformers, where the potential is stepped-up to 63,500 volts single-phase. Each feeder is equipped with three oil circuit breakers, the first connecting the power source to an auxiliary bus, the second, the auxiliary bus to the main bus, and the third, the auxiliary bus to a bank of transformers. By this arrangement a feeder, with a capacity equal to that of a transformer bank may be connected directly to a transformer bank or to the main bus. Through the medium of the auxiliary bus a transformer bank may also be connected to the main bus. This arrangement, while not complicated, offers sufficient flexibility to the circuit, since there are always two oil circuit breakers in series. The feeder switches are equipped with inverse time limit relays. The feeder switches are equipped with inverse time limit relays. Only the bus switches are non-automatic. Disconnecting switches are also supplied on both sides of the oil switches, which are electrically controlled from a switchboard located in the control room; colored lights being employed to indicate the position of the switches.

A service oil switch for controlling the transformers employed for the lighting, mechanical and other station equipment is connected to the 12,000-volt bus.

All 12,000-volt connections, busbars and switches are enclosed in compartments.

The transformers and high-tension switches are located on the main floor. Transformer banks are separated from [illegible]

through a water resistance. The nine 3,000-kv-a. transformers are shell type, oil-insulated, water-cooled, and designed for operation at a potential of 12,000 volts low-tension, and 110,000 volts high-tension. They are equipped with the Westinghouse condenser type of bushing. (Fig. 24).

The transformers and high-tension lines are connected to the buses by automatic three-pole oil circuit breakers, operated from the control gallery in a manner similar to the 12,000-volt oil switches. In general the oil switches are isolated by means of disconnecting switches with blades normally vertical, mounted on post insulators, supported on the walls. All 110,000-volt connections and buses consist of bare one inch seamless copper tubing installed near the roof and supported on porcelain petticoat insulators, of the built-up post type, with an over-all height of 39 inches, in turn secured to special steel structures. These buses extend the entire length of the high-tension switch room, and have a minimum clearance of 6 feet between phases and 3 feet 6 inches between a conductor and ground. The five 110,000-volt three-pole circuit breakers are electrically operated, and equipped with Westinghouse condenser type bushings. Due to the design of these switches, no concrete barriers or brick work are required, and the switches proper will automatically open by gravity, should accidents occur to their mechanism.

The line outlets consist of corrugated porcelain tubes 40 inches long, supported in a horizontal position by four porcelain posts mounted to the plane of the wall in a treated wooden frame five feet square, and having the intervening space filled with plate glass.

The hoods protecting the outlet bushings from the weather are 8 feet wide and extend three feet below the level of the bushing. On leaving the porcelain the leads drop vertically to a post insulator beneath the hood from the top of which the cable is carried directly to the insulator on the arrester structure. Beneath the wall outlet and this insulator is placed a choke coil constructed of aluminum wire in the shape of a helix with porcelain separators between the adjacent turns.

Lightning protection is secured by two sets of electrolytic lightning arresters, one for each outgoing line, equipped with horn gaps and placed on special steel structures outside the building. The aluminum plates are immersed in boiler iron tanks filled with oil.

Two switchboards are installed in the control room. The main board consists of three 28-inch slate panels, each panel controlling one incoming feeder, the two connected 12,000-volt switches and one transformer bank. Two of the

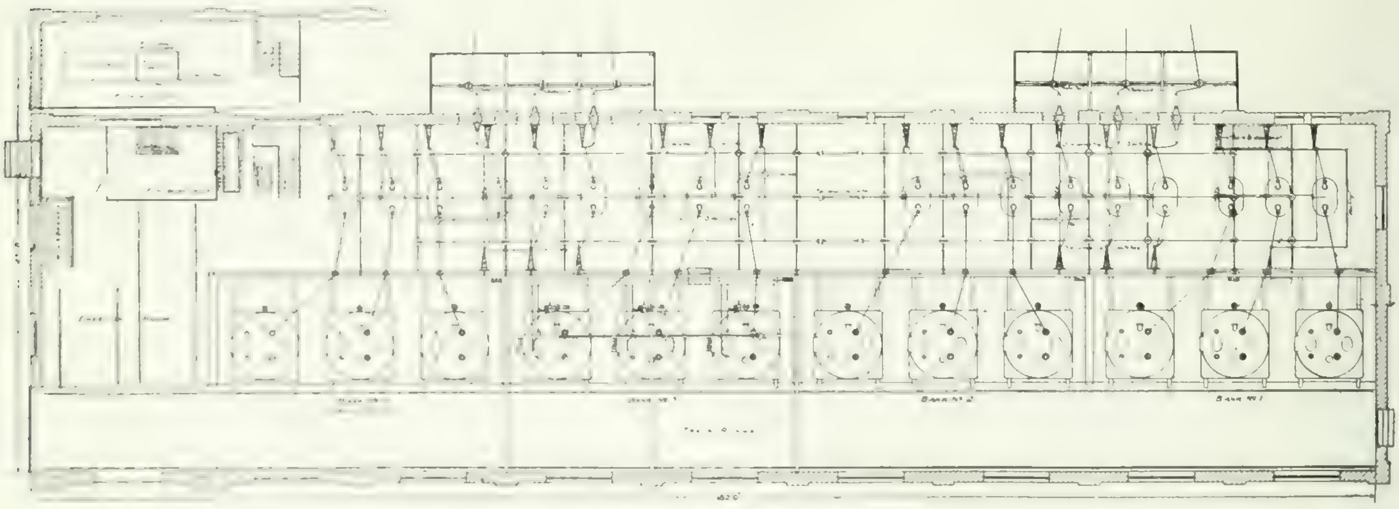


Fig. 23.—Plan View, Niagara Station.

panels, in addition, control the outgoing high-tension lines. Mimic bus connections, and the indicating lamps on the board assist the operator. The recording meters are placed on panels in the rear of the main board. The second switchboard is used only for station service, and controls the main lighting, the motor generator, the battery charging, the crane, the battery, and pump circuits. Illumination is secured by means of incandescent lamps connected to three phases of the 110-volt station circuit. Every third light is wired in such a manner that by means of a no voltage release switch on the service switchboard, these lamps may be quickly thrown over to the battery circuit in case alternating current energy is off.

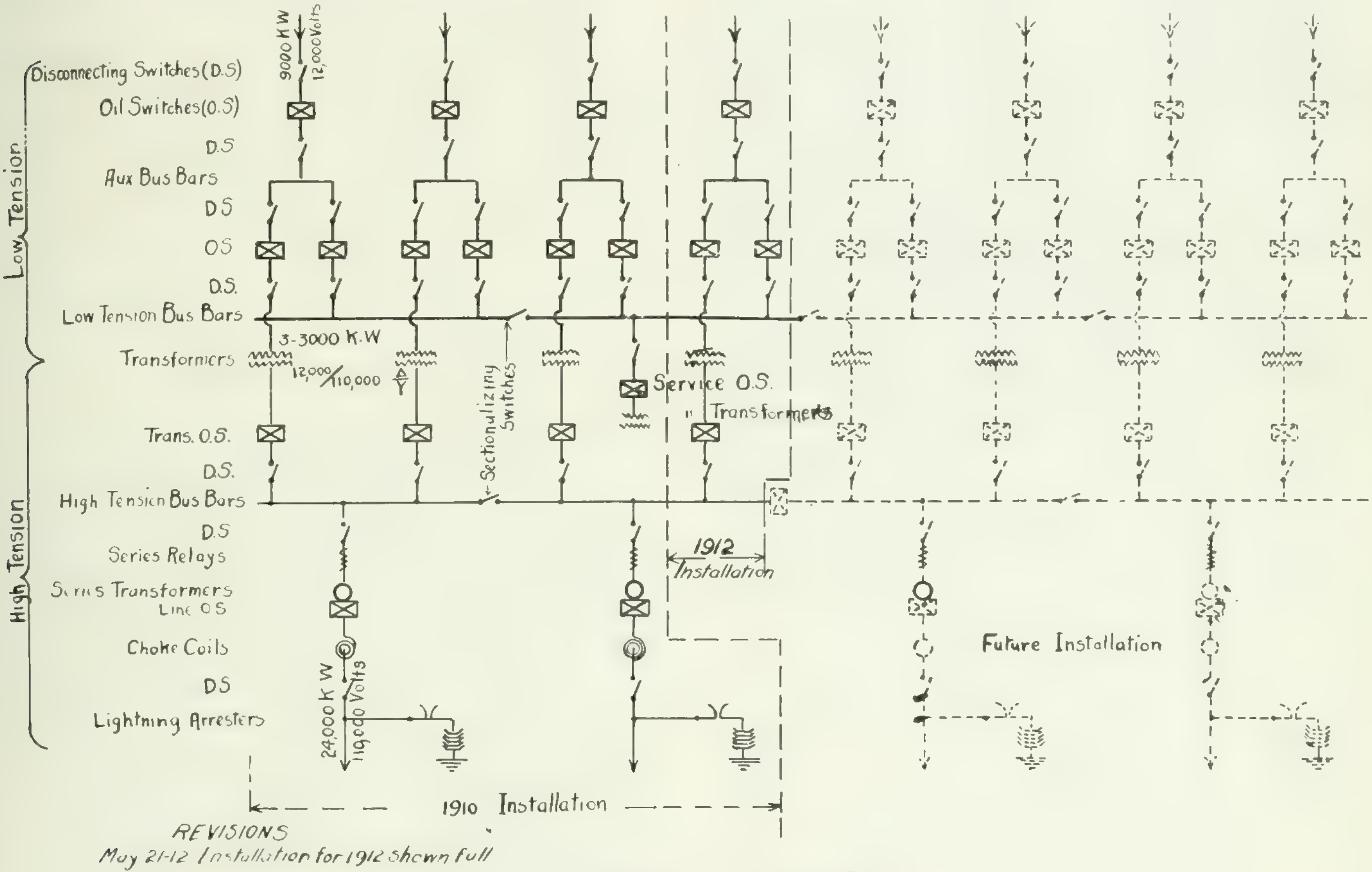


Fig. 24.—Wiring Diagram of Niagara Station.

The water used for cooling the transformers is obtained from wells with auxiliary connections to the city of Niagara Falls and Ontario Power Company's systems. The water, after passing through the transformer coils, is carried to a sprinkling cooling tank, which is an open concrete basin, 6 feet in depth, in two sections, each 30 by 60 feet, with the top just above the ground level. The water is delivered to the basin through sprinklers designed to reduce the temperature of the water, and located some distance above the surface. Duplicate motor-driven pumps are installed for operating this system. The duplicate oil tanks are also installed in the basement, the capacity of each is slightly greater than the oil capacity of one transformer. The transformers are provided at their tops with oil blow-offs piped to a main, running into the "bad" oil tank, which is provided with an oil sealed blow-off and a valve at the bottom for draining purposes. Oil filters and dryers are installed between the tanks, and the oil, after being filtered, is pumped back into the "good" oil tank. An oil pump is also provided for pumping pure treated oil to an "intermediate" oil tank placed on the main floor at an elevation that permits the oil to be drawn into any of the transformers by exhausting the air from the cases by a specially installed motor-driven air compressor and vacuum pump which is pumped to the different transformer cases. This equipment may be operated as a vacuum pump for drawing oil into the case, or as a compressor for pumping in air to assist gravity in emptying it. The high-tension oil switch tanks are connected by pipes to a switch oil tank in the basement, also connected to the oil filter.

All stations in the system are equipped with similar oil and air circulating systems. The water system is varied in the different stations to suit local conditions, but in such case duplicate pumps are provided unless the station is connected to the local mains. The construction room is located near the end of the building, and contains a 45-ton traveling crane, with electric hoist, hand bridge and trolley travels. The control room is situated near the erection room in an enclosed gallery overlooking high-tension switch and erection rooms. From this gallery the operator has an unobstructed view of the erection and high-tension switch rooms. Eventually, the erection and control rooms will be located in the centre of the building, and 344 feet long by 50 feet wide.

The high-tension switch room extends along one side of the building, contains all the high-tension transformer lines, disconnecting switches and high-tension busbars.

◆

A wrecking expedition is now at work over the hulk of the old ship Pewabic which sank in Thunder Bay nearly fifty years ago. The vessel is one hundred and sixty feet below the surface and in order to allow the diver to work at this depth a device known as the iron man is being used. It is known that the Pewabic carried over four hundred tons of copper and it is planned to bring this to the surface, a couple of hundred pounds at a time on days when the lake is calm. The use of the iron man is expected to work a revolution in deep water work. The divers are connected by telephone to the surface.

SOME FALLACIES AND FACTS CONCERNING ENGINEERING WORKS IN GREAT BRITAIN.

By W. A. MARTIN,
Late Assistant General Manager of the Toronto Electric Light Company.

During the past winter I paid a visit of some three months to England looking into the question of the sale of British-made engineering appliances and raw materials in this country, and while there was afforded an opportunity of going over a number of engineering works in the United Kingdom. As a result, my ideas of the methods and general practice adopted in these works have undergone a complete change.

I had always understood, in common, I believe, with the majority of Canadians who have not visited British engineering works, that English methods were old-fashioned and out of date. I pictured to myself old and badly lighted shops crowded with obsolete machinery, a large proportion of which I had anticipated would be standing idle owing to general shortage of work.

I had always been given to understand that the principals of British engineering works were generally very conservative and unapproachable men, and that they were more or less indifferent as to the trade conditions with Canada, and looked upon our market as belonging, for the most part, to our neighbors of the United States.

All these ideas I have found to be entirely fallacious.

At every works visited I received a most hearty welcome from the principals, whom I found to be broad-gauge business-men, showing the keenest interest in the prospects of trade with Canada. The works were, in practically all cases, well laid out and fully equipped with such modern tools and machinery as to secure the maximum output combined with the greatest accuracy, and what surprised me most of all was, that many of the buildings were of comparatively recent construction, thoroughly up-to-date, and in many cases new buildings were being erected to provide for extensions of the plants, owing to the immense amount of work in hand and the constantly increasing orders coming from practically all parts of the world. I saw plant of various kinds in course of construction for South America, South Africa, India, Australia, New Zealand, Japan, China, France, Spain, Italy and the United States and Canada.

New and improved tools were being installed in practically every factory visited, either to replace less efficient tools or otherwise increase the output of the factory. I saw very few tools standing idle, and in many factories day and night [illegible] in order to keep pace with the work in hand.

[illegible]

This inspection of parts is rather a fetish with the Brit- [illegible] some cases. There is no doubt, however, that it is this care [illegible]

[illegible]

[illegible]

manufacturers in the United Kingdom cater, permits of such specializing in a manner that would obviously not be possible in countries where manufacturers cater almost exclusively for home consumption.

Factories operating with from 300 to 600 employees are usually engaged in the manufacture of only one line of machinery, and although the larger works employing many thousands of hands, may specialize in, perhaps, half a dozen different lines, the manufacture of each specialty is confined to a distinct branch or department of the works, under the direct management and control of experts in that particular line of manufacture.

One direct result of this specializing has been that certain manufacturers have been able to establish the highest possible reputation as makers of the particular line of apparatus for which they have become noted, and this reputation is so jealously guarded that the makers' name on an appliance is the best possible guarantee of its high quality.

The name some of these makers have acquired enables them to secure orders for their products even from countries protected by a very high tariff wall.

In several of the works I visited my attention was, for instance, drawn to work in course of construction for shipment to the United States.

Sir W. G. Armstrong Whitworth & Co.

One of the most interesting works it was my good fortune to visit was that of Sir W. G. Armstrong-Whitworth & Co., Limited, of Newcastle and Manchester. This firm employs in its various departments over 20,000 men. Their shops and yards cover a ground area of over 270 acres.

Sir W. G. Armstrong Whitworth & Co.'s name is, perhaps, the best known in connection with their extensive ordnance work and shipbuilding yards, but a very important branch of their manufacture is the hydraulic and electric crane and dock and harbor equipment department. Here are to be seen in course of construction massive hydraulic appliances of a variety of descriptions, including enormous dock gates, swing bridges, cranes of carrying capacities ranging from 30 cwt. up to 250 tons, and hydraulic presses, which for many purposes are now taking the place of steam hammers for every large work. One of these presses in course of construction at the time of my visit, was stated to be of a capacity of 1,000 tons.

Although there are some cases for which Sir W. G. Armstrong Whitworth & Co., recommend and supply electrically operated appliances, as being more suitable than Hydraulic appliances, the latter are, for many reasons, generally preferred for this class of work. While Armstrong & Whitworth make a specialty of traveling cranes for shop and other uses—both electrically and hydraulically operated—they have devoted special attention to the construction of hydraulic cranes for the rapid loading and unloading of vessels. At their Elswick works at Newcastle-on-Tyne, they have an enormous crane erected on the river bank alongside of the building where they carry on the manufacture of ordnance, etc. This crane is capable of handling 150-ton lifts, and is so arranged that is can be swung over the building in question and through openings in the roof; can pick up huge cannon gun mountings and other equipment for the war vessels they build, and lift them bodily on to the vessel which is brought alongside for that purpose.

Whilst fully realizing the advantages of hydraulic power for heavy work such as the above, it struck me that the severe winter conditions in Canada would make it impracticable to use such power here, and I brought this question up. I [illegible] with the statement that Sir W. G. Armstrong

Whitworth & Co. had supplied a number of hydraulic cranes for use in parts of Russia, where the cold is even more severe than in Canada, and that they were operating with entire satisfaction, the danger of freezing being overcome by drawing off the water from the machines when not in use or where this is not practicable by using petroleum or by treating the water with glycerine. I was told that this latter mixture is supplied as part of the equipment in the first place, and that the wastage in operation is so little as to make the cost of future supplies of glycerine negligible.

Messrs. Reyrolle & Co.

Another works visited in the Newcastle district was that of Messrs. Reyrolle & Co., makers of electric switchgear. This business was started in London 26 years ago by Mr. Reyrolle, the present proprietor, assisted by about ten employees. Here, again, we see the effect of specializing in one line of manufacture. By concentrating their attention upon the perfecting of electric switchgear, this firm has been able to establish a reputation which, for that particular line of work, is probably second to no other in the world. They now employ about 500 hands making nothing but electric switchgear, for which they obtain orders from all parts of the world. I was particularly interested to see switches in course of construction for both the Boston and Chicago Edison Companies. Messrs. Reyrolle & Co. have paid particular attention to perfecting a line of switchgear for mining work and sub-station control. This gear appears to be as near fool-proof as it is possible to make it. All the gear is made up of individual units, which are absolutely standardized, and can, therefore, be replaced by, or interchanged with, other units of a similar size.

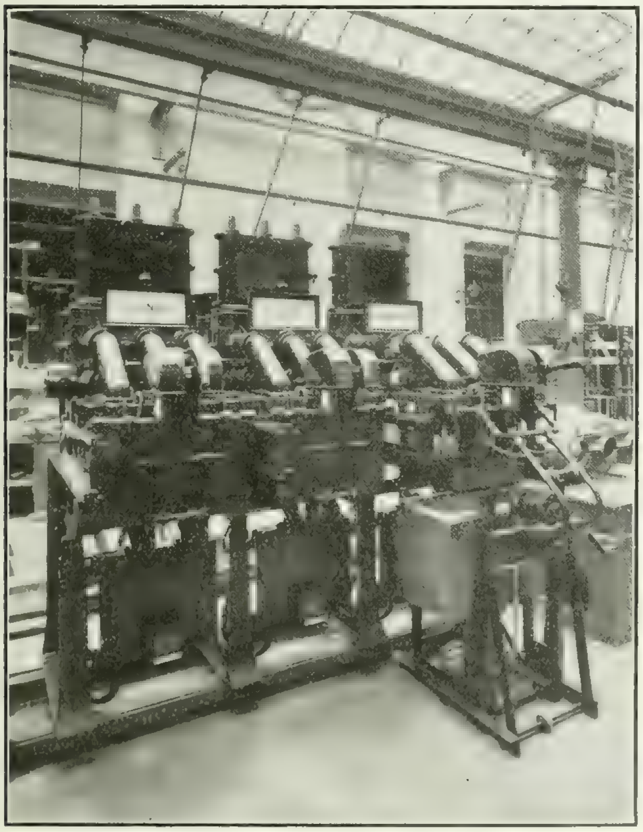


Fig. 1.—Front View of Switch Manufactured by Reyrolle & Co., for Shipment to the United States.

Another switchgear shown on the accompanying photographs was awaiting despatch to another large American power company. The first photograph shows the front view of this switchgear with the switch controlling the transformer circuit isolated and the oil tank lowered on a truck to be supplied for this purpose. The second photograph shows the back view of the same gear.

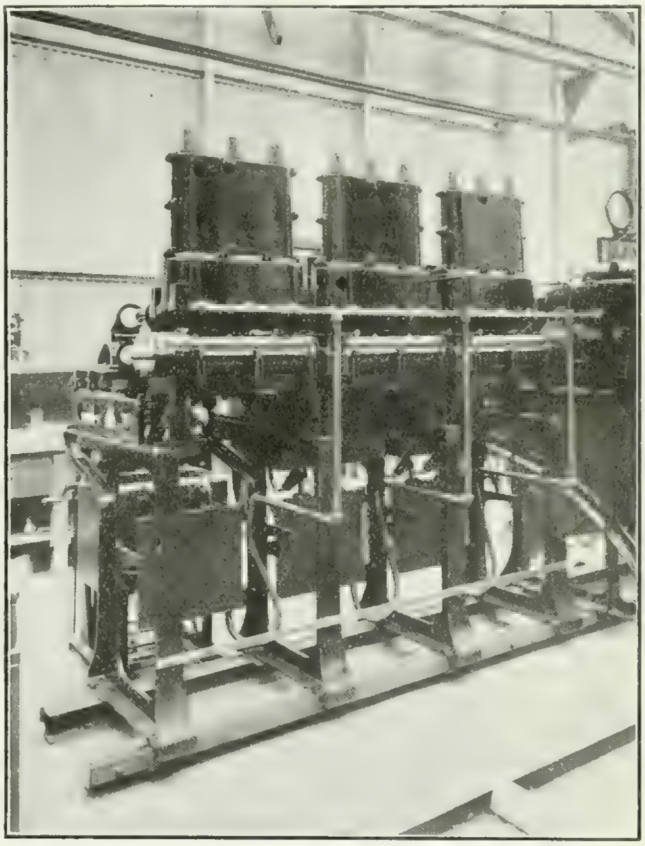


Fig. 2.—Rear View of Switch Gear Manufactured by Reyrolle & Co., for Shipment to the United States.

I was informed that this firm had installed in the Northumberland and Durham district alone about 750 similar panels. These were included in 120 sub-stations in that district and some idea as to the reliability of this gear will be gathered from the fact that the generating plant capacity of the power stations amounts to over 100,000 k.w.

Plans were in hand for power station switch panels to control generator circuits of sizes up to 12,000 k.v.a., and I have heard since that they are making the power and substation gear for Sheffield corporation power station at Neepsend, where 40,000 k.w. generating plant is to be installed.

Messrs. Cammel, Laird & Co.

While in Sheffield I was afforded an opportunity of going through the Cyclop Works of Messrs. Cammel, Laird & Co.

Sheffield steel is synonymous with best quality steel the world over, and of all the many steel workers in that city the name of "Cammel-Laird" ranks at the top as specialists in the manufacture of high-grade steel.

The fact that they employ in their combined works at Sheffield and Birkenhead and Penistone over 16,000 workpeople, is, in itself, some indication of the enormous output from these works. The total area covered by the combined works is over 160 acres. The management are justly proud of the immense business that has been built up and is now under their charge, and I was furnished with very full information as to the history of the company and its progress since its first organization in 1837.

The original firm of Johnson Cammel & Co. has twice been changed, in 1852 having been changed to Charles Cammel & Co., and in 1903, when, in order to share in the advantage of being in a position to build a battleship complete, the well-known shipbuilding business of Laird Brothers, Limited, Birkenhead, was acquired, the style of the firm was again changed to that of Cammel-Laird, Limited. In furtherance of this policy large ordnance works were started at Coventry for the manufacture of armour and guns.

The Cyclops Works have been visited from time to time by many members of the Royal family (including King George V. and Queen Mary when Duke and Duchess of York) and the reigning houses on the continent, as well as by distinguished statesmen and noted military, literary and scientific people from all parts of the world, but it is a unique record to be able to crown the list by the visit of her late Majesty Queen Victoria, who, on the 21st May, 1897, in the 60th year of her glorious reign, witnessed at her own [illegible]. The [illegible] of an armour plate destined for H.M.S. "Ocean.' The event is especially interesting [illegible] and the only [illegible] undertaken by her late Majesty during the [illegible] of her reign.

The [illegible] of the firm include armour plates, guns, projectiles; steel tyres, axles, springs and buffers for locomotives, carriages and wagons; locomotive crank axles, steel rails, fish plate, sole plates, billets, blooms and bars by the "acid" process; steel castings and steel forgings of all kinds for shipbuilders, engineers and mining machinery; high-speed tool steel; nickel steel for motor cars and wagons, etc.; best crucible cast steel for engineers' and blacksmiths' tools, mining drills, etc.; files, hammers, picks, [illegible], etc.

[illegible] the company's various works, but I may say that the annual [illegible]

The [illegible]

[illegible] previous to rolling.

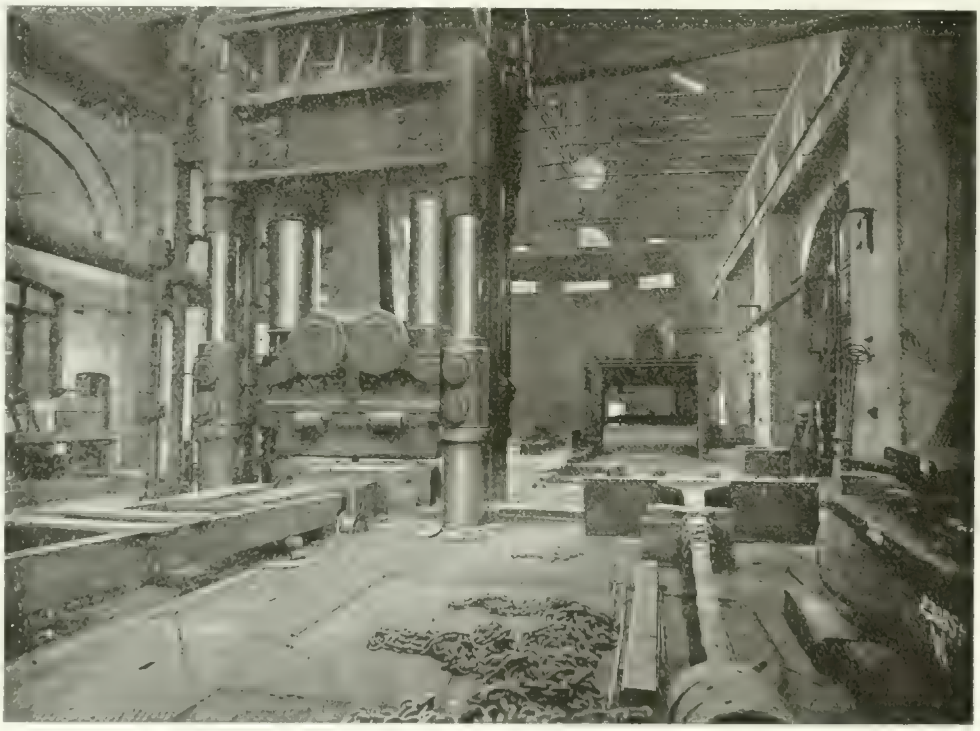


Fig. 3.—View of the Armour and Press Shop of Cammel, Laird & Company, Limited, Sheffield.

The armour mill in the background, one of the largest in existence, has rolls 14 feet long by 4 feet diameter, and is driven by three cylinder h.p. engines, of 12,000 horsepower.

The process of steel making and treating in all its branches is most fascinating. From the large gas-fired furnaces, where it is seen boiling and bubbling like water until it is run off into ingots, and then whilst still red hot carried by goliath cranes to one of the large hydraulic presses, there to be squeezed into a forged block from which later a large gun is to be turned. Or it may be that its fate is to be rolled into railway tyres or carriage springs, or possibly to be hammered into rods of different sections for high speed tool steel, to be eventually made into tools which will retain their cutting edge when red hot. Or again, it may be forged into armour plate 12 inches or more in thickness for the protection of battle ships. The ingredients of the mixture are in some cases varied according to the purpose for which the steel is to be used, and the mixture has to be of different characteristics in different sections of the mass. For instance, in the armour plates referred to the face to a depth of a few inches must be hard and brittle to resist penetration, whereas the back of the plate must be tough and tenacious to avoid risk of fracture.

Messrs. Cammel Laird have established a branch in British Columbia, through which they are doing a considerable business in their special tool steel for mining purposes, including rock drills, stamps and dies, etc.

Messrs. Ashmore, Benson, Pease & Co., Limited, and Messrs. The Power Gas Corporation, Limited.

Messrs. Ashmore, Benson and Pease, of Stockton-on-Tees, specialize in the manufacture of structural iron work, including large gas holders, large rivetted pipes for hydroelectric plants, etc. At the time of my visit this firm were just completing a contract for 450 tons of pipes twelve feet in diameter, to be shipped to British Columbia for the hydroelectric plant of the Ocean Falls Company. They have also recently executed a contract for the supply and erection of a large gas holder for the city of Vancouver, having a capacity of six million cubic feet.

Messrs. Ashmore, Benson and Pease also manufacture [illegible] gas producers, gas cleaning plants, Mond sulphate of ammonia recovery plants, etc., supplied by the Power-Gas

Corporation. Amongst the many interesting installations recently carried out by this latter firm is a plant for the recovery of sulphate of ammonia from peat. This installation is stated to be an entire commercial success. In the process of recovering this very valuable fertilizer from the peat, large quantities of gas are given off, which may be used for generating power in large gas engines. In a similar installation in Germany the waste gas is already being successfully utilized in this way.

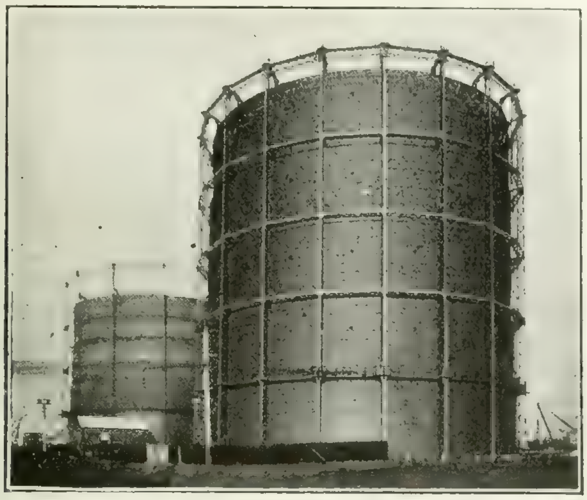


Fig. 4.—Large Gas Holder Manufactured by Ashmore, Benson and Pease for use in the City of Vancouver, B.C.

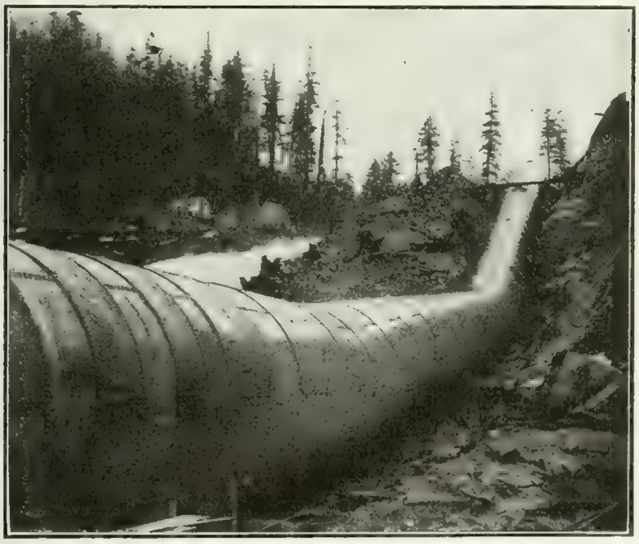


Fig. 5.—A Section of 12-ft. Pipe Line Manufactured by Ashmore, Benson and Pease for the Ocean Falls Power Company, British Columbia.

(To be continued.)

CANADIAN BOUNTY PAYMENTS.

The total amount paid in bounties by the Canadian Government for the year ending March 31 last, was only $538,529, compared with $1,591,663 for the preceding year. The bounties paid were as follows: Wire rods, $160,750; crude petroleum, $141,935; lead, $179,288; manila fibre, used in the manufacture of binder twine, $50,556. Since 1896, when the bounty system was introduced, the total payments have been a little over $21,000,000, of which $7,000,000 went for pig-iron, over $4,000,000 for puddled iron bars, and $6,000,000 in steel bounties.

TURBINE-DRIVEN CENTRIFUGAL PUMPS FOR WATERWORKS SERVICE.*

By W. O. Beyer.

It is only recently that centrifugal pumps have received the serious consideration of waterworks engineers, although their economy and efficiency have long since been demonstrated for supplying water in large quantities to industrial plants. It is our purpose here to show that the combined fixed charges and operating costs of the rotatory unit compare favorably with those of the high-duty vertical triple-expansion unit or other type, where the price of coal is not excessive.

The high duty shown by reciprocating engines in waterworks service, involving the pumping of large quantities of water against a constant head, without any great variation in rate, has long and justly been regarded as a supreme achievement. Due to the direct connection of the pump and engine cylinders and to the high efficiency realized in the unit when the proper attention is paid to its valves and packings, the triple-expansion reciprocating pumping engine has been able to develop duties that are unapproachable by rotatory units consisting of turbines and centrifugal pumps. However, a careful comparison of the total costs of pumping will show that the balance may be entirely reversed when fuel costs do not exceed a certain price per ton. That is, the high first cost of the reciprocating unit, together with the cost of the foundation required, introduce annual charges for interest, upkeep and depreciation, which more than offset the lower duty of the turbine unit.

Of the several types of pumping engines, the following are chiefly used for waterworks service: The low-duty compound condensing engines, costing, with foundations, piping and appurtenances, about $2,300 per million gallons capacity per 24 hours; low-duty triple-expansion condensing horizontal engines, costing about $2,800 per million gallons capacity; cross-compound condensing horizontal fly-wheel engines, costing about $3,300 per million gallons capacity, and high-duty triple expansion vertical condensing engines, costing about $4,800 per million gallons capacity. The figures given are from a paper presented before the American Society of Civil Engineers, May 17, 1911, by the late Charles A. Hague. Since this paper selected the high-duty triple-expansion vertical engine as the only one to be considered in most cases, it is with this type of engine that we shall make our comparison.

The prices for pumping units given below are, to the best of our knowledge, accurate and include condensers, piping and foundations complete.

No account has been taken of the greater volume required in the buildings for reciprocating units, as a unit volume cost must be assumed which would agree with only one architectural design; similarly, no account has been taken of the greater volume required for the larger boiler installation of the turbine units, for the majority of existing plants usually have their building proportions determined, and a saving could not be made in either room without special complications of no account in this discussion. However, the difference in cost of foundations has been taken into account, because this is an addition in existing buildings and can be computed easily.

---

* Paper read before the American Waterworks Association.

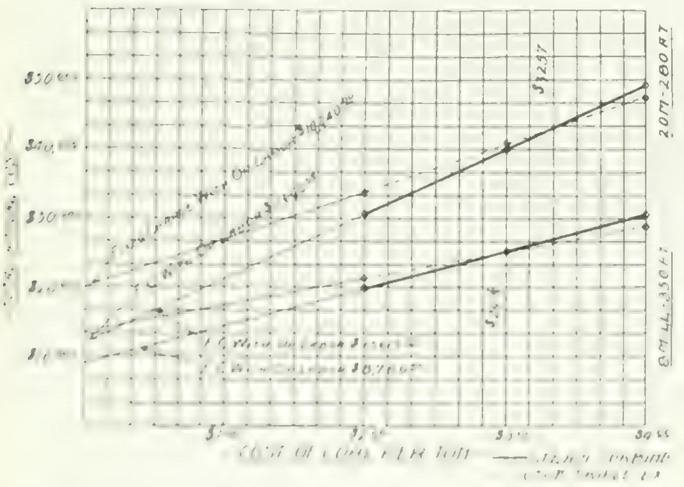
In a new station the turbine should be credited with any saving in floor space, buildings, etc., which it may effect, as compared with the reciprocating engine, and the reciprocating engine credited with the saving effected in the boiler rooms.

In a comparison of this kind certain assumptions must necessarily be made. We have tried to eliminate as far as possible arbitrary assumptions, and all figures of first cost of apparatus have been taken from, or estimated from, recent bids on the two types of machinery under consideration. The first cost per boiler horse-power we have taken to be $30, complete with piping, chimney, stokers, etc. (The use of a lower figure would favor the turbine-driven pump as compared with the high-duty engine, but we believe, with everything taken into consideration, this will prove to be an average figure.) We have assumed the following annual charges against pumping machinery:

Interest	5
Depreciation	3
Repairs and supplies	2%
Total	10

We have also assumed the following annual charges against the boiler equipment.

Interest	5
Depreciation	5
Repairs and supplies	5%
Labor on maintenance	2%
Total	17



Comparisons of Operation Cost of Steam Turbine and Triple Expansion Engines, Small Plants.

[illegible]

[illegible] count, we believe the assumption a fair one. Viewed in the light of possible future development, it would seem that a longer life should be accorded to the turbine-driven unit than to the crank and flywheel unit, as a very thorough canvass of the whole field of pumping equipment does not bring to light any mechanical apparatus which is being developed to compete with the turbine-driven machinery to the same extent as the turbine-driven machinery is being developed to compete with the crank and flywheel machinery.

It further appears that the steam turbine has reached a stage of development, such that improvements will appear only as refinements of type; and steam economies can only possibly be reduced sufficiently to render obsolete the present good designs by better theoretical design and by better steam conditions. The use of high steam pressures and superheat may be expected to gradually obtain further favor in this country as in European practice, where 250 degrees Fahr. superheat and 200 pounds steam pressure are not unusual. This, however, entails practically no change in turbines as constructed for present steam conditions.

Fuel costs are based on a boiler efficiency of 65 per cent., heat content of 13,000 B.t.u. per pound of coal and 24-hour per day operation.

The duties given are on a basis of 150 pounds steam pressure, with no superheat.

Three examples are taken, based on coal at $2, $3 and $4 per ton. Where coal can be obtained cheaper than $2 per ton, the advantages of the turbine-driven pump are more clearly marked.

It will be noted that the point at which the total annual costs are equal for the eight-million-gallon crank and flywheel vertical unit and the eight-million-gallon turbine centrifugal unit is when coal costs $2.91 per ton. Also for the twenty-million-gallon vertical crank and flywheel unit and the twenty-million-gallon turbine centrifugal unit, the total annual costs will be equal when coal costs $3.25 per ton. Above these points the reciprocating unit has the advantage, and below these points the rotatory unit has the advantage, on the basis of these calculations.

Tabulation "A."

8,000,000 Gallons per Day, 350 ft. Head, 401 w.h.p.

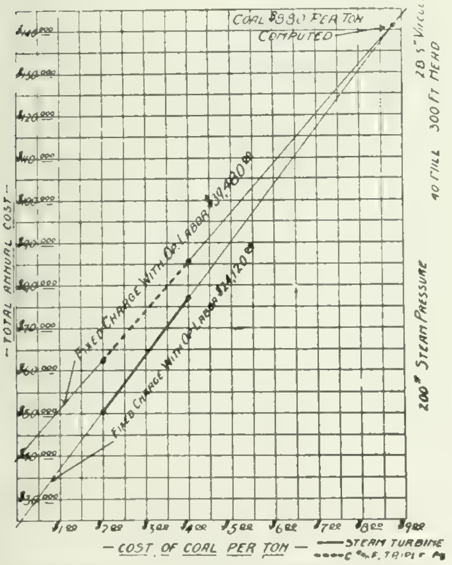
Item.	Vertical C. & F. W. Triple Expansion. 150,000,000 Duty. 3 125-h.p. Boilers.	Steam Turbine Centrifugal. 105,000,000 Duty 3 175-h.p. Boilers.
Cost, pumping unit	$72,000	$16,000
Interest, depreciation, etc., 10%	7,200	1,600
Cost, boilers	11,250	15,750
Interest, depreciation, etc., 17%	1,915	2,680
Labor, three shifts—		
Engines	2,700	2,700
Boilers	1,800	1,800
Total int., depreciation, etc., and labor	13,615	8,780
Fuel cost, $2 per ton	7,467	10,700
Fuel cost, $3 per ton	11,129	16,100
Fuel cost, $4 per ton	14,934	21,400
Total annual cost, $2 coal	21,082	19,480
Total annual cost, $3 coal	24,744	24,880
Total annual cost, $4 coal	28,549	30,180

Tabulation "B."

20,000,000 Gallons per Day, 280-ft. Head, 981 w.h.p

Item.	Vertical C. & F. W. Triple Expansion, 165,000,000 Duty, 3 225-h.p Boilers.	Steam Turbine Centrifugal, 120,000,000 Duty, 3 300-h.p. Boilers.
Cost, pumping unit	$120,000	$26,000
Interest, depreciation, etc., 10%	12,000	2.600
Cost, boilers	20,250	27,000
Interest, depreciation, etc., 17%	3,700	4,590
Labor, three shifts—		
Engines	2,700	2,700
Boilers	1,800	1,800
Total int., depreciation, etc., and labor	19,940	11,690
Fuel cost, $2 coal	13,570	18,630
Fuel cost, $3 coal	20,335	27,945
Fuel cost, $4 coal	27,140	37,260
Total annual cost, $2 coal	33,510	30,320
Total annual cost, $3 coal	40,275	39,635
Total annual cost, $4 coal	47,080	48,950

We believe it can be assumed safely that the development of pumping machinery in the future will be along somewhat the same lines as the development of power-producing machinery. At the present time one of the most noticeable features in the development of power machinery is the increasing favor with which larger units are being adopted. In large central station work five years ago, the ordinary size of unit was from 10,000 to 15,000 k.w. Now, not only in European practice, but also in American practice, 25,000 k.w. units are being installed in the larger stations. There are two reasons for this development, the first being the continual endeavor to obtain better economy, not only in actual steam consumption, but in capital charges, including first cost, buildings, real estate, etc. The second reason for the development along this line comes from the fact that engineers of to-day seem to have more initiative than formerly, and where before the development of a 15,000 k.w. turbine would have seemed an impossible task, now the installation of 25,000 k.w. turbines is becoming a matter of course.



Comparisons of Cost of Steam Turbine and Triple Expansion Engines, Large Plants.

We have assumed that there will be progress along this line in waterworks pumping machinery, and that installations of very large units will be made in the future. We have evolved a comparison between two units of the types under consideration, each having a capacity of 40,000,000 gallons per 24 hours, against a total head of 300 feet. This comparison is based on utilizing the greatest range of steam temperature which the best modern practice has established as commercially practicable, and which at the same time is not too intensely theoretical. We refer here to European practice, in which steam pressures of 200 pounds, 275 degrees superheat and 28.5 inches vacuum are successfully and commercially utilized. Especially important in this connection is the item of high vacuum, since in the case of waterworks large quantities of water are always available for condensing purposes.

Extremely large capacities and high heads present no difficulties nor disproportionate costs in the construction of steam turbine-driven centrifugal pumping units, since it is an inherent characteristic of the centrifugal pump that the larger the capacity, the greater the efficiency for a given head.

There is practically no development necessary on the turbine to take advantage of these conditions, as the turbine of almost exactly the same characteristics that would be necessary for this installation is now in successful operation in hundreds of power-producing plants to-day. We have had to assume no steam consumption, as this is a matter of test, and practically have had to assume no pump efficiencies, as we have taken the minimum which we know can be obtained on this size pump.

Further, the turbine is well adapted to take advantage of the improvement in steam conditions as mentioned above, and reciprocating engines can also be designed as to take advantage of the initial and terminal conditions favoring high economy.

The results of this comparison are shown in Table "C." It is apparent from these tables that the point at which the two curves of overall economy of the two units cross is at a cost of approximately $8.80 per ton for coal.

It would appear, therefore, that the field of these large capacities at high heads for ordinary coal costs belongs to the turbine-driven centrifugal pump exclusively.

Tabulation "C."

40,000,000 gallons per day, 300-ft. head, 2120 w.h.p., 200 lbs. steam pressure. 275 deg. F. superheat. 28.5 in. vacuum.

Item	Vertical C. & F. W. Triple Expansion, 223,000,000 Duty, 3 350 h. p. Boilers	Steam Turbine Centrifugal, 193,000,000 Duty 3 400 h. p. Boilers.
Cost, pump	$210,000	$55,000
Interest, depreciation, etc., 10%	21,000	5,500
Cost, boilers	31,500	36,000
Interest, depreciation, etc., 17%	5,360	6,100
Labor, three shifts—		
Engines	7,200	7,200
Boilers	5,320	5,320
Total int., depreciation, etc., and labor	39,480	24,120
Fuel cost, $2 coal	23,265	26,800
Fuel cost, $3 coal	34,897	40,200
Fuel cost, $4 coal	46,330	53,600
Total annual cost, $2 coal	62,475	50,920
Total annual cost, $3 coal	74,377	64,320
Total annual cost, $4 coal	85,810	77,720

In conclusion, if the above data are correct—and it has been our sincere endeavor to present only such figures as are fair for both types of machines—it would seem that the steam turbine centrifugal pumping unit must be conceded a place of primary importance in the field of waterworks engineering.

RESULT OF FILTRATION AT ALBANY.

The filtration plant at Albany, N.Y., which receives its supply from the Hudson River and comprises a sedimentation basin, 16 roughing filters and 8 slow sand filters, each having an area of 0.7 acres, purified during the year ending September 30, 1911, an average daily quantity of 21,506,490 gal. at a cost of $5.32 per million gallons, including a charge of $2.64 per million gallons for pumping. The latest annual report of Mr. H. J. Deutschbein, superintendent of the Bureau of Water, to Mr. Wallace Greenlach, commissioner of Public Works, contains the following data on the operating results during the year.

The raw water was remarkably uniform in its character during the year. The turbidity average 22 parts per million, the color 35 parts and the bacteria 37,166 per cubic centimeter. There were no especially heavy freshets: each reaching its maximum height gradually and subsiding slowly. The sharpest flood stage occurred from December 31 to January 21, when the water rose to El. 105 in 24 hours. The largest freshet extended from February 27 to May 23, the highest stage being reached on April 17 at El. 106.8. The turbidity was highest at this time, being 400 parts per million. Table 1 shows the efficiency of the system under extreme conditions:

Table 1.—Operating Results During Largest Freshet, March 29.

	Suspended matter.	Turbidity.	Turbidity coefficient.	Suspended matter efficiency, per cent.	Turbidity efficiency, per cent.
River ..	[illegible]	400	0.43	....	....
Basin ..	[illegible]	320	0.19	62.9	20.0
Primary Eff. .	[illegible]	80	0.24	69.8	75.0
Secondary Eff.	0	0	...	100.0	100.0

From table 1, it is seen that most of the matter in suspension was of a coarse nature, nearly 70 per cent. being taken out by the basin. The primary filters easily removed the remainder. The plant as a whole experienced no difficulty in handling this flood.

Owing to the uniform conditions the water was of a weaker nature than of past years. The average bacterial content per cubic centimeter being 37,000 against 44,000 of last year. The organic matter likewise was below normal. During the latter part of July and the early part of August, a heavy growth of sponge developed, which seeded up the basin and primary filters to such an extent that the spores were carried over onto the secondary filters and materially lessened their lengths of runs. The life cycle of this organism was short, however, and did not necessitate any remedial measures.

The basin was out of commission from November 1 [illegible] Since the last cleaning 16,514,600,000 gal. of water passed through the basin. This amount of water caused the deposition of 1,770 tons of silt, or approximately 0.11 ton per million gallons. Most of this silt subsided immediately upon entrance, the remainder settling [illegible]

[illegible] experienced from aquatic organisms.

[illegible]

Primary Filters.—[illegible] cent., it was necessary to employ two supplemental washes during the year. At these times the entire sand layer down to the gravel was ejected and replaced by means of the Nichols separator. Before these beds were washed in this manner, the average initial loss of head at a 70,000,000-gallon rate was 2 feet. After washing, the initial loss of head was reduced to 0.8 feet.

Primary filter No. 9 is supplied with a uniform quartz sand whose effective size is 0.65 mm. All the other beds have a uniform sand of effective size of 0.45 mm. Table shows a comparison between primary No. 9, with a coarse sand, and primary No. 12, with a fine sand, before and after the supplemental wash:

Table 2.—Washing Coarse and Fine Sands.

Primary Filter No. 12 (Fine Sand).

	Before Wash.			After Wash.		
Section.	Turb.	Org-N.	Ox-con.	Turb.	Org-N.	Ox-con.
0-10 in.	4000	2.04	43.8	1200	0.97	25.5
10-30 in.	3500	2.44	35.6	1500	1.45	26.4

Primary Filter No. 9 (Coarse Sand).

	Before Wash.			After Wash.		
Section.	Turb.	Org-N.	Ox-con.	Turb.	Org-N.	Ox-con.
0-10 in.	3200	1.45	40.0	950	0.13	11.6
10-30 in.	2000	1.20	21.6	1000	0.18	12.5

Note.—Organic nitrogen and oxygen consumed determinations are expressed in parts per 10,000 dry sand.

From the above table it is clearly shown that the normal upward flow wash is much more effective with a coarse sand, and that the efficiency of the supplemental ejection is far greater.

Table 3.—Sand Before and After Washing.

	Turbidity.	Organic Nitrogen Pts. per 10,000	Required Oxygen Pts. per 10,000
Secondary No. 7.			
Top 10 in. before wash	2000	2.00	17.5
Top 10 in. after wash	 650	0.15	4.2
10 in.-20 in. after wash	 850	0.20	5.0
20 in.-30 in. after wash	 900	0.22	6.2
Secondary No. 1.			
Top 10 in. before wash	1800	2.15	15.4
Top 10 in. after wash	 525	0.20	3.8
10 in.-20 in. after wash	 700	0.22	4.3
20 in.-30 in. after wash	1000	0.48	8.1
Secondary No. 6.			
Top 10 in. before wash	2200	0.35	15.0
Top 10 in. after wash	700	0.17	3.2
10 in.-20 in. after wash	 750	[illegible]	4.7
20 in.-30 in. after wash	 900	[illegible]	[illegible]
Secondary No. [illegible]			
Top 10 in. before wash	[illegible]	[illegible]	[illegible]
Top 10 in. after wash	[illegible]	[illegible]	[illegible]
10 in.-20 in. after wash	 650	0.25	5.8
20 in.-30 in. after wash	 900	[illegible]	6.0
Secondary No. 8.			
Top 10 in. before wash	[illegible]	[illegible]	[illegible]
Top 10 in. after wash	[illegible]	[illegible]	[illegible]
10 in.-20 in. after wash	[illegible]	[illegible]	[illegible]
20 in.-30 in. after wash	 950	[illegible]	[illegible]

Secondary Filters.—When the entire sand in all the secondary filters was washed and replaced down to the gravel, by ejection in the fall of 1909, the sand was of the following degree of cleanliness: Turbidity, 800; average of organic nitrogen, 0.25 part per 10,000 gm. sand and oxygen consumed equivalent of 3.5 parts per 10,000 gm. dry sand. One month following the cleaning of this sand the top 2 in. of the beds were in the following condition: Turbidity, 1,300; organic nitrogen, 1.40; oxygen consumed, 11.3. Five inches below the surface was in the following condition: Turbidity, 900; organic nitrogen, 0.38; oxygen consumed, 7.2. It is thus seen that there is a decided penetration of silt and organic matter into the top 4 in. of the bed, the degree of penetration depending upon the conditions in the river. As a consequence of this penetration the bed becomes hard and compact in time, so that remedial measures must be adopted.

In the spring of 1911 so much sand had been removed from the tops of the beds in the consecutive scrapings, and the top 10 in. had become so silted up and compacted, that it was decided to eject and replace. Five secondary filters had 10 in. of their top sand washed and replaced, and 10 in. of fresh sand added. Table 3 shows the condition of the sand before and after washing and replacing.

The total quantity of water filtered during the year was 7,849,869,000 gallons, making an average of 21,506,490 gallons day. The average rate of filtration was 4,018,000 gallons per acre per day for the secondary and 80,500,000 gallons per acre per day for the primary filters. The average quantity of water filtered per unit of 0.7 acre, between scrapings, was 85,338,000 gallons, or 121,911,000 gallons per acre. The maximum rate at which any secondary filter was operated was 6,000,000 gallons.

All filters have been operated at a 5,500,000-gallon rate when necessary, and have given good results. Cleanings were made on the eight filters 93 times, and two units were raked and put in service. The average scrapings for the eight units was 11.66 times each. During the past year 316,386 sq. yd. of filter surface was scraped in 2,663 man-hours, making an average of 2,865 man-hours per scraping of each filter or each 3,402 sq. yd.

During the year 5,100 cu. yd. of sand have been washed and replaced in 2,897 man-hours. There were 2,666 cu. yds. replaced from the storage pile in 1,666 man-hours. During the year 5,572 cu. yds. of sand have been ejected to the rear of the filters in 4,126 man-hours, an average of 48.54 per cleaning, and an average of 65.5 cu. yds. per cleaning; there were 85 cleanings ejected. The sand to a depth of 10 in. has been washed and replaced, and sand from the rear filters replaced in filters Nos. 1, 6, 7, and 8, leaving them with a uniform depth of 3 ft.

All pre-filters have had the sand removed, washed and replaced twice during the year, as it was found necessary to do so. The sedimentation basin has been thoroughly cleaned and 1,770 tons of silt removed. The hypochlorite machine has been in operation all year and has proved satisfactory in the results obtained.

During the year there was cut and housed 125 tons of ice, the full capacity of the ice house.

The average removal of the preliminary filters was 81 per cent. of the bacteria, incubated on gelatin at 68° Fahr., 74 per cent. of the acid colonies incubated on litmus lactose bile agar, 72 per cent. of the turbidity and 10 per cent. of the color. The efficiency of the filters was lowest during the winter months; the average removal of the bacteria incubated on gelatin from Nov. 1 to April 1 was 70 per cent., and for the remainder of the year 88.3 per cent. Twice during the year the entire sand layers in these filters was ejected, washed and replaced.

The average effective size of the sand in the preliminary filters is 0.45 mm. In December, 1909, a sand of an effective size of 0.65 mm. was placed in Filter No. 9. This sand has proven more advantageous, giving as great efficiency as the finer sand, and materially lengthening the runs and reducing the required wash-water. The average length of run for the past year of preliminary Filter No. 9 was 55 hours, the average rate 79,300,000 gallons per acre per day, and the wash-water percentage of the gross yield 2.6. It is proposed to equip one preliminary filter with sand of an effective size of 1.2 mm., with a view of determining that size of sand which will operate most economically and maintain the standard of efficiency desired.

Commencing on Nov. 19, 1910, and continuing throughout the year, hypochlorite of lime has been applied to the effluent of the slow sand filters. The average application has been 0.35 part per million of available chlorine. This treatment was used as a safety factor during the cold months, and was continued during the summer, in order to determine whether by such treatment the number of cases of typhoid fever and diarrhoeal diseases could be diminished. Owing to the large number of factors entering into the causation of these diseases, it is impossible to determine from one season's record whether such effect has been produced. Before a definite conclusion can be reached, the application of bleach will have to be continued for a period of two or three years.

With the help of sterilization the average removal of bacteria, gelatin count, between the influent of the slow sand filters and the pure well has been 99 per cent.

The average number of bacteria sent to the city for the year was 39 per cubic centimeter, with a maximum average for November, when hypochlorite was used but half the month, of 183 per cubic centimeter, and a minimum average in the month of August of 4 per cubic centimeter.

The cost per million gallons of delivering filtered water to the consumers of Albany is subdivided among the following items: Pumping station expenses, $2.64; sedimentation basin, 3 cents; preliminary filters, 53 cents; slow sand filters, $1.04; laboratory, 53 cents; hypochlorite plant, 26 cents; superintendence, 29 cents; total, $5.32 per million gallons of water filtered.

ACCIDENTS IN BUILDING WITH REINFORCED CONCRETE.*

By Dr. F. von Emperger, Vienna.

(Translated by C. Salter.)

Experiments in which accidents in the course of building are brought about by design are known to be capable of affording valuable information on the properties of materials; and thus an accident during building also forms a material test, carried to the point of rupture and furnishing particulars of a defective property of the material. It is naturally to the general interest that these tests should be confined to the laboratory and we believe therefore that these experiments and the increased knowledge gained thereby on the building materials and their coaction form the means whereby accidents in practice may be prevented. In order, however, to ascertain what are the points on which our knowledge is capable of improvement, and where experimental investigation should begin in order to attack the problem effectually, we must endeavor to trace the main origin of these building accidents and find in what their causes consist. The same dual task had to be faced in drawing up the report on building accidents, presented to the Brussels Congress in 1904. The inadequacy of private means for an exhaustive representation was expatiated upon in that report, and the desire was expressed that a clearer insight into the circumstances of the case might be afforded by the aid of unimpugnable official statistics.

---

* Paper delivered to International Association for Testing Materials.

This endeavor, the primary aim of which is the prevention of accidents, has, in the meantime, been able to record an important success, inasmuch as two countries have given effect to the aforesaid wish of the Congress by introducing a system of official reports, thereby creating an unimpeachable basis for further work of the kind. This was affected in a particularly thorough manner in Germany by an ordinance issued by the Minister of Public Works on 18 September, 1911, which, at the outset, was applicable only to Prussia (see "Beton und Eisen," 1911 p. 361).

This ordinance not only prescribed the procedure to be adopted in all kinds of building accidents (and therefore including also such accidents as, not being attended with any injury to life or limb, were not previously subjected to any jurisdiction), but also ensured competent judgment, by providing a list of experts, whereas the pre-existing reports on building accidents were not only very imperfect, but had also been drawn up, as a rule, by persons more or less unqualified for the work.

A similar, though less detailed ordinance was issued by the Austrian Ministry of Public Works at a somewhat earlier date, viz., on May 8th, 1911, (see "Beton und Eisen," 1911, p. 449). These two important ordinances fulfilled a principal wish expressed in the report of the Brussels Congress in 1906, in this connection, and at the same time created an influential example. At all events they have restricted the system of private reports to the other countries exclusively.

Since the date of the last report, only a few accidents, of little importance, have occurred to excite general attention. In view of the circumstance that these have all been reported in due course in the columns of "Beton und Eisen," the author considers it unnecessary to recapitulate them here, more especially since the published reports lay no claim to completeness, and in many instances are derived from sources that are not always reliable.

One of the chief causes of such accidents has always resided in imperfect knowledge of the material at the same of removing the false work of the concrete, since, in view of the divergent influences to which the material is exposed in building operations, the quality of the material can only be imperfectly judged in the laboratory; or also because, in the absence of any connection between the laboratory and the building site, the material has actually escaped any checking. It has happened, for instance, that the false work has been taken down from concrete which had been spoiled by frost or checked in its development, although the regulations laid down for ordinary average conditions have been strictly complied with, and that the premature dismantling of the false work had [illegible]. Moreover, it has [illegible]

[illegible] the most [illegible] perhaps, at [illegible] builders do not always possess the warning consciousness of danger at the time when the latter is most imminent. For such contingencies, the present writer has found a trustworthy and proved auxiliary* in the form of check — or test beams, which enable one to ascertain, in a simple and reliable manner and on the spot, whether the concrete of a structure is quite ready for the falsework to be taken down, or whether that operation should be delayed, The use of this auxiliary is strongly recommended when building operations are being carried on under unusual conditions, especially in autumn and winter; also in excessively hot weather and when unknown material is being used; and a warning must be uttered against the assumption, so frequently expressed, that an experienced concrete layer can judge concrete by touch. For instance, I have, on several occasions on which specimens of sand and gravel have been rejected, or declared, from their appearance, as bad, by experienced men in the trade, obtained fundamentally different results by means of the test beam. How much less is it possible to determine the influence of cold on the concrete from its external appearance only. For the purpose of affording a thorough check on concrete, I have applied and tested this method (for a description of which, see "Beton und Eisen," 1903) during several building operations in Vienna in 1910; see more especially, Kromus: "Die Betonkontrolle beim Neubau des k. k. Kriegsministeriums in Wien" ("Benton und Eisen," 1911-12) and also an exhaustive description by G. Neumann: "Eine Güterprobe für Beton, System Dr. F. von Emperger," ("Forscherheft" XLI.).

Taking all these circumstances into consideration, the further continuance of the system of making private reports does not seem advisable; and it is recommended that the German and Austrian official representatives should be approached, in order that a report from official sources may be available for the next Congress. The wish might also be expressed that the other States would follow the example, and by means of these facts, afford a comprehensive review of the measures to be adopted for the prevention of building accidents. The matter would become more complicated and important by the inclusion of the Latin countries, such as France, in which there is no stringent building-police supervision, at least of the kind customary in the Germanic countries. It would furnish an opportunity for comparing which of the methods gives the best results, or in which respect they have an improving influence on the contractor, if the statistics were compiled in an approximately uniform manner. The question at issue is whether a high condition of independence and the consequent feeling of responsibility are able to replace the present extensive but always insufficient supervision, or not. The matter of uniformity of the reports demands an international pronouncement, which, however, is only possible on the occasion of our congresses; and it would be desirable if this could be brought about by the time of the next congress.

As one of the most important measures in connection with the widening of our knowledge on the matter in question, the fostering and extension of experiments in building-mechanics in general and in their simplest, and therefore so important form, namely, the test beam, are warmly recommended to all interested in the matter. It would also, in the first place, be desirable that reports on the use of the test beam in practice should be presented to the next congress.

---

* "II. Bericht der Tagung der höheren deutschen Baupolizeibeamten," Berlin, 1911, published by W. Ernst & Sohn.

SOME NOTES ON BAND CONVEYORS.

By F. Tissington.

(FOURTH ARTICLE.)

One of the most recent developments in the details of these conveyors consists of a special type of carrier, or roller sets. The idea consists in making each individual roller complete in itself with supports, spindle and bearings, and these are then arranged in twos, threes, fours, etc., to make up a complete carrier for any width of band.

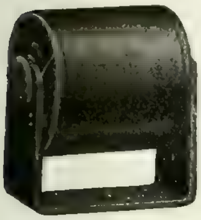


Fig. 18.

Fig. 21 shows a section of a conveyor as made by the Jeffrey Manufacturing Company. This indicates the general appearance of the rollers, and it will be noticed that the three rollers forming the troughing set are each supported in their own bearings.

Fig. 22 is of a similar character, but includes a set of guide rollers such as were referred to in a previous article. This figure is also by the above firm.

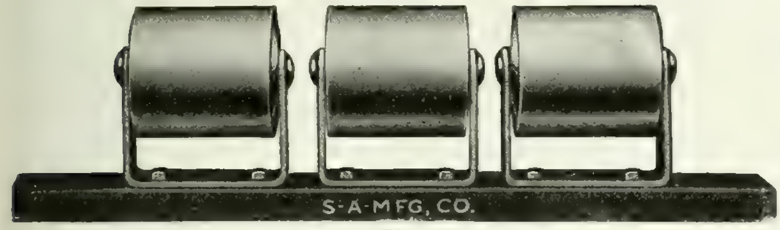


Fig. 19.

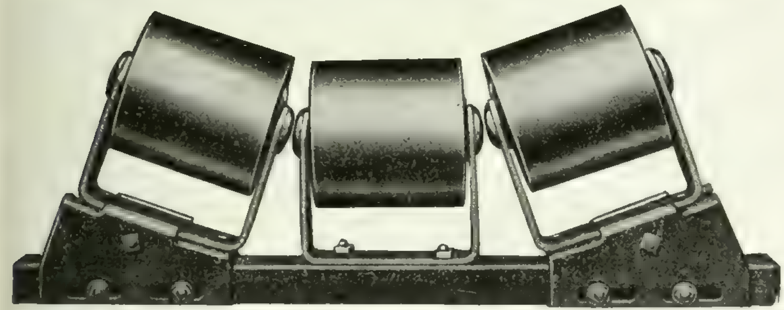


Fig. 20.

Figs. 18, 19 and 20 show carriers as made by the Stephens-Adamson Manufacturing Company.

The first illustration depicts one of their new unit sections which are arranged to suit both the carrying and return sides of the band, and may be with equal facility used for either flat or troughed bands without any alteration in the unit of any kind. The manner in which this is accomplished is seen in the last two figures, viz., 19 and 20.

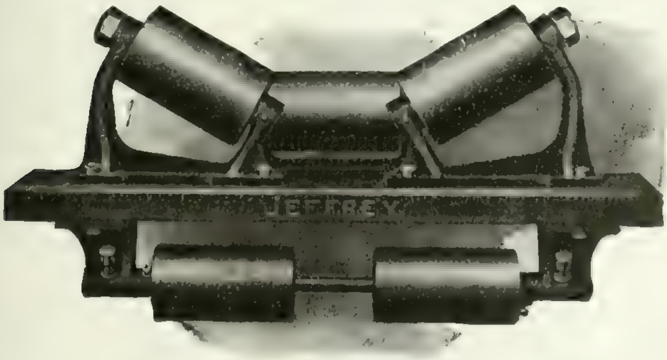


Fig. 21.

If a wider belt is required it is only necessary to add more units to make up for the increased width.

The advantages to be gained with the use of this style of carrier are fairly obvious.

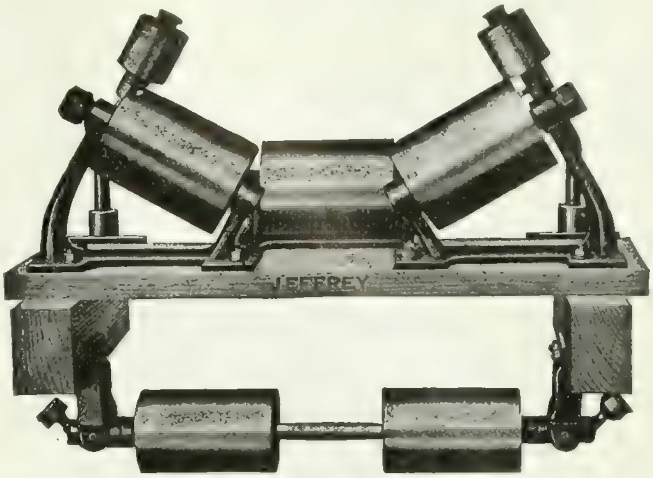


Fig. 22.

(1) Similarity of design for all belts, both flat or troughed, enables a few spares to be kept in stock which will suit any number of conveyors.

(2) If it is found necessary to alter the width of a band, the old style of rollers would be useless, but with these unit rollers all that need be done is probably a little resetting and increase of the number, and the belt will be quite as perfect as it was in its original state.

(3) Probable lessening of the cost of manufacture due to all the parts being alike, but on this point the author has no figures available.

In addition to these points Messrs. The Stephens-Adamson Manufacturing Company state that their rollers are practically dust-proof and indestructible, and further, owing to the method of construction the rollers are much lighter than the other type.

Another advantage claimed is a saving in power, and the makers state that for a flat level conveyor using this type of carrier 40 per cent. of the power required for a conveyor of the old type would be saved.

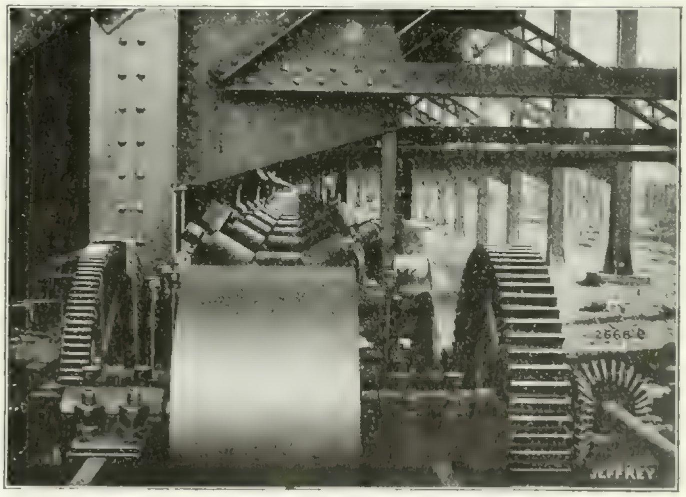


Fig. 23.

This appears to the writer to be rather a big amount and he assumes their figures are based on a conveyor running light, so that the actual percentage of saving on a conveyor fully loaded would be something less than this.

Fig. 23 shows a typical arrangement of the driving gear of a modern conveyor. It will be seen that the motive power is supplied by a shaft running parallel with the length of the conveyor, and this is transmitted by a pair of mitre wheels to a shaft at right angles, and thence through straight teeth cast iron gear wheels to the drum shaft.

Fig. 24 gives a very good idea of the general layout of a band conveyor installation, and shows two bands conveying stone.

The last two illustrations have been supplied by the Jeffrey Manufacturing Company.

The rapid strides that have been made in the manufacture of these conveyors during the last few years is very apparent to all those in any way connected with their use and with the improvements made and decrease in the cost of manufacture their field of usefulness has been extended into practically every branch of manufacture.

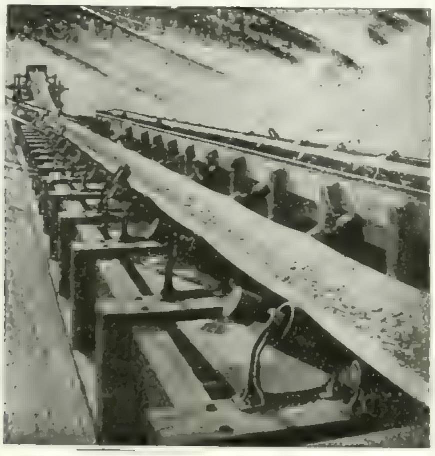


Fig. 24.

In conclusion, the writer would like to impress upon purchasers of this type of machinery that the great point to aim at is simplicity in general outline and details. Then, after buying a good conveyor, spend a reasonable amount on same for attention, such as oiling, overhauling and cleaning. If this is faithfully carried out the best results will be obtained, both as to efficiency and maintenance.

◆

EXTENSION TO WINDSOR STATION, MONTREAL.

Improvements in train departure and in handling crowds have been under way for some time in the Canadian Pacific Railway depot in this city. Two of the new tracks are now in use and a third track is rapidly nearing completion. The work on the new building is being pushed ahead with all speed and the workmen engaged in demolishing the wall of the old building [illegible] the old [illegible] are now [illegible] the foundation.

◆

GREAT BRITAIN'S CONTRACTORS SUCCESSFULLY COMPETE AGAINST FOREIGNERS.

A firm of British engineers, in competition with [illegible] firms in the United States has secured the contract for the steel work [illegible]. The length [illegible]

BITUMINOUS ROAD SURFACES.

In a paper before the American Society of Civil Engineers, Mr. A. W. Dean takes up the question of superficial coats of bituminous material with or without stone for road surfaces.

Bituminous pavements of various types have been in use for many years, whereas bituminous surfaces are of recent adoption. The early superficial applications of oil were made largely for the purpose of dust prevention on dirt roads, a crude light oil being used, having very little binding quality. The advent of motor-vehicle traffic, however, has led to a very extensive use of bituminous surfaces, not only for the purpose of dust laying, but for the preservation of the roads. As a natural consequence, many experiments have been tried by road authorities to determine what methods and materials are best adapted to overcome the difficulties encountered, and by producers to determine what quality of bituminous material can be manufactured at a minimum cost to meet the requirements of the road authorities. Being still in the experimental stage, final conclusions regarding methods and materials are obviously impossible. It has been clearly demonstrated, however, that no uniform specification can be adopted defining a material which will produce a good bituminous surface on roads of every type and under every condition of traffic. Experience has shown, for instance, that while a heavy refined tar may be used to advantage on a macadam road, it is of no value as a surface application on an ordinary gravel or dirt road.

For surface treatment of dirt roads, a light oil helps somewhat to preserve the road, in that it prevents the particles composing the surface from blowing away, and assists, to some slight degree, in hardening the surface.

For surface treatment of gravel roads, the best results appear to be obtained by using an asphaltic oil of what might be termed medium viscosity, or by approximating the maximum viscosity that will permit application through an ordinary distributor at a temperature of 50 degrees Fahrenheit.

For surface treatment of broken stone roads, a light or medium oil acts mainly as a dust layer, yet if frequently applied it preserves the road to a very appreciable extent. In determining what bituminous material would be the most economical and advantageous for the preservation by surface treatment of broken stone roads, a knowledge of the traffic over the road is absolutely essential. If the road is subjected to light motor-vehicle traffic and light team traffic, with the motor vehicles predominating, experience has shown that an asphaltic oil, of such viscosity that it requires heating to at least 250 degrees Fahrenheit before application, forms a bituminous surface which withstands the traffic and thoroughly preserves the road for a period of time depending partly on the quality of the material and workmanship and partly on the quantity of traffic.

Chemists do not agree unanimously on definite requirements for bituminous materials to be used for surface applications, and, as this method of treatment of roads is of such recent practice, it is probable that at least two years more must elapse before positive specifications can be drawn. Producers claim that the best oils for the purpose contain 90 per cent asphalt. Residuum oils placed on roads in Massachusetts early in the season of 1909, still show life, and an indication of durability for a considerable time to come, and this fact would show that, while natural asphalts may possibly be superior, the residuum asphalts are, nevertheless, suitable for the purpose.

Fully as important as the quality of the bituminous material is the quality of the workmanship in applying it. In the preparation of the broken stone surface, extreme care should be taken to sweep and remove every particle of dust and dirt, so that the stones will be absolutely bare. Many failures of bituminous surfaces can be traced directly to the improper preparation of the broken stone surface, the heavy oils being distributed on dusty and dirty sections, and, consequently, peeling up through lack of adhesion. In order to get the best adhesion of asphaltic oils, it appears that the stone surface should also be somewhat moist ratner than extremely dry. In distributing the oil, if the stone surface is comparatively new and smooth, the best results appear to be obtained by applying the oil under pressure in two applications, each of ¼ gallon per square yard, covering the first application with grit or pea stone before putting on the second, and covering the second application with the same material as soon as possible after it has been made. The effect of applying the material in this manner is to make the distribution more uniform and prevent surplus oil from flowing on the sloping crown of the road, thereby causing ridges and bunches to appear after the work has been done. If the stone surface is full of slight depressions, however, a single application of ½ gallon per square yard, applied with or without pressure, has proved satisfactory. The oil tends to run to the depressions, causing a slight surplus of oil in them, so that when the grit is applied on top of the oil, the portions over the depressions absorb more grit, consequently rendering the road smoother.

The character of the grit or other material used for covering the oil is of great importance. Where the traffic is confined exclusively to motor vehicles, sand appears to be as effective as any material for covering, but if there is some steel-tyred horse-drawn traffic, a coarse material like pea stone or fine gravel is necessary.

The cost of a bituminous surface as just described will vary, of course, with the availability of the material to be used for covering, and the length of haul of all materials. In Massachusetts, during the last four years, several hundred miles of macadam road have been improved or preserved by a bituminous surface of this kind. The average cost during 1910 was a little less than $0.08 per square yard, and, during 1911, a little more than that price, with labor costing from $1.75 to $2.00 per 8-hour day, and asphaltic oil costing $0.06 per gallon delivered in cars.

In maintaining these bituminous surfaces a re-treatment of about ¼ gallon of bituminous material per square yard is only made on those places from which the bituminous material has disappeared. The present condition of these roads indicates that the expense for patching and sanding in 1912 will not exceed $0.01 per square yard, in which case the total expense of maintenance for four years will have been $0.1076, making the average cost $0.0269 per square yard, or approximately $236.72 per mile per year for a 15-foot road. Whether such a surface on a macadam road will withstand the traffic of heavily loaded motor trucks cannot now be determined, as such trucks have not been in service sufficiently long to permit of determinations.

On roads where the prevailing traffic consists of steel-tyred horse-drawn vehicles, this application of bituminous surface, consisting of heavy asphaltic oil and grit, has proved unsuccessful, in most instances, the surface being cut and dented to such a degree that it soon disappears. On such a road, it is possible that a heavy, refined tar surface may be economical, or it may be economical to use oil of a lighter grade, applying it with sufficient frequency to keep the surface of the stone covered with oil at all times.

EXPERIMENTS ON CONCRETE WATER BARRELS AS APPLIED TO FIRE PROTECTION OF RAILWAY BRIDGES.

By Hunter M'Donald.

The maintenance of water barrels for fire protection on bridges and trestles may seem to the uninitiated to be a comparatively small matter. To the person upon whom the responsibility for their maintenance and efficiency rests the matter presents an entirely different aspect. To be efficient, water barrels must be kept full of water and be easily accessible, which essentials entail the following requirements:

The water must not freeze; the barrels must not leak; the water must not evaporate or be drunk by cattle; frequent inspections must be made; the barrels must be filled when installed and frequently refilled; the barrels must be placed at proper intervals for effective use in case of fire; they should be provided with small cans or vessels, in which the water can be carried to the point where it is needed.

The principal damage other than fire risk, caused by freezing, is that it makes the barrels leak. This can be prevented to some extent by fastening in the barrel a stick running in a slanting direction from near the top to the bottom. The addition of salt will, of course, lower the freezing point, but will not prevent freezing. The only consolation to be derived from frozen water barrels is the fact that fires in bridges are not likely to occur in freezing weather.

Where water barrels are completely buried in the earth at the ends of the trestles, they seldom leak until the wooden staves become rotten, which occurs in about four years. If wooden barrels are not buried they require frequent refilling If carefully covered to prevent evaporation, the interval of filling is lengthened. Should the water in the barrel get low from any cause, the barrel is usually permanently injured by having the tops of the staves dry out—a condition very difficult to remedy. A prolific cause of leaky barrels is the tendency of the idle man or boy with a gun to use them for targets. Axes and hammers are sometimes used as a means of destruction.

Barrels must be substantially covered to prevent evaporation. When tight barrels are buried at the end of the trestle and well covered, refilling is seldom needed more than once a year. Covering is also necessary on account of the tendency of cattle in the dry season to drink the water up. It seems impossible to cover them so tightly as to prevent large crops of mosquitoes from being raised. Barrel covers which sink below the outer rim of the barrel are very advantageous, as they catch all the rainfall and allow it to run into the barrel. Where no leaks occur, this is sufficient in many climates to keep the barrels full.

Unless inspections of the barrels are made at frequent intervals by a responsible officer, they are likely to go to pieces early and be absent or empty at the time most needed. It is not sufficient for the inspector to merely call attention to the defects, but each one should be followed up immediately and remedied.

When barrels are first installed, they should be filled by the party installing them; after this, they should be given over to the section foreman, whose duty it should be to keep them properly filled.

Water barrels can be effective only in the incipiency of a fire. More effective means must be had when the fire has assumed some headway. How to get the water out of the barrel and put it on the fire is a question. On some divisions oyster and tomato cans are sunk to the bottom of the barrel or fastened to the underside of the top by a wire. Sometimes an old paint bucket is used and sometimes a box made of heavy plank. The object is to use something that nobody wants to take away. It is almost impossible to maintain such vessels in the barrels, and the best way is to assume that the person who discovers the fire will use his hat, shoe or something else until organized help arrives. In studying the water barrel question the concrete barrel has come in for its share of discussion, and two experimental barrels were made two years ago. They have the self-feeding top—that is the top is depressed so as to catch the rain water. Neither has required refilling. Both have proved themselves to be proof against bullets fired from a 38-calibre revolver. Below is a table of the estimated cost of making these barrels:

---

* From a paper presented before the Engineering Association of the South, January 22nd, 1912.

Covers:		
Galvanized iron, 5 square feet at 3 cents..	$0.15	
Hinge, bolts, rivets and wire, 5 cents....	.05	
Cost of making, one man one hour.......	.20—	$0.40
Barrel:		
17 square feet expanded metal (0.6 pound, a foot) at 5 cents	$0.51	
10 cubic yards 1:2:4 concrete at $2.40....	.24	
Cost of forms (assuming twenty-five barrels to one set)	.10	
Cost of labor for making barrels at 15 cents	.30—	1.15
		$1.55
Add 10 per cent. for engineering and incidentals..		15
Total cost		$1.70

Another experiment has been tried, consisting of a concrete box let into the ground all but about one foot, this upper part being used for the number of the trestle.

It is believed that good concrete water barrels, with metal tops, can be made for $1.30 each when made in large quantities. The wooden barrel is the most expensive of the two, considering its capitalized cost on a basis of six years' life, which is reasonable, leaving out all consideration of increased cost of maintenance.

Other experiments have been made, using galvanized iron forms, and poultry netting reinforcement. Plastering the mortar on has not resulted in tight barrels, but 1:2:4 concrete cast and rammed into forms has given good results. Experiment is also being made with joints of 24-in. clay pipe with concrete bottom, with the bell set upward and buried in the ground.

The ballasted deck trestle is rapidly becoming the [illegible] and it is thought that in the future the water barrel will seldom be needed.

◆

AMERICAN TEST OF WIRE ROPE.

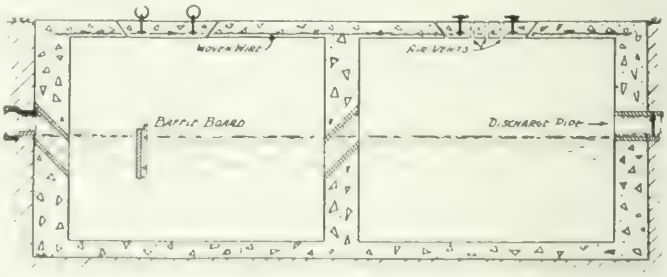
[illegible] test? (Some authorities believe this to be superfluous) and [illegible] of abrasive tests? (6) Biggart, Stone and others have proposed and made tests in which the life of cables, and other properties, are investigated by passing them over a series of pulleys direct and reversed, the cables being subject to different direct tensions. What is the relative value of such tests, and how should they be carried out? (7) Samples of cables have been taken under actual service conditions after a number of years' usage in mine or elevator service, and tests compared with the unused original material. Is anything in this line desirable? (8) Are any other physical tests necessary (9) Chemical tests will be made. What are the suggestions in this respect (10) What number of duplicate tests is suggested for any one type or specimen? Tetmajer used two in his tests. Three would seem more desirable. For the individual wires he used eleven. Would not a lesser number, say six, be sufficient?

◆

SEWAGE DISPOSAL FOR COUNTRY HOMES.

The general use in country homes of the modern conveniences of the bath and toilet has made necessary some effective and inexpensive means of disposing of the sewage. Otherwise the drinking water will be polluted and the health of the family endangered. Entire satisfaction is obtained by the use of the septic tank, which is nothing but a long water-tight cistern through which the sewage passes very slowly and evenly. The purified sewage may be discharged into an ordinary farm drain tile.

Although the odor from a small septic tank is practically unnoticeable, yet it is best to locate it at least a hundred and fifty feet from the house. Choose a spot where it can be sunk to ground level and will be out of danger of flood waters. The tank should be large enough to hold the entire sewage for one day. For a family of eight to ten, plan a concrete tank of two compartments each 4 by 4 by 5 feet long. Since the top and bottom are each 4 inches thick and the division and sidewalls 8 inches, dig the pit 4 feet 8 inches deep, 5 feet 4 inches wide and 12 feet long.



Cross-Section Through Tank.

If the ground stands firm, only inside forms will be needed. Make two, each 4 by 4 by 5 feet long. Old 1-inch lumber will do for the siding. The compartment into which the sewage first enters is called the "charge tank." In each end of the wooden form for this tank cut openings for a 5-inch tile with the lower edge of the hole 10 inches above the bottom of the form. Through each of the sidewalls of this same form, [illegible] inches from the [illegible] end and 1½ and 2 feet above bottom, bore 1-inch holes and insert in them greased wooden pegs extending 4 inches into the future sidewalls. Likewise, in the other form for the discharge tank, cut openings for a 5-inch tile, this time with the lower edge of the hole [illegible] feet above the bottom.

Mix the concrete one part Portland cement to two parts sand to four parts crushed rock, or one part cement to four parts of gravel. Place the 4 inches of concrete in the bottom and trowel to an even surface. Immediately set the forms in place so as to leave room for 8-inch division and sidewalls. Fill the forms with mushy wet concrete. At the proper heights insert the 5-inch drain tile through the holes in the forms. Be careful that the outside end of the inlet tile to the charge tank is 2 feet and its other end 16 inches above tank bottom. The pipe leading from the charge tank is also set at the same sharp slope. The outlet tile from the discharge tank is 2 feet above bottom and with both ends level. By this arrangement of pipes, the sewage is kept in the tank to the depth of 2 feet and the ends of the tile in the charge tank are trapped or air-sealed, which aids the activity of a certain kind of bacteria. Likewise, other bacteria are developed in the discharge tank by means of the free circulation of air through the discharge drain tile and holes in the manhole cover.

After the sidewalls are three days old, floor over the top of the forms and prepare to lay the 4-inch concrete top. As molds for the manhole covers, have the tinner make two round bottomless dishpans, 18 inches in diameter at the bottom and 24 inches at the top. Grease these tin molds and set one on the wooden floor over each compartment. Bore six 1-inch holes in the floor inside the one manhole mold over the discharge tank and insert in them greased pegs projecting upward six inches.

Place one inch of concrete over the entire floor and at once lay on it, crosswise the tank, strips of heavy woven-wire fencing 5 feet 2 inches long, or ⅜-inch rods running in both directions and spaced one foot. Likewise reinforce the manhole covers. Immediately place the remaining 3 inches of concrete and do not stop until the tank top and manhole covers are finished. Provide two lifting-rings for each cover by setting in them halves of old bridle-bits, or hitching-post rings, fitted with knobs of wire or with nuts and large washers. If a square wooden manhole mold is used, the concrete cover cannot be cast at once. In such case, carefully remove the wooden manhole form five hours after the top has been finished. Three days later mold the cover the same as for the tin form with this important exception—place heavy paper or cardboard around the edges of the opening to prevent the fresh concrete of the cover from setting to the old concrete.

When the top of the tank is ten days old, lift off the manhole covers, saw openings in the wooden top and remove the forms. In the holes made in the sidewall by the greased wooden pegs, insert ½-inch bolts and set them with mortar. To these bolts fasten the 1 by 12-inch wooden baffle-board which extends across the tank and breaks up the current of the inflowing sewage. To carry the sewage from the house to the tank, use 4-inch sewer pipe laid with tight mortar joints. Connect the discharge end of the tank with a string of drain tile.

The materials required for the tank described above are 5½ cubic yards of crushed rock, 2¾ cubic yards of sand and 9 barrels of Portland cement. If good pit gravel is used, no additional sand will be required.

When the septic tank is two weeks old it may be put to use. It will need cleaning at intervals of two to three years. By its use the health of the family will be protected and life in the country home will be made much more comfortable.

◆

A NEW LINE OF BLOWERS DESIGNED FOR TURBINE DRIVE.

It is an established fact that turbines driving pumps or blowers in power plant service, where the exhaust is used to heat feed water or for steam heating, are more economical than the main driving units, even if these are run condensing. With the exception of a slight loss through radiation, what heat is not converted into mechanical work is either returned to the boilers or utilized, so that the heat efficiency closely approaches 100 per cent. This certainly commends turbo-auxiliaries as economical as well as reliable to maintain overall plant efficiency.

However, as is well known, turbine power increases with the revolutions per minute up to a best speed that is invariably higher than that of ordinary turbine pumps or ordinary blowers. The writer has in mind a small steam turbine that develops 15 brake horsepower at 1000 r.p.m. and 40 horsepower at 3500 r.p.m. with the same pressure and total steam per hour. A larger turbine of another type develops 80 brake horsepower at 600 r.p.m. and 160 brake horsepower at 1600 r.p.m. with the same pressure and total steam per hour. The best pumps or blowers for these two turbines would therefore be the ones having economical speeds close to the higher turbine speed figures in each instance.

With these considerations in mind, Mr. C. V. Kerr, inventor of the original Kerr Turbine, has designed, and McEwen Brothers of Wellsville, N.Y., are now marketing a new line of pumps and blowers for turbine drive, having best speeds practically the same as those for the turbine and having an economical range within 25 per cent. above, to 25 per cent. below, rated capacity.

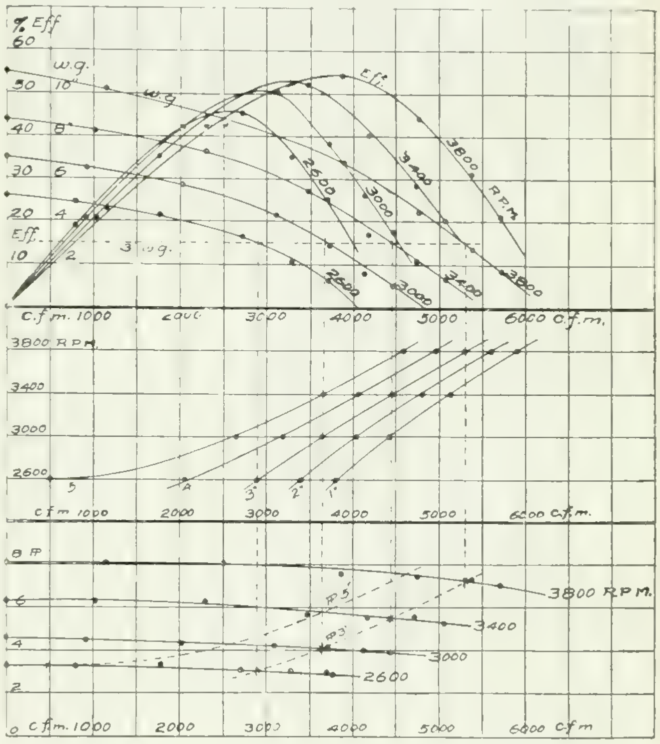


Fig. 1. Test of 16-in. Blower with helical impellers.

The blowers, are built in two types, the smaller sizes with double helical runners and the larger with increase pitch propellers. The manufacturers claim for both types a unit economy or steam per air horsepower better than ever reached before, especially on forced draft pressures. Both types have the runners opposed and balanced for high speed and have a central deflector to prevent cross flow. The runners are removable endwise and may be reversed on the shaft for right or left hand discharge. The bearings are lead-bronze, or babbitt lined, ring oiled and dust proof. The helical runner type has a solid cast-iron volute, and the propeller type is made with cast-iron sides and steel volutes.

The former, is designed especially for forced draft for forges and furnaces and in connection with underfeed stokers. Tests on a 16-inch blower of this type, and made with a calibrated steam turbine, Pitot tube and a series of nozzles showed the results indicated in Figure 1.

The propeller type blower, shown in Figure 2, has blades with an increase-pitch helical surface to reduce the shock losses due to impact at entrance. The kinetic efficiency of these blades is said to be high and in connection with the volute casing, reduces the discharge velocity to produce pressure instead of eddies which decrease the efficiency and delivery pressure of an ordinary disc fan.

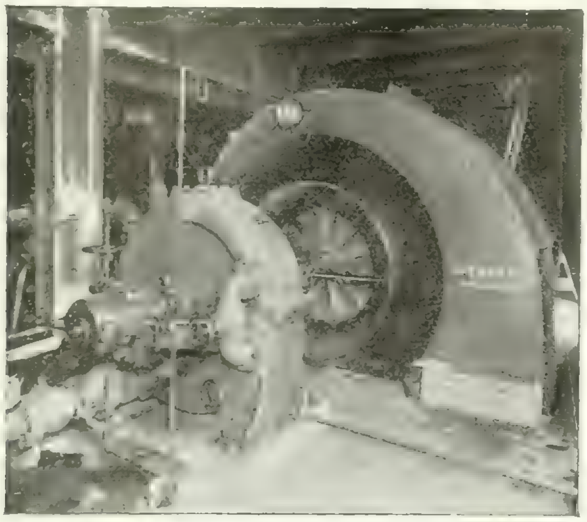


Fig. 2. Blower in the plant of the Brooklyn Edison Company, Maximum capacity, 80,000 cubic feet of air per minute at 4-in. total water gauge and 1500 r.p.m.

Losses from back flow are prevented and a strong construction assured by dovetailing the blades into a solid hub. It is evident too that as the pull of centrifugal force is radial there is practically no blade distortion at high speed. A [illegible] at any number of points on the line of [illegible] and running at the same setting [illegible] producing different pressures [illegible] the same speed and [illegible].

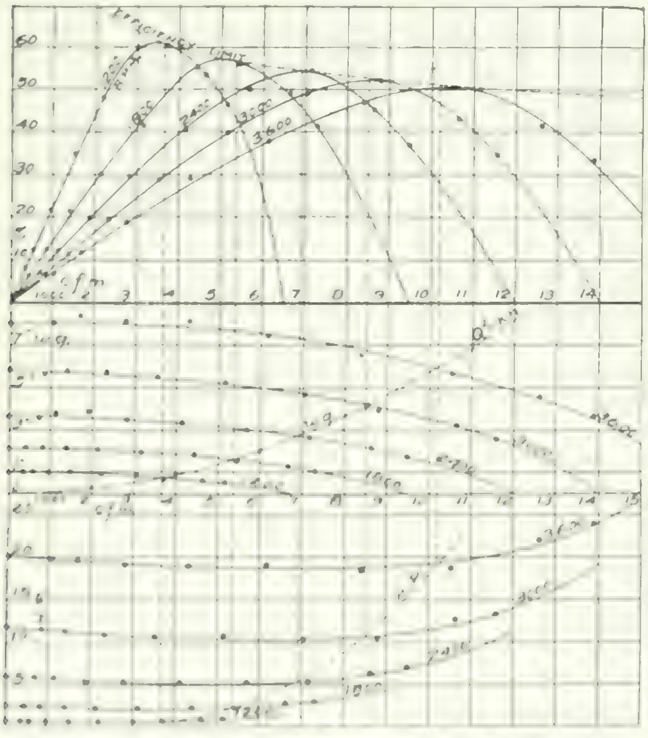


Fig. 1. Test of an 18-in. Propeller Blower.

The performance of a blower of this type, the smallest of the series offered is shown in Figure 3.

These tests also were made with a calibrated turbine, Pitot tube and a series of nozzles at the end of a duct. The smoothness to which the points plot can be taken as an indication of accuracy of observation. The relation of the parabola of highest efficiency, $Q^2=KH$, (Q=quantity, H=head, K=constant), to the dot at the top of efficiency curve located by the same nozzle in each case is worthy of note. This suggests that if the discharge connection is reduced to the proper area the blower can be operated always at highest efficiency, regardless of speed. Beyond this throat the duct should be expanded to reduce velocity losses.

The head or pressure curves show the facility with which a number of these blowers can operate in parallel on the same duct, and how rapidly the dischage increases at constant head with increase of speed. The variation of power required as the blower is worked along the path of highest efficiency is also worthy of note.

Incidentally, the test results show that this blower, developed especially for forced draft work, is practical with either steam turbine or motor drive. On account of high efficiency and noiseless running at required pressures this blower is also useful for heating and ventilating service, including mine ventilation.

◆

THE STRENGTH OF CROSSARMS.

The strength of crossarms has been tested by the Forest Service of the United States and it was found that for all ordinary pole-line conditions the crossarm is stronger than the pole. The arms tested were of Douglas fir, long-leaf pine (50 per cent. to 100 per cent. heart), short-leaf pine (plain and creosoted) and white cedar. The arms were about 3 x 4 in. in section (somewhat varying) and 6 ft. long, with three 1½-in. vertical pin-holes on either side of the centre. The two inner pin-holes were each 8 in. from the middle. For the test the crossarm was gained and bolted to a short piece of pole and the outer end of the attachment bolt was supported by an iron strap bracket. Vertical load was applied by the testing machine acting on a series of distributing levers, which brought equal load to bear on rods passing through the six pin-holes. The maximum load which the crossarm carried ranged from 4,800 to 10,240 lb. (based on a standard section of 3.16 x 4.10 in., the average size of Douglas fir arms). The crossarms of long-leaf pine were strongest, ranging from 9,000 to 10,240. Douglas fir and short-leaf pine were slightly weaker. White cedar showed a strength of only about 5,000 lb.; the failure in the case of white cedar was in nearly all cases a brash tension failure. In each case the corresponding lateral strength of the arm would be about 80 per cent. of the vertical strength, or about 4,000 lb. for the white cedar crossarm. Since tests of poles have shown that their resistance to side pull is rarely as high as 3,000 lb., and usually below 2,000, it is seen that the crossarm is the stronger. The values above given are all averages of a considerable number of samples.

The compressive strength of the wood in these crossarms ranged from 4,700 lb. per sq. in. for the white cedar to 9,000 lb. for the better samples of long-leaf pine and about 7,000 lb. for Douglas fir. Short-leaf pine ranged from 7,300 for the plain arms to something below 6,000 lb. per sq. in. for the creosoted arms.

It is concluded that for standard 6-ft. crossarms the question of strength need not enter into calculations of line construction except in rare cases of abrupt change in grade. The ability of the timber to resist decay, and methods of preventing decay, are much more important.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, AUGUST 8, 1912. No. 6

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Bloor Street Viaduct 287
Water Sterilization 287
Another Sewage Disposal Scheme 288

Leading Articles:

The High Tension Transmission System of the Hydro-Electric Power Commission of Ontario. 269
Some Fallacies and Facts Concerning Engineering Works in Great Britain 272
Turbine-Driven Centrifugal Pumps for Waterworks Service 275
Result of Filtration at Albany 278
Accidents in Building with Reinforced Concrete... 279
Some Notes on Band Conveyors 281
Bituminous Road Surfaces 282
Experiments on Concrete Water Barrels as Applied to Fire Protection of Railway Bridges 283
Sewage Disposal for Country Homes 284
A New Line of Blowers Designed for Turbine Drive 286
Programme of the 6th Annual Convention of The Illuminating Engineers' Society 289
The Construction of the Algoma Central and Hudson Bay Railway and the Algoma Eastern Railway .... [illegible]
Port Arthur Water Supply .... [illegible]
Aluminum Overhead Conductors 296
First Report of the Montreal Tramways Company. 297
District Heating Business .... [illegible]
Depreciation and Sinking Funds .... [illegible]
Personals .... [illegible]
Coming Meetings .... [illegible]
Engineering Societies .... [illegible]
Market Conditions .... 24 [illegible]
Construction News .... [illegible]
Railway Orders 74

THE BLOOR STREET VIADUCT.

The following is extracted from a report by Commissioner of Works Harris, of the city of Toronto, to the Board of Control on the proposed Bloor Street viaduct:—

> "We are making a thorough survey of the route adopted for the Bloor Street viaduct, and taking the necessary levels and cross-sections, to enable us to prepare plans and specifications for the proposed bridge. I have gone into the matter thoroughly with Mr. C. W. Power, Engineer of Railways and Bridges, who advises me that a concrete bridge would involve minimum maintenance charge, but that other considerations enter into its construction, which renders it inadvisable to use this material. Extensive bridges of this class are, as yet, an experiment, and we do not think that the city of Toronto should make any investment along experimental lines, especially where the issue is so much in doubt. It is found, frequently, in structural concrete, that the slighting of a comparatively small portion of the work destroys the integrity of the whole structure. **Concrete bridge design is not well understood, while that of steel is upon an assured basis.**"

Mr. Harris surely did not desire that the last sentence of the above should be read literally. If he did mean it, we can only say that Mr. Harris has misunderstood what he has been told regarding concrete bridge design. To the question of whether concrete or steel should be used for the Bloor Street viaduct, we have nothing to say. That is a question to be decided on the local conditions—foundations cost, maintenance, suitability, etc. To the statement of Commissioner Harris that "concrete bridge design is not well understood" we must take issue. The analysis of stresses and the knowledge of the action of concrete is to-day on as high a plane as any other branch of structural design. Commissioner Harris is on uncertain ground when his duties compel him to report on work demanding a knowledge of engineering.

◆

WATER STERILIZATION.

In an engineering contemporary the treatment of drinking water by means of violet ray sterilization, in Chicago, is described. The plant is the initial installation for sterilizing water by this means in a commercial way in America, and it is, therefore, interesting to note what results have been obtained. One of the most interesting features of it has been the experience with air. It seems that the water to be treated must be perfectly free from turbidity, either in the form of solid material or in the gaseous state as from liberated air. Erratic results were obtained with a perfectly clear water until the experimenters one day noticed through the peek-hole of the lamp that the water in the sterilizer appeared cloudy to the eye, although the final product was crystal clear. The installation of a tank to eliminate the air solved this problem. In an $11\frac{1}{2}$-in. diameter sterilizer the proper position for the lamp was found to be $2\frac{1}{2}$ in. from the surface. The brilliancy given to water by treatment with aluminum sulphate seems to be particularly advantageous, in permitting the rays to penetrate the water.

There is some evidence to indicate that violet rays kill spores as well as vegetative bacteria. Ordinarily, a sterile water offers a nidus for a host of harmless organisms, but the analyses of samples taken from commercial bottles at Chicago at various intervals up to a month gave insignificant counts. Such results are manifestly dependent on the care with which the empties are washed. It is to be hoped that further corroborative results on a number of these points, as well as the limits in the rate at which water can be treated, will be obtained. The current cost at this plant is necessarily so low that it is hardly a factor in the total expense.

However, assuming a 110-volt, 4½-ampere lamp capable of sterilizing 150 gallons of water per hour, and estimating the cost of electricity at $25 per kilowatt per year, or 0.3 cents per kw-hour, the cost for 1,000,000 gallons is only $10, a figure not beyond the reach of those who wish a final polish on a water already coagulated, settled and filtered, and who do not care to take the possible chance of a taste and odor due to a chemical sterilization. For small domestic supplies, such as high-class residence towns, hotels and bottled-water service, this new method of meeting the ever-increasing demand for a more safe drinking water will bear study.

ANOTHER SEWAGE DISPOSAL SCHEME.

We noted in last week's issue that the United States Secretary of War had decided to refuse the application of the Sanitary District of Chicago for the right to divert an increased amount of water from Lake Michigan. This question has been up for discussion for some time, and Canadians will be pleased to note the action of the Secretary of War. A new scheme has now appeared, which, if allowed to materialize, would cause ill effects as great as increased diversion of water for the Chicago Drainage Canal.

The municipalities along the Niagara frontier, from Buffalo to Lewiston, in New York State, are investigating the possibilities of joint action with regard to their sewage disposal. It has been suggested that the towns and cities in that vicinity collect their sewage in a trunk sewer tunnel, which would run from Buffalo, on Lake Erie, to Lewiston, on Lake Ontario. As the fall from Lake Erie to Lake Ontario is over three hundred feet, by this means it is expected that about 250,000 horse-power would be utilizable by the installation of a power house at Lake Ontario or on the Niagara River. Leaving aside the practical difficulties, such as irregularity of flow, necessity of a pressure tunnel, and the consequent difficulty in collecting sewage from the towns along the route, etc., the promoters of this visionary scheme neglect to consider the effect of dumping the combined sewage of practically a million people, without treatment, into Lake Ontario. It is extremely likely that a good deal of opposition will develop if it is attempted to carry out the plan. The scheme, on the face of it, looks like a veiled attempt to secure water power privileges for the interested municipalities. No doubt the Canadian Branch of the International Joint Commission and the Commission of Conservation will look after Canadian interests when the right time comes. Their energetic action in the case of the Chicago Drainage Canal diversion cannot be too highly commended.

EDITORIAL COMMENT.

It is stated that President Maurice Connolly, of the Borough of Queens, New York City, has prepared an ordinance providing for a tax of $1 on every funeral cortege which passes through the borough, for the purpose of establishing a fund for maintaining the roads of the borough. The proposed tax would be a revival of a former ordinance covering nearly the same ground. Practically all the convenient routes which lead to the several cemeteries in which the dead of New York are buried lie in the Borough of Queens. The income which would be derived from such a source is estimated to amount to about $100,000 annually. The present state of Yonge Street, Toronto, might warrant the York County Highway Board raising a fund in a similar way. There are four cemeteries on Yonge Street, and no doubt the annual income from such a source would be large. We offer this suggestion to them gratis, if it will in any way help in Yonge Street improvement.

* * * *

Ottawa is reaping the harvest from the council's policy of procrastination with regard to the water supply situation. Two typhoid epidemics in two years would appear sufficient to justify more action and less talk.

LETTER TO THE EDITOR.

CONCRETE FOR THE BLOOR STREET VIADUCT, TORONTO.

Sir,—According to the reports in the daily press the Commissioner of Works of the city of Toronto has recommended the city council to consider only the use of steel in the construction of the Bloor Street viaduct. He is reported to have added to this recommendation some reflections on the permanence of concrete construction which are liable to recoil on his department which, under his predecessor, has been a very successful user of concrete on a large scale, and in some novel and unusual ways. Doubt as to the strength and permanence of the Harbord Street bridge and of the poles of the city's hydro-electric system may be counted on to follow such comment, and we shall probably hear from Pro Bono Publico recommendations for the thorough painting of these and other structures before their permanence is seriously impaired.

It is unfortunate that concrete construction should thus seem to be attacked by one who, from his position, will be looked on by outsiders as an expert. By those who are able to appreciate the magnificent possibilities of concrete work this action will be taken as amusing or deplorable, according as they view it as a personal opinion or as the policy of the engineering department of a large city. By the general public it will be taken either as a sweeping condemnation of concrete or as another instance of the worthlessness of expert advice. In any event, the city council will be well advised if the recommendation is rejected.

Whether concrete or steel is the cheaper material there can be little doubt that from an architectural standpoint a much more pleasing effect can be secured from concrete. There are several steel viaducts in the city of Toronto, but only one of these, the Wilton Avenue bridge, has any artistic merit. The remainder stand as examples of what the bridge engineer can create when cheapness is the first and only consideration. Several of these refuse really to stand, but vibrate to such an extent that the city has given up the attempt to keep them lighted with electric lights. They are a continuous source of expense, and call for frequent renewals of the wooden floors and sometimes call in vain for paint. They were at their strongest the day they were erected and are weaker for every day they stand—concrete built at the same time would now be over ten per cent. stronger. A fine effect is, of course, possible with steel, but Toronto can only show one example in steel, while the

Harbord Street arch and the concrete bridges at Centre Island show what the works department has accomplished in the past in very satisfactorily harmonizing structures to their surroundings.

Great stress is laid on the fact that good foundations must be obtained for a concrete arch, and this elementary engineering consideration is granted. The steel superstructures of the skyscraper office buildings can stand an amount of settlement which would wreck a concrete arch, but they are carried to rock on concrete footings. The foundations of a steel viaduct ought to be at least as secure, and, if made so, can as safely carry a superstructure of concrete as of steel. As a matter of fact, it is doubtful if the foundations for the Bloor Street viaduct would require to be carried as far down as the piers under the C.P.R. building. In the absence of information to the contrary it is fair to assume that only ordinary difficulties would have to be overcome in getting down to depth.

The point has been raised that failures of concrete structures have occurred. Leaving out the "tu quoque" arguments of the failure of brick and steel which prove nothing concerning concrete, the fact need only be emphasized that in every case the contributing cause was outside entirely of the material used—dishonest or unskillful workmanship or design, not poor material.

One argument on which might be poured the choicest sarcasm of a Macaulay flaying a Montgomery is that it is inadvisable for the city of Toronto to take the lead in using concrete for a work of such unheard-of magnitude. With a graduate of Toronto University building the largest steel truss bridge in the world, another responsible for the foundations of most of the office buildings in America and a Toronto engineer building concrete arches unsurpassed for magnitude in Canada, it is time some one awakened the Rip-van-Winkle responsible for this amazing argument. Without leaving this continent for examples we can find one viaduct with foundations going to double the depth required, another of double the proposed height, another of double the length, and still have left the notable achievement at the Florida Keys of one running over two miles over the ocean. If these are too far afield we shall be content to mention that the pioneer work has been done by Port Arthur and that before the Bloor Street viaduct is designed in steel the city of St. Catharines will have one of concrete 70 feet high and 700 feet long.

Were it not for the size and importance of the city of Toronto it would not be worth while to take up this matter seriously. But we have here a case in which steel is to be recommended to the express exclusion of concrete when the latter is necessarily permanent as against the certain deterioration of steel, whence an artistic architectural effect is certain to be obtained in concrete and almost certainly not in steel, and where it is within the bounds of possibility that concrete construction may be cheaper in first cost and is certain to be cheaper if a fair valuation is placed on maintenance expenses.

The Canadian Cement and Concrete Association is not opposed to steel construction and will not oppose steel for the Bloor Street viaduct if a committee of engineers should recommend it. The stand taken by the association is that the city of Toronto has much to gain and nothing to lose by rejecting the present recommendation of the Commissioner of Works and allowing concrete and steel to compete on equal terms for use in the construction of the Bloor Street viaduct.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.
W. SNAITH,
Secretary-Treasurer.

Toronto, August 6th, 1912.

PROGRAM FOR THE SIXTH ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY TO BE HELD AT HOTEL CLIFTON, NIAGARA FALLS, ONT., SEPTEMBER 16th to 19th, 1912.

1. Report of Committee on Progress. This report will deal with the recent progress and developments in the lighting industry both in this country and abroad.

2. A report of the Committee on Nomenclature and Standards, which will deal with certain definitions and terminology of illuminating engineering.

3. "Steel Mill Lighting"—a report of the committee on illumination of the Association of Iron and Steel Electrical Engineers—to be presented by the chairman, Mr. C. J. Mundo.

4. "High Pressure Gas Lighting," by Mr. F. W. Goodenough, chairman of council, Illuminating Engineering Society, London, Eng.

5. "The Status of High Pressure Gas Lighting," by Mr. George S. Barrows. This paper will be a collation of domestic and foreign correspondence pertaining to high pressure gas lighting.

6. "Recent Developments in Gas Lighting," by Mr. R. F. Pierce.

7. "Indirect and Semi-Indirect Illumination," by Mr. T. W. Rolph.

8. "Recent Developments in Series Street Lighting," by Dr. C. P. Steinmetz.

9. "Research Methods," by Dr. E. P. Hyde.

10. "The Problem of Heterochromatic Photometry and a Rational Standard of Light," by Dr. H. E. Ives.

11. "Reflection from Colored Surfaces," by Claude W. Jordan.

12. "Diffuse Reflection," by Dr. P. G. Nutting.

13. A Study of Natural and Artificial Light Distribution in Interiors," by Mr. M. Luckiesh.

14. "The Physiology of Vision," by Dr. T. A. Woodruff.

15. "The Efficiency of the Eye Under Different Systems of Illumination," by Dr. C. E. Ferree. This paper will be a report of a research carried on for the American Medical Association.

16. "A Proposed Method of Determining the Diffusion of Translucent Media," by Mr. E. L. Elliott.

17. "Illumination Charts," by Mr. F. A. Beuford.

18. "The Determination of Illumination Efficiency," by Mr. E. L. Elliott.

19. "An Absolute Reflectometer," by Dr. P. G. Nutting.

20. "Colored Values of Illuminated Surfaces," by Mr. Bassett Jones, Jr. This subject will be presented in the form of a series of experimental demonstrations.

21. One session will be arranged for, a potpourri, at which discussions will be in order on miscellaneous phases of illuminating engineering. It is expected that this session will bring out interesting and valuable points not particularly covered by the above papers and reports.

The scenic wonders of the Falls render possible an entertainment program which will surpass that given at any previous convention of this society.

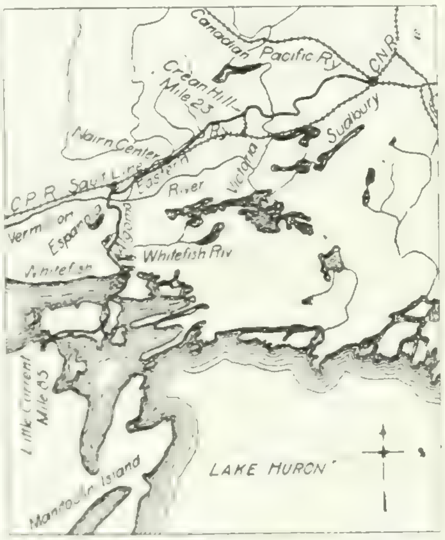
Inspection tours of the power houses and other wonderful development enterprises peculiar to this location have been arranged for.

Reduced railroad fares will be available for delegates.

THE CONSTRUCTION OF THE ALGOMA CENTRAL AND HUDSON BAY RAILWAY, AND THE ALGOMA EASTERN RAILWAY.

By R. S. M'Cormick.*

Algoma Central and Hudson Bay.—The construction of the Algoma Central & Hudson Bay was begun in the spring of 1900 by the Old Lake Superior Corporation, under the management of F. H. Clergue, a land grant and subsidy being arranged for at that time with the Canadian Government. In the spring of 1903 a continuous line had been graded from Sault Ste. Marie, Ont., to Josephine Junction, 170½ miles north, with a line extending down to Lake Superior, at Michipicoten harbor. This section, 20 miles long, was built in 1899-1900 to gain access to valuable iron mines in this territory, owned by the corporation. The grading work on the main line was not completely finished, however, as financial misfortunes overtook the corporation. Track was only laid to a point about 55 miles north of the "Soo." A large number of bridges and trestles between this point and Josephine Junction were not built, but otherwise the line was completed to subgrade.

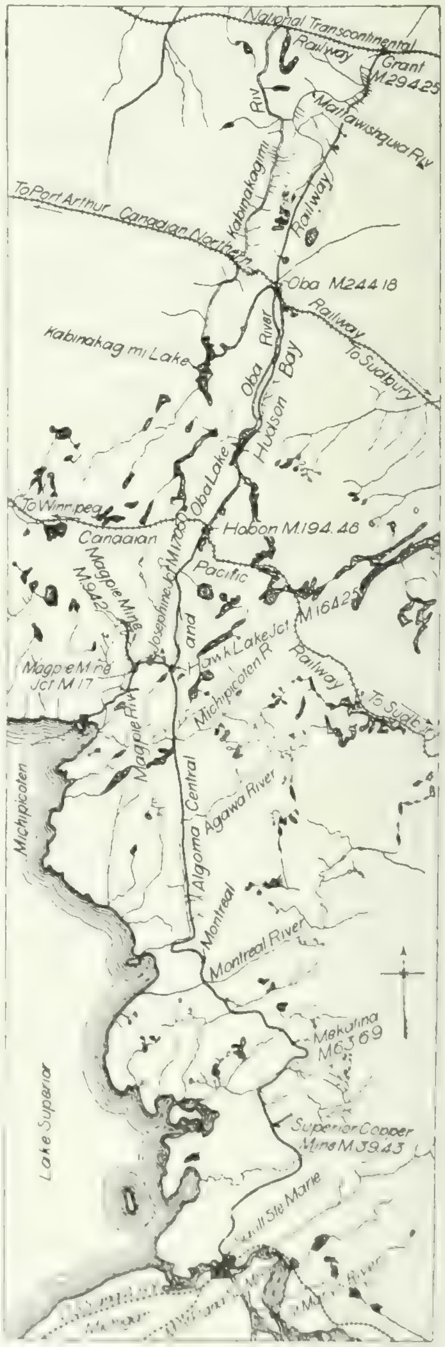


Map of the Algoma Eastern Railway.

Between the [illegible] 1908 additional track was laid to bring the end of steel at mile 68, no other work being done north of this point, however, [illegible] active measures were begun by an English syndicate to complete the road, which had, in the meantime, secured control of the Lake Superior Corporation, including the Algoma Steel [illegible] the completion and proposed extension of the railway, a report [illegible] F. H. McGuigan, of Toronto. Mr. McGuigan reported favorably on the completion and extension of the line to connect with the National Transcontinental Railway, Canada's new coast [illegible]

The necessary financial arrangements being successfully [illegible] line to connect the old grade near Hawk Lake with the Can[illegible] Hobon. S. Keemle, locating engineer, Toronto, was in [illegible] Junction, mile 170½, including regrading in cuts where slides had occurred, bringing up settled embankments, all the bridging (excepting Montreal River), track laying and ballasting.

In the meantime a spur of 9½ miles long was located from a point 17 miles from Michipicoten harbor on the line extending from the lake to the mines, northerly to a new iron mine known as the Magpie mine. In May, 1910, active work was started on this section. The company also started to repair and re-tie the upper 10 miles of the 20 miles extending from the harbor to Josephine Junction known as the Josephine branch, which had been wholly unused for over eight years. This line was in wretched shape. The ties were rotten, and as very little ballast had originally been used it was necessary to re-ballast the whole section. This work was done with company forces, with some help from the O'Boyle company.



Map of the Location of the Algoma Central & Hudson Bay Railway.

From May, 1910, to August, 1911, the work on the main line, north from mile 68 and south from Josephine Junction, the grading of the Hawk Lake—Hobon section, the building of the Magpie branch and the re-building of the 10 miles of the Josephine branch, proceeded with the usual ups and downs peculiar to railway construction work in such a country. Labor was poor and generally scarce, and bush fires, whiskey and all the troubles incident thereto [illegible] By August [illegible], 1911, the Magpie branch [illegible] practically $[illegible] The [illegible] compensated grade against [illegible]

The [illegible] from the junction to the [illegible] except for some [illegible] the river, at [illegible] per cent. compensated.

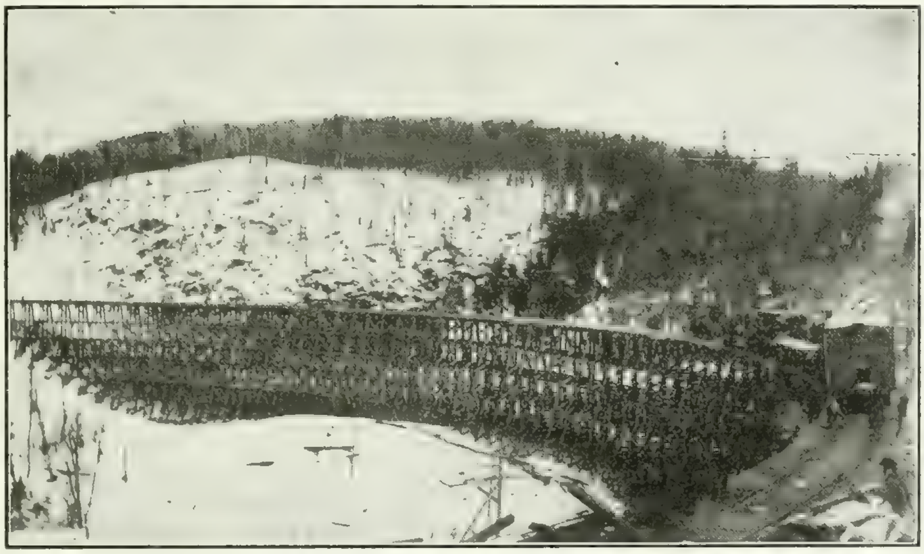
---

*[illegible]

was located. From the river crossing to the mine the line is heavy, and at mile 7½ there is a timber trestle 900 ft. long, 80 ft. high, located on a 12 deg. curve and a 1.75 per cent. grade. Up to this point the grade is 2 per cent. maximum, from here to the mine site it is 2½ per cent., 12 deg. being the maximum curve. Very large expenditures are being made by the company in opening the mine, and in addition to a plant for treating the siderite ore a model mining town is being built. This branch is laid with 80 lb. A. S. C. E. rail, with tie plates on all curves, and is most substantially built in all respects, except that timber and piles were used in bridging.

On July 15th the sub-contractors on the Hawk Lake—Hobon section finished the grading. These sub-contractors were Murdock Brothers on the lower 19 miles, and Cavicchi & Pegano on the upper 11 miles. The work was quite heavy, the grading quantities being 732,933 cu. yds. classified, 261,269 cu. yds. solid rock, 94,378 cu. yds. loose rock, and 377,286 cu. yds. common excavation. In addition there was 20,178 cu. yds. over break in rock cuttings, and overhaul amounting to 1,500,000 cu. yds. About 3,000,000 ft. B. M. of bridge timber, 40,000 lineal feet of piling, 170,000 ft. B. M. of culvert timber, 220,000 lbs. of bridge iron, 291 cu. yds. of dry stone masonry, 423 cu. yds. of cement masonry and other small items were required for this work.

The rock work was exceptionally well done, as the specifications only allowed common excavation for over break, and all the time the work was in progress this was enforced. On final estimate, however, a fair amount of over break was given as solid rock. Track laying and some ballasting was done this year, and the bridge work was completed. On January 10th, 1912, track was connected up giving a railway connection from the Canadian Pacific into the mines of the Michipicoten district. Some ballasting was also done this year.



Laying Track on Algoma Trestle.

Work on the main line completion progressed slowly from June, 1910, to May, 1911, at which time track had reached the Montreal River, mile 91½ north of the "Soo." Here a steel viaduct 1,550 ft. long and 130 ft. high located at the head of the falls 150 ft. high had to be built. This viaduct was designed in 1902 by Boller & Hodge, New York and was erected under contract by the Canadian Bridge Company. There are 1,745 tons of steel in this viaduct, and as the alinement is on a curve at each end, it was a very interesting piece of erection. The viaduct consists of tower girders supported on steel legs with concrete pedestal piers and end abutments. There are 13 30-ft. and 1 40-ft. tower girders situated on an island in the middle of the river. The intermediate girders consist of 1 85-ft., 5 75-ft., 10 60-ft., and 2 30-ft. spans. The structure is designed under the Dominion Government specifications, class 1 loading. Some poor work in concreting the piers requiring their rebuilding, delayed the erection, but track was laid over the viaduct in October, 1911.

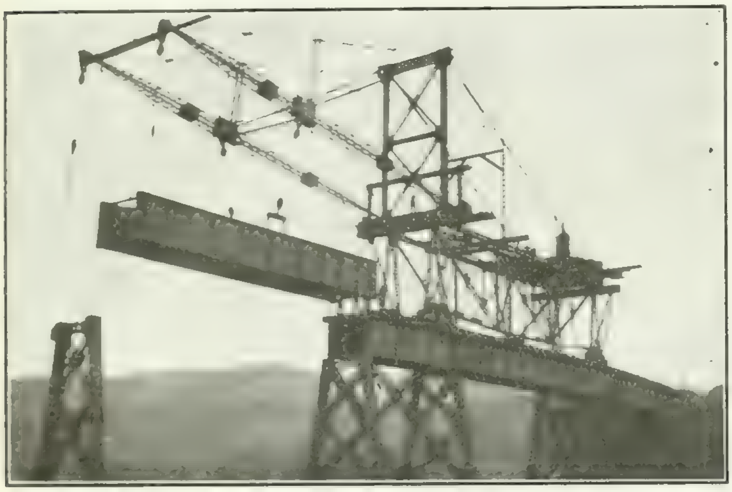
In the meantime track laying had progressed on the north end, the gap being closed about the middle of June, 1912. The slow progress made in track laying is due principally to the excessive amount of bridging and trestling on this line. Between the "Soo" and Josephine Junction there is about 16,000,000 ft. B. M. of bridge timber in 140 structures, besides 100,000 lineal feet of piling. Some of these bridges are very large, and as all the bridge timber used, excepting a few thousand feet cut in the country, is British Columbia fir, it is necessary to build these bridges from the end of steel.

The old line from Sault Ste. Marie to Hawk Lake Junction is through a most difficult country to build in, and while the location secured was good on the whole, the line is badly handicapped with heavy grades and sharp curvature. To improve this grade and alinement would require extensive relocating, which for the present is not contemplated. The route, however, is very picturesque and travelers have a treat in rugged scenery awaiting them on the opening for traffic of the Algoma Central north of the "Soo."

While the above work was progressing south of Hobon, a location was made north to the Transcontinental Railway at the new town of Hearst (or Grant) the first division point west of Cochrane, 101 miles north of the Canadian Pacific. This location is on the same grades and curvature as that of the Hawk Lake-Hobon section, viz., 0.6 per cent. compensated grade and 6 deg. maximum curves. Louis Whitman, locating engineer, had charge of the locating with Sanford Hazelwood and W. H. Wilkie in charge of the parties The route traversed by this line is through rough country for 30 miles north of the Canadian Pacific, but north of this the line enters the great clay belt of northern Ontario, and the grading work is light. The south 30 miles, however, bring up the average cost of this line to about $30,000 per mile, including track and structures.

The crossings of the Canadian Pacific and the Canadian Northern Ontario extension (under construction) are made at grade. There are very few bridges on this 100 miles, and none at all of any size excepting a bay crossing of Oba Lake, where four pile trestles were driven, one of them being 1,302 ft. long, with deck 10 ft. above the water. The balance of the bridging consists of pile structures, the largest being the crossing of the Mattawishquia River, 700 ft. long, near Hearst at the junction with the National Transcontinental. The grading quantities on this 100 miles will be, approximately, 360,000 cu. yds. solid rock, 250,000 cu. yds. loose rock, 1,500,000 common excavation, and 3,500,000 cu. yds. overhaul. About 80,000 lineal feet of piling and 1,500,000 ft. B. M. bridge timber are required. Corrugated ingot iron pipe is used principally for culverts, there being a few of native timber, but none of concrete. In August, 1911, a contract was let to the Superior Construction Company, Sudbury, Ont., for the construction of this section complete, including grading, bridging, track laying and ballasting. The grading is more than 60 per cent. completed, and track laying was started about June 15th, at Hobon. It is expected to reach the Canadian Northern crossing in October, thus placing the Algoma Central in a position to deliver construction material and supplies to the contractors for this line at Oba.

Explorations for extensions of the Algoma Central & Hudson Bay north of the National Transcontinental have been made. A copper metallic circuit telephone line has been constructed from Sault Ste. Marie, through to Michipicoten Harbor and extension to the mines and north to Hobon and Hearst will be made this summer.



Construction of Montreal Viaduct.

At Sault Ste. Marie, new terminals, consisting of a modern engine house, machine shop, store and office building and a new terminal station and office building are all contracted for and the work started. This work involves the expenditure of about $500,000, and includes an extension of the main line to reach nearer the centre of the city of Sault Ste. Marie. A new yard will be built at Tagona, the industrial centre, where extensive alterations and additions to the terminal facilities are being made. The company will also build a large coal and ore dock at Michipicoten Harbor in the near future.

The Algoma Eastern.—The original charter for the 85 miles of this railway now being completed from Sudbury to Little Current on the Manitoulin Island, was obtained by F. H. Clergue at about the same time the Algoma Central project was launched. As in the case of the latter road a land [illegible] of the charter. Actual construction of the line was delayed from year to year, after the first section of 13 miles, extending from Sudbury to Gertrude Mine, was constructed in 1900-1901. An extension of [illegible] connection was made with a spur track connecting with the Canadian Pacific at Victoria Mine station. This spur, three [illegible] per Cliff.

[illegible]

A party, in charge of Louis Whitman, locating engineer, was started at Little Current on a route over which the writer had run a line for the old Sault Company in 1900. This line traversed the islands and skirted the shore of the north channel to the mainland at the mouth of the Whitefish River where it cut through a range of high rock hills facing the lake, thence to a connection with the Canadian Pacific at a point on the Spanish River called Espanola. A section of 1½ miles of this original surveyed line was constructed in 1901 connecting the Spanish River Pulp & Paper Company's plant on the Spanish River with the Canadian Pacific Sault branch. This little section of spur was constructed by the Sault Company and turned over to the Canadian Pacific to operate, under an agreement contemplating the ultimate completion of the whole project.

When the writer took charge of the work, a location was pushed through to connect with the Sudbury end at Crean Hill, a distance of 62 miles from Little Current line with a maximum 1.25 per cent. compensated grade and maximum 11 deg. curves (with a 12 deg. curve near Whitefish) was secured at a cost of about $32,000 per mile complete including track, ballast and building. In July, 1910, a contract was let to the O'Boyle Bros. Construction Company for building the 20-mile section from Little Current to the main shore at Whitefish, and in March, 1911, another contract was let to the Superior Construction Company for the balance of the work from Whitefish to Crean Hill, 42 miles. The grading work on this 62 miles is practically complete and track laying has just been started at Espanola. The 62 miles of track will be laid and ballasted about October 30th, next.

The country traversed by this railway is almost wholly unsettled and south of Espanola is very rugged. From the Whitefish River to Little Current the scenery is most picturesque as the line here follows close to the water and winds around the headlands and bays of that section of the North Channel known as the Bay of Islands. The grading on this section, while practically all solid rock, was not excessive in cost, averaging about $20,000 per mile, including bridging. From Espanola easterly to the junction with the old line at Crean [illegible] country, but, from an agricultural point of view, of little value.

End of Steel A. E. Ry., May 22nd, 1912.

An under crossing of the Canadian Pacific Sault branch is obtained near the village of Nairn Centre, the Canadian Pacific tracks being carried over the Algoma Eastern on a 27 ft. 7 in. skewed deck plate girder span on concrete wing abutments. The bridging on the entire line from Sudbury to Little Current is light for such a country. The steel structures consist of one 105 ft. and one 60 ft. deck plate girder span on stone abutments and centre pier at the Vermillion River crossing, 17 miles west of Sudbury, one 180 ft. through riveted truss span at the Spanish River crossing, mile 42, one 176 ft. through riveted truss span at the second crossing of the Spanish River at Espanola (built in 1901) and two 100 ft. girder spans at two other points together with a 36 ft. deck girder span on concrete at an overhead crossing of the government trunk road near Espanola. These major structures are supplemented by a number of timber trestles and pile bridges. At Little Current, in order to cross the channel, in front of the town, through which there is considerable vessel traffic, a bridge, some 600 ft. long with a draw span is required. This structure will be erected this year.

View of Roadbed at Mileage 87, S. C. & H. B. Ry.

The traffic expected for this railway consists of ore, pulp and paper, coal and the products of the Manitoulin Island, which previous to the construction of this line, was entirely dependent on water communication with the main land. This island is 90 miles long averaging 8 to 12 miles wide, and is capable of great development. The population at present is about 20,000 and at least one-half of the island is fine agricultural land, particularly adapted to hay and stock raising. The construction of the Algoma Eastern formerly known as the Manitoulin & North Shore Railway has been most eagerly looked forward to for years by the Manitoulin Islanders.

The above work has all been in charge of the writer, as chief engineer of both roads. On the Algoma Central & Hudson Bay G. F. Horsey and C. Le B. Miles are in charge of the work at the north end, and L. C. Maxwell and J. A. Hedgecock at the south end as division engineers. B. E. Barnhill is division engineer of the Algoma Eastern with headquarters at Sudbury. W. C. Franz is general manager and G. A. Montgomery superintendent of both roads.

◆

ANOTHER ACCIDENT ON WELLAND CANAL.

Navigation in the Welland Canal is tied up as the result of an accident at lock 23, near Thorold, at 11.30 a.m. August 2nd, when the steamer Wiley M. Egan, bound light from Deseronto to Ashtabula, crashed into the lock and carried away all four gates. Water from the upper levels rushed through the narrow enclosure into the lower level of lock 22, carrying the boat back some distance.

New gates were sent from Port Dalhousie, and Superintendent Sullivan notified, but the placing of them will take some time. The loss is estimated at about $8,000.

PORT ARTHUR WATER SUPPLY.

The city of Port Arthur and Fort William in experiencing the growth and development which has been their lot during the past few years have at last had to face the problem of an abundant supply of pure water for drinking and domestic purposes. The supply of these centres has for many years been Lake Superior, and with the intake many thousands of feet from the shore this source left nothing to be desired, until the industries, many of which located along the water front began to pollute the water front with their discharged refuse; when this pollution reached the proximity of the intake, the matter took on such a serious aspect that the corporation council requested Mr. T. Aird Murray of Toronto to make a report on a possible future supply from certain sources north of the cities, and generally known as Hazelwood Lake and Current River; if this were not practical to make such recommendations as would give the citizens a clean and efficient service for considerable time to come.

In addition to the fact that the water on the land side of the municipalities was practically free from pathogenic bacteria and organisms, this source commended itself on account of the possibility of drawing the supply to the taps by gravity and thus reducing pumpage expenses.

That it is entirely feasible to obtain an abundant supply of water from the Current River at a static head requisite for city purposes, has been demonstrated by surveys and levels. At a point immediately above the Cascades a level of water may be obtained about 400 feet above the level of Lake Superior. This is practically the nearest point from which water can be diverted by a gravity system and the relative costs and efficiencies between a gravity and lake supply are based upon water being diverted from the river immediately above the Cascades.

In order to make a favorable comparison between the two systems it is necessary to assume an equal volume of supply by both gravity and pumping. In the preparation of the report Mr. Murray assumed that the quantity made available be 10,000,000 gallons per day, equal to a per capita supply of 100 gallons for a population of 100,000.

The feasibility of obtaining a supply from Hazelwood Lake was discarded after an investigation, owing to the boggy nature of the water shed and the increased distance from the cities which necessitated additional outlay for pipe, etc.

Chemically and characteristically, the water in Lake Hazelwood, in Hazelwood Creek near the junction at Current River, and in the Current River itself are the same for all purposes.

It is reported that, before the natural level of Hazelwood Lake was raised and flooded lands added, that the water was clear instead of bog colored as at present. At the present time the bog coloring matter both in Hazelwood Creek and in the Current River, is extremely high and for all practical purposes, may be taken as similar in content. So high was the color of this water that the different phases of the chemical analyses of the same, depending on the color of the reagents and precipitates, was rendered extremely difficult and to this fact the slight variations in the table of analysis is due. In the tabulation of the ammonias, this, of course, does not hold, for the water is distilled at as constant a temperature as possible before the reagent is added to compare the tint.

It is possible that if the flood land was scraped and al brush, weeds, tree stumps and soil to a depth of at least one foot were removed that the original clear color might be recovered.

The drainage area of Hazelwood Lake is about 24 square miles and the lake itself about 1,875 square miles, and it is at once seen that this would involve an immense amount of work and an expenditure of about $201,666. That this water ever was sufficiently clear to allow of its use as a domestic supply is based upon hearsay evidence, and that the removal of the organic soil and vegetation will effect the removal of the present bog coloring matter sufficiently to render it suitable for domestic supply without artificial treatment, is problematical.

The question, however, of a gravity supply from Current River deserves serious consideration as the water may be conveyed from a point much nearer the city and the quantity available is ample for all future city requirements.

The waters of the Current River watershed appear to be free from sewage contamination, but reference to the chemical analysis proves this water to be heavily charged with organic matter. The oxygen consumed averages 19 parts in million. The water is very soft, averaging 53 parts in one million, equal to 3.71 grains of hardness to the gallon. The total alkalinity of the Current River waters is low, being 25 parts in one million; and the alkalinity of Hazelwood Lake and Creek is still lower, being 18.5 parts in one million. The amount of vegetable dye or peaty coloring matter in this water is also extremely high and shows a color content of 156 parts per million on the platinum cobalt scale. Generally speaking the water is fit for human consumption but owing to the coloring matter it is extremely objectionable.

The examination of the waters was made in the early spring, and it must be anticipated that the vegetable content will prove much more objectionable in the autumn when the process of decay sets in.

The coloring matter is in almost perfect solution, and cannot be removed by filtration alone, but can be removed by a combined method of filtration and coagulation. It has been shown that to remove 57 per cent. of the coloring matter, leaving a color content of 67 parts per million, will require the use of 3 grains of alumina sulphate per gallon and 7/10ths of a grain of soda ash. No data is to hand of such large quantities of coagulant being necessary elsewhere. The color of this water is extremely difficult of coagulation, owing to the low alkalinity of the water, as water required a pronounced alkaline base in order to set up the necessary [illegible]

ITEMS INCLUDED IN COST OF GRAVITY SCHEME TO PROVIDE 10,000,000 GALLONS PER DAY FROM CURRENT RIVER.

Head works and dam	$ [illegible]
[illegible]	[illegible]
Filtration plant and coagulation basin ..	120,000.00
Duplicate 24-inch mains, head works to [illegible]	[illegible]
Single 24-inch main, reservoir to River [illegible]	[illegible]
[illegible]	[illegible]
[illegible] Street, Balsam and Van Norman ...	20,205.00
[illegible]	[illegible]
	[illegible]
[illegible]	[illegible]
	[illegible]

The cost of sodium carbonate and sulphate of alumina in this country is very high as it is not manufactured in this country and is, therefore, subject to duty. Calculations of the cost of sulphate of alumina and soda ash delivered at Port Arthur show that the cost of coagulants at the above ratio of treatment amount to $9.30 per one million gallons decolored, and that if 97 per cent. of the color be removed the cost is $22.08 per one million gallons of water decolored. Apart from this cost there must be considered the cost of cartage from the rail cars to the treatment works and the expense of filtering.

It will be readily seen that owing to the density of the coloring matter and the low alkalinity of the Current River waters, that the removal of this color is its chief objection to its availability. Although the color is less in Hazelwood Lake and Creek than in the main stream, the alkalinity is lower and the cost of treatment is much the same, there being required a greater proportion of soda ash than alum.

Items included in cost of pumping scheme to provide 10,000,000 gallons of water from Lake Superior, with an intake at city limits:

Duplicate 24-inch water pipe	$ 55,000.00
24-inch mains	350,000.00
12-inch mains	26,264.00
Pumphouse	8,000.00
Pumps	24,000.00
Removing old pumps	3,000.00
New well	4,500.00
Two houses	7,000.00
	$477,764.00
Deduct cost of pumps not required at present	12,000.00
	$465,764.00
Add 10 per cent. for contingencies, supervision, etc.	46,576.00
	$512,340.00

In order to compare the relative cost and efficiency of a gravity supply with a pumping supply, it is necessary to estimate the cost of a pumping supply delivering from a point at the city limits 10,000,000 gallons of water per day to the city. And a plan has been prepared which shows the layout of a force main system, designed to deliver 10,000,000 gallons of water per day. It is suggested that duplicate steel intake pipes be laid into about 41 feet of water 2,500 feet in length, working under a static head of 15 feet [illegible] inches. Each of the pipes will be capable of delivering to the pump well approximately 8,000,000 gallons per day, or a total delivery of 16,000,000. The suggestion, as far as a steel pipe is concerned, is only tentative, as no borings have been made at this point to prove the class of strata. If solid rock, which is probable, it will be as economical and more efficient, to construct a tunnel.

Duplicate lines of [illegible]-inch force main are shown from the pumphouse to the corner of Algoma and McDougall Streets. In former reports [illegible] mains were suggested, but [illegible] supply than [illegible] per day.

Under a [illegible] gallons per day supply, [illegible] the energy required to raise the water from the pumphouse to McDougall and Algoma [illegible]. If the pipes be [illegible] diameter then the energy required [illegible] pounds to [illegible].

COST OF INSTALLING PUMPING SUPPLY FROM CITY LIMITS AND 24-INCH DUPLICATE FORCE MAINS IN ORDER TO SUPPLY 10,000,000 GALLONS PER DAY, IN ACCORDANCE WITH PLAN, $512,340.

Operating Cost.

To pump 10,000,000 gallons per day for low level supply requires 953 H.P., and for high level supply 238 H.P. Total horsepower, 1,191.

Above is for a head of 500 feet, assuming that low and high level is half this amount, or 250 feet head in each level.

*1,191 H.P. at $15	$17,865.00
Operating for 365 days at $10	3,650.00
Incidental expenses per annum	500.00
Annual operating expenses	22,015.00
$22,015.00 capitalized at 5 per cent. equals a capital amount of	440,300.00
Total capitalized cost of pumping scheme from city limits, delivering 10,000,000 gallons per day	952,640.00

***Note.**—Power costs fifteen dollars per H.P. when consumption reaches 10,000,000 gallons.

Capitalized Cost of Gravity and Pumping Supplies Compared.

With 57 per cent. of the color removed:—	
Current River scheme	$1,432,819.00
Pumping scheme	952,640.00
Balance in favor of pumping	$ 480,179.00
With 97 per cent. of the color removed:—	
Current River scheme	$1,861,500.00
Pumping scheme	952,640.00
Balance in favor of pumping	$ 908,860.00
With no color removed:—	
Current River scheme	$ 644,319.00
Pumping scheme	952,640.00
Balance in favor of gravity scheme	$ 308,321.00
Cost of gravity scheme apart from operating expenses	$ 600,619.00
Cost of pumping scheme apart from operating expenses	512,340.00
Balance in favor of pumping	$ 88,279.00
Cost of gravity scheme, capitalized operating expenses only	$ 832,200.00
Cost of pumping, operating expenses only	440,300.00
Balance in favor of pumping	$ 391,900.00

The question has been raised as to what effect the choice of either of the above alternative systems may have upon the problem of the disposal of the city sewage.

At present the sewage of both Fort William and Port Arthur is discharged in a raw state into Thunder Bay. It has been felt that any decision to rely upon Thunder Bay water for purposes of domestic supply will entail the necessity, in the near future, of a large expenditure in trunk sewers and efficient disposal works for the purification of the sewage before it enters the bay. Fort William has a supply of water by gravity independent of the bay water, and it has been suggested that if Port Arthur could also obtain a similar source of supply, then the necessity for sewage disposal will cease to exist.

The real question to be asked is: Apart from any law of the land prohibiting the discharge of raw sewage into fresh water, will the citizens themselves be content to turn their harbor into a cesspool and sewage disposal area? Apart from the question as to any effect such a discharge of sewage may have upon the domestic water supply, is it not possible and very probable that as the Twin Cities grow in population and the amount of raw sewage increases and the effect upon surrounding waters becomes apparent to the senses, that the citizens will demand that the nuisance be removed.

The history of the pollution of Toronto harbor and the demand by the people that an apparent nuisance be removed by the construction of trunk sewers and disposal works, is an illustration to hand.

In Toronto there has recently been installed an up-to-date filtration plant to remove turbidity and bacteria from the water; also there has been constructed trunk sewers and sewage disposal works, not with the object of removing disease infection from the sewage and safeguarding the water supply, but simply for the purpose of removing from the bay what has been considered a nuisance and disgraceful condition in Toronto harbor.

With similar increase in population, conditions will gradually assume just as objectionable features at Port Arthur and Fort William as at Toronto.

Apart from the actual water consumed from the tap, there is also a summer floating population to be considered, which will at times consume the water direct from the bay.

The question of sewage disposal has not been gone into in any detail, but it is considered that when this problem is taken up, that a trunk sewer system should be constructed from north to south, with disposal works located west of the Canadian Pacific Railway, and north of the McIntyre River. The area suggested is hatched with black lines on Plan B.

Conclusions of the Report.—That owing to the density of color matter in the Current River and its branches, that this watershed does not present a character of water which can economically be presented as an efficient domestic supply to the city.

That a pumping supply be installed at the north city limits.

That duplicate 24-inch intakes be installed.

That the pumping units at the new pump-house consist of the present turbine pump, and a new 2,000 gallons a minute turbine pump.

That the routes for the new 24-inch duplicate force mains be adopted.

That the present water wheel driven pump be maintained at the present pump-house as an auxiliary supply.

That hypochlorite treatment apparatus be installed for use only when required.

The estimated cost of construction of scheme is $512,340.

◆

NEW GRAIN ELEVATOR FOR WEST ST. JOHN, N.B.

The Canadian Pacific Railway have recently concluded arrangements for the construction of a one-million bushel grain elevator at the above-mentioned point.

The elevator will be of reinforced concrete. It will be capable of unloading 160 cars in 10 hours, and of shipping to ocean vessels at several different berths. The elevator will be electrically-driven, a power plant for the generation of electric power being included in the contract. An extensive shipping gallery system will also be a part of the work. The elevator is to be ready for the winter shipping season of 1913 to 1914.

The approximate cost of this work is $500,000, and the John S. Metcalf Company, Limited, of Montreal, have been awarded the contract to erect the structure.

ALUMINUM OVERHEAD CONDUCTORS.

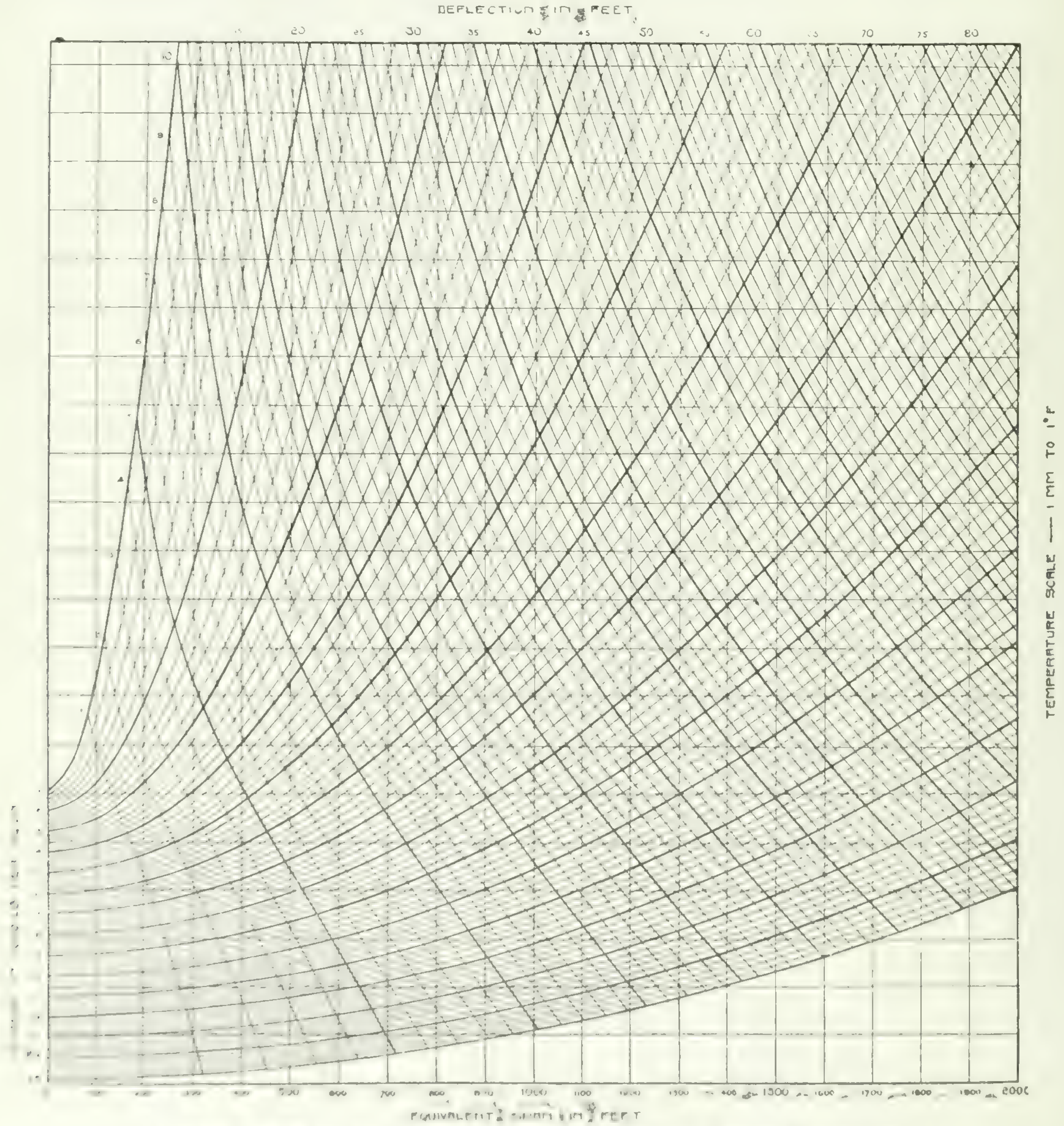
The accompanying chart has been developed by the British Aluminum Company, Limited, of 109 Queen Victoria Street, E.C., for the purpose of determining the deflection and stress in overhead conductors of aluminum. The Electrical Review received permission to reproduce the chart, of which the company retains the copyright. As the use of metal is increasing, we present the matter herewith to our readers.

The company claims that this is the first logically correct means of determining the physical characteristics of aluminum conductors that has yet been placed in this country, and it would take the place of the calculations, often [illegible] approximations, which have hitherto been used. Information not found on the chart will be readily supplied by the company; a useful and complete comparison between copper and aluminum conductors will also be found in the article by Mr. E. V. Pannell, which was published in *The Canadian Engineer* issue of July 18th, 1912.

It is important to note that the chart as here reproduced is reduced in the ratio 5:2; the temperature scale is therefore modified, and each division represents 20 mm., or 20 deg. Fahr.

1. At constant temperature the intercept of the ordinate of the span with the curve of required stress will give the corresponding deflection; e.g., span 700 ft., stress 10,000 lb. per sq. in. Deflection 7.2 ft.

2. To allow for a rise of temperature follow the ordinate vertically upwards (1 mm. to 1° Fahr.); e.g., as above, allowing for a rise of 50° Fahr. Deflection 11.8 ft., stress 6,100 lb. per sq. in.



Universal Stress-Deflection Chart for Standard Aluminum Overhead Conductors.
Based Upon the Laws of the Elastic Catenary.

Modulus of Elasticity [illegible] lb. per sq. in. Coefficient of linear expansion [illegible] per 1° Fahr. Weight per sq. in. per ft. run 1.175 lb.

3. Again, as example 1, but taking into account a wind pressure of 30 lb. per sq. ft. on a conductor of 0.6 sq. in., the stress to be as before, multiply the span by the appropriate value of "q" given below, i.e., 700 × 2.33 = 1,631. Proceed as before, but divide the deflection so obtained by "q," i.e., 39/2.33 = 16.7 ft.

4. The deflection on the line in still air will be found by following the horizontal line through the point just determined until it intercepts the ordinate corresponding to the true span of 700 ft., giving a deflection of 13.6 ft., and a stress of 5,300 lb. per sq. in.

The value of "q" is the ratio of the total loading per ft. run to the weight of conductor per ft. run. Thus, if "w" be the weight and "p" be the effective wind pressure per ft. run of projected area (reduction factor 0.6) then $q = \sqrt{w^2} + p^2/w$.

Cross-section of conductor, sq. in.		0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6
Value of "q" with wind pressure of	30 lb. per sq. ft.	5.21	3.48	2.77	2.33	2.08	1.92	1.79	1.71	1.64
	20 lb. per sq. ft.	3.58	2.61	1.99	1.72	1.57	1.48	1.41	1.36	1.32
	10 lb. per sq. ft.	1.98	1.51	1.32	1.22	1.17	1.14	1.12	1.10	1.09

FIRST REPORT OF MONTREAL TRAMWAYS COMPANY

The first comprehensive report of the Montreal Tramways Company has just been compiled. The appearance of this report has been awaited with interest, the reason being the many changes which have taken place in connection with the affairs of the company during the past year. It is only two years since the present management assumed control of the street railway. It was not until about a year ago that, in the reorganization, the Montreal Tramways Company took the place of the Montreal Street Railway Company. Many changes have been effected during the year, among these being the formation of the holding company known as the Tramways and Power Company, through the medium of which the desired object of the present control was brought about—namely, the joining up of the street railway interests with those of the Canadian Light and Power Company.

The common stock of the Tramways Company, which company succeeded the Street Railway Company in all its rights, franchises and privileges, was in the nature of a bonus stock to accelerate the exchange of street railway shares on the basis of the offer made public at the time. The public was unwilling to commit itself to any very definite views regarding the value of the tramways common stock, some claiming that it was too much of the nature of water to be of much value, and others assuming that its value was somewhere in the vicinity of $30 to $35 per share. Of late this stock has been advancing constantly and recently it reached par. This week buyers were asking 110 for it.

Difficult as it has been to place any specific value on Tramways Common, the work of valuing Tramways and Power has been much more difficult, inasmuch as the latter company is a holding company into which go the surplus earnings on the stock of both the Tramways Company and the Canadian Light and Power, so that it becomes necessary to know somewhat of the earnings of both companies before the value of Tramways and Power can even be approximated. The stock has been experiencing a somewhat interesting movement of late and prices advanced to 60, later declining again to slightly above 50.

The financial report just issued shows that the company has made progress since the last annual report. The result of the nine months makes a good showing as compared even with the entire previous twelve months, as the following will show:—

	9 Months, 1912.	12 Months, 1911.
Gross earnings	$ 4,355,403	$ 4,775,300
Op. expenses	2,618,943	2,679,805
Exp. p.c. of earnings	60.13	56.12
Net earnings	1,736,549	2,095,080
Pass. carried	104,458,960	118,268,080
Car earnings per passenger	4.06	3.94
Transfers	34,947,315	40,488,545
Total pass. carried	139,406,275	158,756,625
Car earnings per pass. total carried	3.04	2.93

It will be observed that the car earnings per passenger shows a considerable increase. This is not surprising to Montrealers who have been raising objections to the overcrowding of cars. It is estimated that on the basis of passengers carried there should be an increase of 27,000,000 in passengers for the full year. The total carried last year was somewhat less than 159,000,000, while during the nine months period, according to report, somewhat less than 140,000,000 passengers were carried, making about 186,000,000 passengers per year.

It is also worthy of comment that the earnings for the nine months of this year are in excess of those for the full year ending September 30th, 1910, as well as for all full years previous thereto. The financial report for the nine months ending June 30th will, it is understood, be presented at the annual meeting on August the 6th and is as follows:—

Gross earnings		$4,355,403.57
Operating expenses		2,618,943.65
Net earnings		$1,736,459.92
From which deduct:—		
City percentage on earnings	$279,030.17	
Interest bonds and loans	449,513.67	
Interest debenture stock	600,000.00	
Taxes	50,850.00	
		1,379,393.84
Surplus		$ 357,066.08
From which has been appropriated for:—		
Contingent account		150,000.00
Transferred to general surplus		$ 207,066.08

No statement has heretofore been made of the number of shares of street railway which have actually been turned in for exchange. While President Robert in his report does not mention the actual number still outstanding, he states that only a few shares have not been exchanged. Reference is also made to negotiations in progress between the city and the railway for the purpose of securing a new contract.

The recent general manager, Mr. Duncan McDonald, has been succeeded by Mr. James E. Hutcheson, former superintendent of the Ottawa Street Railway, who has already taken up his work. It is understood that other changes will take place on the staff shortly.

FUEL OIL FOR SHIPPING

Officials of oil companies have learned that the Canadian Customs Department will probably decide to admit fuel oil for shipping use free of duty to Canada. Since July 12, when a tank steamer with a cargo of fuel oil for shipping use reached Vancouver from San Francisco, and a duty of 2½c. a gallon was demanded, the companies engaged in the fuel oil trade have been awaiting a decision by the Minister of Customs on an appeal taken as a result of this duty. Many of the trans-Pacific steamers of the Canadian Pacific and Grand Trunk railroads use fuel oil, and the imposition of such a duty would mean a doubling in the price of the product of these and other companies operating oil-burning ships.

Within the last seven years, according to oil authorities, practically all the local steamers at Vancouver and on Puget Sound have been converted into oil burners, while to-day a large majority of the larger off-shore liners are burning fuel oil. The saving in space and operating expenses has appealed to owners, and with the improvement in atomizing the fuel, its use has become much more satisfactory. Many manufacturing plants also have discarded coal for oil, and this ever-growing market has brought the importations of oil to Vancouver and vicinity to unexpected proportions.

Hon. Winston Churchill, the First Lord of the British Admiralty, recently announced that an investigation into oil fuel would be made. Oil burning engines are going to play an important part in many of the new crafts that are now being built and those in contemplation in the principal shipyards of the United States and England. According to a well-informed marine builder, there are no less than 242 steamers fitted for burning liquid fuel, the largest being the Toyo Kisen Kaisha liner's Tenyo Maru and Chiyo Maru of 13,454 tons gross and 13,431 tons gross respectively. In this connection it is of interest to note that the new Cunard liner Aquitania of 50,000 tons gross in the course of construction on the Clyde is to be similarly equipped, while the White Star boat of 18,000 tons which is now being built at Belfast for the Cape-Australian routes, and which is to be named the Ceramic is also to use oil. Quite a large number of the oil burners are now employed in the Pacific, two of them the Ventura and Sonoma recently inaugurated a service for the Ocean Steamship Company between San Francisco and Sydney, New South Wales. Another line of steamers burning oil fuel, the Crown Line, will soon be running between Pacific Coast ports and Australia.

The Colonial Transportation Company of Mexico is equipping its barges with oil engines and the use of oil for fuel promises to supersede other fuel upon nearly all the river and coastwise vessels on the east coast of Mexico. There is [illegible] for fuel by manufacturing plants in various parts of Canada and the United States.

Since the British coal strike in the early part of this year [illegible]

[illegible]

makers that many English firms are, as a result of the late strike, seriously considering the advantages of motor transport. Commercial travellers are using motor-cycles in increasing numbers when calling upon their customers, as they can travel, it is stated, a hundred miles upon a gallon of petrol (gasoline) and carry their samples, unless they are of great bulk, be entirely independent of the railways and be able to call upon a greater number of people than they possibly could if restricted to steam travel.

◆

DISTRICT HEATING BUSINESS.*

By A. D. Spencer.

The district heating business is nearly as old as the electric lighting business. As early as 1890 a number of electric lighting companies were selling exhaust steam for heating purposes. At the present time there are over 300 heating plants in the United States. The National Electric Light Association committee gives answers from 100 companies, one-half considering the business directly profitable, while practically all agree that it is of great advantage in connection with electric supply.

While the value of a combination electric and heating system is being recognized more fully as the companies extend their field to include the large commercial establishments formerly considered out of the reach of the central station, it is impossible to find another business so well established and in which so many companies are engaged where one-half believes that the business is yielding no profit.

It is doubtful if a majority of heating companies have the necessary data to make up a reliable operating balance. Heating plants are outgrowths of the electric business and generally are operated in connection with it; therefore, the expenses frequently are not separated. The heating revenue is credited to the fuel account and often assumed to be practically all profit; a cost analysis is considered unnecessary. Where an analysis is made, it is many times inadequate, the general expenses, fixed charges and depreciation being omitted.

Failure to show profit may be due to inadequate rates. Many managers consider heating revenue practically all net gain and they establish schedules without considering the value of the service to the consumer or of its cost to the company. The popularity of the service shows conclusively its value.

The value to the consumer is easily from 10 to 25 per cent. more than the cost of maintaining his own plant, due to the absence of smoke and dust, to lower insurance rates, to the release of valuable space otherwise occupied by the plant, and to the greater convenience and reliability of the district heating service. The value of the service will generally permit rates based on the cost of supplying live steam, and rates should always be so based, rather than on the not always correct assumption that the steam is a byproduct.

Faulty construction or improper operation may cause a financial loss. The same care should be exercised in designing and constructing a heating system as in the electric-supply system. In general, the distribution system should [illegible] density of business with the minimum length of mains. The load on existing mains should be increased and extensions made only where it is certain profitable business can be obtained.

---

*[illegible] District Heating Association, at [illegible]

Customers' installations should be subject to supervision. Where flat rates are in use, rigid regulations should be enforced, underground construction should be of best quality to reduce maintenance costs and minimize heat losses. But it must be kept in mind that investment charges on expensive underground construction form a serious item in the cost of district heat supply, and construction costs must not become so heavy that the charges more than offset the resulting operating economies. Where meters are used, a thorough system of inspection and tests is necessary to prevent serious losses of revenue. Above all, adequate records are essential for intelligent and economical operation.

Local conditions have much to do with the success or failure of heating systems; and plants are operated in many places where local conditions do not warrant the investment. This is partly due to the idea that any heating revenue is net profit, and to considerations of policy, such as necessity for occupying the territory to prevent undesirable competition and the ability to offer heating service in connection with electric service. Among the points to be considered in local conditions are location of steam plant, density of available business, probable growth of district, obstructions to underground construction, probable loss of electric-plant capacity and efficiency due to back pressure, length and character of heating season, probable coördination of heating load and electric loads and relative costs of steam coal and domestic coal. These points apply to exhaust heating. Where live-steam heating is contemplated, other considerations enter and the chances of loss become much greater.

Plants depending principally on electrical business may be operating at a loss because they carry undesirable business, such as restaurants, etc., which require summer service. Low rates may be intentionally established to facilitate taking over private plants, with combined heating and electrical load, but this does not seem warranted except where the value of the service to the consumer will not permit higher rates and where the net result is an advantage to the entire electric business.

DEPRECIATION AND SINKING FUNDS.*

By C. A. Smith, A.C.U.A., Accountant Municipal Tramways Trust, Adelaide.

I have decided to continue the discussion on depreciation and sinking funds as introduced by George Macoun in his paper, which was read before the Australasian Tramway Officers' Association in Sydney on October 9th, 1908.

Mr. Macoun's object was evidently to open up ground for discussion with a view of promoting a better understanding of the subject generally. He quotes the statement of James Dalrymple (manager of the Glasgow Tramways), who, at the Municipal Tramways' Association at Leeds in September, 1906, said: "I have always looked upon municipal corporations very much as I look upon an individual. If I, as an individual, borrow £1,000 to start business, I must pay that £1,000 back before I am a free man," and concludes that he approves of the remark "that a sinking fund has nothing whatever to do with a depreciation fund." Undoubtedly Mr. Dalrymple is right in the latter contention, but his argument that because an individual should pay off his loans the corporation should do the same is not necessarily logical, nor is it incumbent upon the individual to repay his loans, unless, perhaps, with the borrowed capital. Mr. Dalrymple's ideal of a "free man" and "free corporation" is largely a matter of sentiment and will be dealt with in connection with municipal debt and credit later on. Mr. Macoun also says that at the same meeting G. W. Holford, general manager of the Salford Tramways, stated the view that rolling stock, buildings and overhead equipment could be maintained out of revenue, but that a reserve for renewals of permanent way is absolutely necessary. I do not think it advisable to introduce to such an extent different principles in the treatment of different parts of the undertaking, as this destroys to some extent the value of the comparative statements of operating costs. It is clearer and better to keep operating expenses, including ordinary maintenance, distinct from renewals, and separate accounts should be kept for the renewal of each class of plant and machinery, etc., but permanent buildings of an incalculable length of life may be maintained out of revenue.

The rates at which the various tramway undertakings provide for their depreciation reserve are as variable as they are interesting. Especially interesting is the reserve of the Glasgow Tramways, which to-day stands at about 50 per cent. of the capital cost. In the opinion of Mr. Dalrymple, therefore, the Glasgow Tramways have depreciated 50 per cent., notwithstanding their high standard of maintenance and the large sums already expended in renewals. This is referred to as being a very gratifying financial position for the Glasgow corporation; undoubtedly, nevertheless, the reserve may be unwarranted, and I have very grave doubts as to whether the Glasgow corporation values its assets at only half of the capital cost.

Obsolescence.—As Mr. Macoun has pointed out, obsolescence is a quantity as incalculable as an earthquake, and it may happen that in the reserve to cover obsolescence there may be a provision greatly in excess of the requirements of the more modern parts. Whichever way it may occur, in all probability it may only be partial in an electrical tramway system for a great number of years, and a large residual value may remain; but if it is a question of life or death, which we cannot cover by insurance, we must take the risk.

As a matter of course the renewal fund is raised from year to year, and renewals are made during the same periods, so improvements are introduced and obsolescence gradually gives place to modern inventions, and the great "bogey" obsolescence, which has hitherto been more imaginary than real, is no more to be provided for, other than in the renewal fund, than an earthquake.

Depreciation is not provided for generally by state governments, but they pay for their renewals, when convenient, out of the then current year's revenue. Such renewals sometimes include a proportion of capital expenditure left unrecorded as such. This is a system to be deprecated. Ultimately the undertaking may thereby show a greater percentage of revenue to the capital cost recorded in the books, but a government which treats its accounts in prosperous seasons in this manner shows fictitious results and deludes itself and the public, believing that its railways and tramways are subsequently paying, whereas, had the capital expenditure out of revenue been capitalized instead of written off as expended, a loss might have been manifest later. Revenue expenditure is thus imposed upon in prosperous seasons, and the so-called capital cost is kept far below the actual capital outlay.

This system is also to be deprecated because in poor seasons the permanent way and rolling stock become starved, and depreciation then sets in at on increased ratio and there is no provision to meet it. Generally speaking, however, the tendency is to load the capital and let the working cost down too lightly.

---

* Abstract of paper read at third conference of the Australasian Tramway Officers' Association.

A company with keen competition and limited rights is situated very differently from a company with a monopoly and limited rights. Both of these must charge a price sufficient to cover all losses and also sufficient to provide profits with which to pay lucrative dividends. Again, a municipality with a monopoly and an unlimited franchise is situated so favorably that its costs of transport should be unapproached by any other system, being free from competition and the necessity of making profits. But under any system the price of the ticket should be sufficient to create an ample reserve for renewals, as this undoubtedly is required to provide for one of the losses which should be covered in the price paid for the fare, being the extent to which depreciation is estimated to have occurred.

Depreciation.—The subject is very wide because different classes of assets depreciate at different rates, but as a matter of principle when capital is spent in the purchase of machinery, plant, land or buildings with a view to a profit being earned, provision must be made for the replacement of the capital before the return can be regarded as profit.

In determining the rate of depreciation the main facts to be kept in view in reference to a particular subject are:

First—The original cost.
Second—The annual repairs required.
Third—The probable life.
Fourth—The market value.
Fifth—The break-up or residual value.

In allowing for depreciation the rate may be calculated on the original value or upon the diminishing value from which the depreciation of previous years has already been written off.

Where the depreciation allowed is on the original cost a much lower rate is sufficient than where the depreciation is calculated on the diminishing value. The usual method is to calculate depreciation on the diminishing values, the effect being that in later years the charges for depreciation are lighter; but this, as a rule, is counterbalanced by the increasing cost of repairs as the assets get older. As an example, if the life of a machine be taken at twelve years with a residual value of 10 per cent. of the prime cost, then depreciation would need to be written off at 7½ per cent. per annum each year. To arrive at the same result, if the percentage is written off the decreasing value each year, it will be necessary to write off at the rate of 17.46 per cent. per annum on the decreasing value; and again in providing a reserve for renewals to be invested at compound interest at current rates pending the amortization of the plant, a still lower percentage may be taken, shown as follows: £100 in twelve years on diminishing values, with a residual value of £10, equals 17.46 per cent. per annum; £100 in twelve years on original cost, with a residual value of £10, equals 7.50 per cent. per annum; £100 in twelve years invested at 3½ per cent. interest, with a residual value of £10, requires a reserve of 6.16 per cent. per annum.

The latter system of providing and investing the reserve is preferable, as the annual charge is regular and lower than [illegible] and there is provision available to carry out the renewals as they become necessary.

Reserve for Renewals and Sinking Fund.—The reserve for renewals should stand entirely upon its own foundation and not be associated with the requirements of a sinking fund which may exist for distinctly different purposes.

The object of the reserve for renewals is to replace worn-out assets. The object of the sinking fund is to accumulate capital for the purpose of paying back borrowed capital.

The reserve for renewals and the sinking fund may be [illegible]

In determining the reserve for renewals we take into consideration the amortization of the plant and provide for its continuance, or, in other words, we keep up the value of the capital, either in plant or investments, and base its upkeep on its life.

In determining the sinking fund, should we not also consider the amortization of the community, which is responsible for paying off the loan, or whether the community may be considered at all to amortize? In the former case the machinery and plant will, we know, be entirely renewed in a given number of years, and the community using that machinery and plant will be obliged morally and economically to pay the cost; but having done that, the community, as a community, continues as juvenescent during the period of the depreciation and renewal of the whole undertaking. Also, as a sinking fund is the accumulated wealth of a continuing community, the question is, how far will the present generation participate in the advantages of the sinking fund? and just to this extent should they contribute toward it in the price they pay for their tram fare. It is not a simple proposition that if the life of a generation is forty years one-fortieth should be paid off yearly; but the proposition is this—provided that obsolescence is not contemplated, at what rate should a continuing, ever-juvenescent and increasing community accumulate capital in the form of a sinking fund, or is there any moral obligation or economic reason why it should create a sinking fund at all? In forty years, in all probability, owing to the increased population, the debt per head will have been reduced 50 per cent., and with increased land values I consider it quite unnecessary to bestow upon the next generation a system fully equipped and free of cost.

◆

WATERPROOFING CONCRETE.

A method of treating concrete proposed in a report submitted to the National Association of Cement Users, is the following. On flat surfaces lay a base of concrete at least 2 inches thick, and plaster while still wet with ⅛ inch of neat cement, trowelled hard; follow with another layer of finishing concrete not less than 3 inches thick. On wall surfaces, as soon as the timbering has been removed, thoroughly wet the surface, trowel on ⅛ inch of neat cement, and follow with a 1 inch coat of 1 : 2 cement mortar before the neat cement has begun to set appreciably. If the surfaces treated in either way are of large areas, the materials applied should be reinforced to obviate cracking.

◆

TESTS FOR INSULATED WIRE.

A revised set of regulations issued by the Electrical Department of New York City provide that the insulation shall be of rubber or other homogeneous compound which has been approved, and specify a definite thickness for each size of wire. As a protection against too soft an insulation, the rules stipulate certain tests, among which is the following: The braiding is carefully removed from a portion of the sample, and the copper wire is connected with one terminal of an electric circuit, of which a testing tool forms the other terminal. The portion of the sample from which the braiding has been removed is placed on a flat surface, and the tool edge, which is placed across the sample, is pressed down on to the insulating cover with a pressure of 5 lbs. which is maintained for about a quarter of an hour. The electric current, which must be at least 100 volts alternating, is then turned on, and the tool edge must not sink far enough through the insulation to touch the copper wire and complete the electric circuit.

MANUFACTURE OF RAILWAY TIES

Approximately 70% of ties purchased in Canada in 1910 were hewn. It is apparent that methods of manufacture of ties are not undergoing any great general and permanent changes. Sawn ties were 30 per cent. of the total, which is the same proportion as in 1909. The only important species which has a majority of sawn ties is oak, 95 per cent. of which were sawn ties. Cedar ties were 81 per cent. hewn, and 61 per cent. of the jack pine ties were hewn. Hemlock and Douglas fir were about evenly divided in the method of manufacture. In the case of tamarack, 98 per cent. were hewn ties, while the minor varieties were principally sawn ties. The hewn ties are nearly all pole ties, the sawn ties are made chiefly from larger timber.

Sawn ties cost on the average 36 cents per tie. Hewn ties cost 3 cents more, or 39 cents per tie. Oak was the most expensive of sawn ties, costing 74 cents per tie. White pine was the cheapest of the sawn ties, costing only 23 cents per tie. In hewn ties, oak was also the most expensive, costing 68 cents, and spruce ties were the cheapest, costing 25 cents per tie.

The steam railways use 96 per cent. of all the ties. The decrease in use of ties in 1910 is due chiefly to decreased purchase by the steam railways, which used 5,159,697 ties less in 1910 than in 1909. All the white pine and chestnut ties purchased in 1910 were purchased by steam roads.

Hewn cypress ties were imported, but not used by steam roads.

With electric roads 61.4 per cent. of the ties purchased were hewn, as contrasted with the steam roads, where 70 per cent. were hewn. Douglas fir constituted 50 per cent. of the sawn ties and cedar constituted 34 per cent. Cedar made up 57 per cent. of the hewn ties and Douglas fir 20.7 per cent. The species which are chiefly used sawn are cedar, Douglas fir and oak. The species which are chiefly used hewn are hemlock, tamarack, cypress, spruce and jack pine. All the cypress and jack pine ties used were hewn. The average price of hewn ties was 37 cents, or 2 cents per tie less than was paid by steam roads. It is interesting to note that whereas with steam roads hewn ties cost 3 cents per tie more than sawn ties, with electric roads sawn ties cost 9 cents per tie more than hewn ties.

Imports from the United States of cross-ties in 1910 amounted to $1,096,832. Exports in 1910 were 1,995,582 ties at a value of $463,508. Of this total $376,913 was to the United States. The balance of imports over exports was $633,324, which represents about 891,000 ties at the average price paid for ties in Canada in 1910.

Two plants are now being established for the chemical treatment of railway ties. One is being erected at Fort Frances, Ontario, and the other is being started at Winnipeg. It is stated that a plant will also be erected at Vancouver. The plant at Fort Frances will be capable of treating 2,000 ties per day. The zinc-chloride-aluminium patent immersing process will be used, which both prolongs the life of the timber and rends it fireproof. It is questionable if this process will give as good results in Canada as would creosote.

This is a matter which for some years has been necessary for the preservation of the forests of Canada. At the same time it would have reduced the annual cost of railway maintenance. The average life of untreated ties as reported by the steam roads is: cedar, 9 years; tamarack, 8 years; hemlock, 7 years; Douglas fir, 7 years; jack pine, 6 years; spruce, 6 years. As may be noted from the tables, cedar is the species principally used, because of its durability, but the supply of cedar is rapidly becoming exhausted. Unless preservative treatment of ties is introduced, the species of short life will have to be used untreated, which, on account of the necessary frequent renewal, will increase the cost of mileage maintenance. If treated ties were used, which would cost about 30 cents extra per tie for creosoting and equipping with tie plates, the inferior species, which are very plentiful and cheap in Canada, could be used with economy. With such a treatment these woods would last at least 15 years, and if protected from wear would probably last much longer.

The lodgepole pine of the West would be greatly increased in usefulness by this treatment. This species is used chiefly for mining timbers and props and occurs, fire-killed, in vast areas on the mountain slopes of Alberta and British Columbia. It cannot be used for lumber, on account of checking, and, if untreated, it lasts only about 5 years when used for railway ties. At present this wood stands dead and perfectly seasoned and would take chemical treatment readily, after which it would make lasting and economical ties. By the use of such inferior qualities of timber, railway companies would assist conservation and at the same time decrease the cost of railway maintenance.

HILL ROADS IN CANADA.

The Canadian Northern Railway has granted trackage rights from Emerson, Man., on the international boundary line, to Winnipeg, 68 miles, to a new company formed in the interest of the Great Northern and the Northern Pacific. The new corporation is known as the Midland Railway of Manitoba. The agreement is for 20 years with a provision for extending it to a total of 999 years.

Trains of the United States roads are allowed to be run into Winnipeg but are not to do any local business unless by order of the Railway Commission, in which case the Canadian Northern is to have 80% of the gross receipts. The rental of the Winnipeg Terminal is to be $2.50 for each revenue train movement, with 50 cents additional for every car above eight, and certain other charges.

The line to be used is a part of the 355 miles of Northern Pacific's road in Manitoba, all of which was leased in 1901 to the provisional government for 999 years and subleased by it to the Canadian Northern.

PERSONAL.

MR. W. H. SCOTT has been appointed general agent for the Manitoba Government Telephone Commission.

MR. W. W. POWELL has been appointed land surveyor in the offices of the city engineer of Vancouver, B.C.

MR. H. RUSSELL HILL, B.A.Sc., was recently appointed to the position of sales manager for the Tagona Water and Light Company at Sault Ste. Marie, Ont.

MR. F. F. LONGLEY, resident engineer of the Toronto filtration plant, has resigned his position on the city's service and has accepted a position in the firm of Allen Hazen, New York.

MESSSRS RIDOUT AND MAYBEE, patent solicitors, are removing from their present premises at Manning Chambers to new and more commodious quarters at 59 Yonge Street, corner of Colborne Street. Owing to the increase in the legal business of the firm, Mr. J. F. Edgar, barrister-at-law, has now been associated with the firm as counsel.

MR. C. H. RUST, municipal engineer, city of Victoria, B.C., has been honored by the American Society of Civil Engineers, having been elevated to the position of First Vice-president, the first time in the history of the society that a Canadian has been so honored.

MEETINGS.

The 23rd annual convention of the Canadian Association of Stationary Engineers closed on July 25th last in Belleville, Ont., with the installation of the following officers,—President, J. A. Robertson, Stratford; vice-president, C. Cosford, London; conductor, F. H. Chester, Belleville; doorkeeper, H. L. Bishop, Hamilton; secretary, A. Kastella, Stratford; treasurer, W. E. Archer, Toronto.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, [illegible] 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912. Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. [illegible] Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meet- [illegible]

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

[illegible] Secretary, Mr Hugh [illegible] Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill [illegible] ge, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone- [illegible] University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

[illegible] K. W. McKay, County Clerk, St. Thomas, Ontario.

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES—[illegible]

[illegible]

[illegible] r, W. D. Lighthall, K.C., [illegible]

[illegible]

[illegible]

[illegible]

[illegible] Centre, B.C.

[illegible]

[illegible] Pipestone, Man.; Secy Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, [illegible] Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, [illegible] Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, [illegible] Hon. Secretary, [illegible] No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; [illegible] Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—[illegible] Secretary, [illegible]

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. [illegible] Secretary, Norman S. Rankin, [illegible]

WESTERN CANADA RAILWAY CLUB.—President, [illegible] Secretary, [illegible] Winnipeg, Man. Second Monday, except [illegible]

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-5	—Electric Generating Machinery, Canora, Sask (S.)	7-18
8-31	—Trenching and Backfilling, Edmonton, Alta (S.)	8-8

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Beaverton, Ont., breakwater, sheet piling and dredging	Aug. 26.	Aug. 1.	78
Brantford, Ont., dormitory buildings	Aug. 8.	Aug. 1.	68
Cape Croker, Ont., schoolhouse.	Aug. 26.	Aug. 1.	67
Cobourg Harbor, Ont., breakwater	Aug. 14.	July 25.	68
County of York, Ont., bridges	Aug. 10.	Aug. 1.	80
Dorval, P.Q., water works, etc.	Aug. 15.	Aug. 1.	67
Edmonton, Alta., gas holder and tank	Aug. 9.	July 4.	67
Edmonton, Alta., gas plant	Aug. 23.	July 18.	67
Kempenfeldt Bay, Ont., wharf and approach	Aug. 21.	Aug. 1.	67
Kirkfield Park, Man., incinerator	Aug. 8.	July 18.	78
Moose Jaw, Sask., switchboard	Aug. 9.	Aug. 1	67
Northern Ont., right to cut pine.	Oct. 1.	July 25.	68
Norway House, Man., school and hospital	Aug. 19.	July 11.	63
Ottawa, Ont., supply of coal.	Aug. 28.	July 25.	67
Ottawa, Ont., wire fence	Aug. 20.	Aug. 1.	67
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., twin screw steel steamer	Sept. 2.	Aug. 1.	67
Pas Reserve, Sask., school building	Aug. 19.	July 11.	68
Port Colborne, Ont., repair of headblock	Aug. 21.	Aug. 1.	67
Regina, Sask., electrical plant.	Aug. 14.	July 25.	68
Toronto, Ont., drip guards	Aug. 13.	July 25.	68
Winnipeg, Man., 36 inch pipe.	Aug. 28.	July 25.	68

◆

COPIES OF ENGINEER WANTED.

One copy each of our issues of July 4th and 11th, 1912, are required. The usual extension of the senders' subscription will apply in this case.

TENDERS.

Dunnville, Ont.—Tenders for road machinery will be received until August 14th, 1912, by the Corporation of the County of Haldimand. For full particulars apply to Alan Mair Jackson, county engineer, Dunnville, Ont. (See advt. in Canadian Engineer.)

Eastview, Ont.—Sealed tenders addressed to the Reeve of the village of Eastview, will be received by H. R. Washington, secretary-treasurer, up to 4 p.m. Saturday, August 10th, 1912, for the construction of a concrete sidewalk along the northerly side of the Montreal Road from Cumming's Bridge to Notre Dame Cemetery.

Edmonton, Alta.—Tenders for trenching and backfilling approximately 25 miles will be received by the City Commissioners, city of Edmonton, until noon of August 31st, 1912. Specifications, etc., at the office of The Canadian Engineer, 62 Church Street, Toronto, or at the office of the Gas Engineer, city of Edmonton. (See advt. in Canadian Engineer.)

Edmonton, Alta.—Proposals for the design, manufacture and fixing complete of electric lighting fixtures for the Parliament Buildings, Edmonton, will be received up to 12 o'clock noon, August 31st, 1912, addressed to John Stocks, Deputy Minister of Public Works, and endorsed "Proposals for Lighting." Plans and particulars can be obtained upon application to the office of the provincial architect, New Parliament Buildings, Edmonton.

Fort William, Ont. — Sealed tenders addressed to the chairman of the Utilities Committee and marked "Tenders for water pipe," will be received up to August 28th next. (See advt. in this issue of Canadian Engineer.)

Grayson, Sask.—Sealed tenders will be received by W. B. Thomson, Town Secretary, until August 10th, at 6 o'clock p.m., for the erection and completion of a public hall building in the town of Grayson, Sask. Plans and specifications may be seen at the office of the above.

Guelph, Ont.—Tenders for the construction of bridges will be received until noon of Aug. 14, 1912, by the County Clerk of Halton County, at Milton. Plans and specifications may be seen at the county clerk's office, Milton, or at the office of Messrs. Malcolm & Rudd, engineers, Metropolitan Bank Building, Guelph. (See advt. in Canadian Engineer.)

Jackson's Point, Ont.—Tenders for the construction of a 90 ft. through truss steel bridge, with concrete abutments and concrete floor, at the mouth of the Black River, on Jackson's Point, will be received up to noon of August 17th, 1912. Plans and specifications at the office of Frank Barber, Esq., civil engineer, 57 Adelaide St. E., Toronto. (See advt. in Canadian Engineer.)

Montreal, Que.—Tenders will be received up to noon of 12th August, 1912, for the hiring of one or more spoon dredges; also one or more floating or land derricks for clamming material from flat scows to the shore; also one or more attending tugs and the necessary scows. Full particulars may be obtained upon application to Mr. F. W. Cowie, chief engineer. M. P. Fennell, jr., acting secretary, Harbor Commissioners of Montreal, Montreal.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, Secretary Department of Public Works, will be received up to 4 p.m., August 28th next for the construction of a breakwater at Port Arthur, Ont. (See advt. in this week's issue of The Canadian Engineer.)

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, Secretary Department of Public Works, will be received up to 4 p.m. on Monday, July 10th, for the construction of a wharf at Metchosin, B.C. (Nanaimo District).

Ottawa, Ont.—Sealed tenders addressed to the Director of Contracts, Department of Militia and Defence, Ottawa, will be received up to noon of August 12th next for the construction of a fence around the military cemetery in Montreal.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, Secretary Department of Public Works, will be received up to 4 p.m. Monday, August 26th, 1912, for the construction of a wharf and approach at Parry Sound, Ont.

Ottawa, Ont.—Tenders for additions and alterations to laboratory No. 1 experimental farm, Ottawa, will be received until August 24th. Plans, etc., at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Ottawa, Ont. — Tenders for external painting, Work Point Barracks, Esquimalt, B.C., will be received up to noon of August 20th, 1912. Specifications, etc., may be seen at the office of the officer commanding District No. 11, Victoria, B.C., and the Director of Engineer Services, headquarters, Ottawa. Eugene Fiset, colonel, deputy minister, Department of Militia and Defence, Ottawa.

Ottawa, Ont.—Tenders addressed to A. J. Jarvis, Asst. Deputy Minister and Secretary of Agriculture, Ottawa, will be received up to noon of August 19th, for the several works and materials required in the erection and completion of a stable and barn at Rosthern, Sask. Specifications and plans at the office of the superintendent of the experimental farm station, Rosthern, Sask.

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, for the erection and completion of superintendent's residence at Lockport, Selkirk District, Man., will be received until August 20th, 1912. Plans and specifications at the department, and at the offices of W. Z. Earle, district engineer, Winnipeg, Man., and A. S. Innes, supt., Lockport, Man.

Redcliff, Alta.—Bids are wanted for the building of a ferry of the standard government type at Redcliff. Detailed drawings and blue print will be furnished upon application to C. W. White, secretary-treasurer of village.

Sherbrooke, Que.—Tenders are being called for two steel highway bridges for the township of Ascot, Quebec. W. W. Baker, secretary. Tenders close August 10th, 1912. Plans and specifications at the office of the secretary.

Toronto, Ont.—Sealed tenders endorsed "Tenders for Packing House," will be received by the Department of Public Works of Ontario up to Monday, August 12th, for the erection of a packing house at Jordan Harbor. Plans may be seen at the department and at the fruit station, Jordan Harbor, Ont.

Vancouver, B.C.—Messrs. Sharp and Thompson, 536 Hastings Street West, will receive (bulk and separate) tenders up to noon August 21st next, for the following trades: Constructural steel and concrete, bricklayer, stonemason, terra cotta, carpenter, external and internal millwork, bronze and ornamental iron, sheet-metal work, roofer, tiling and marble plasterer, painter and decorator, glazer. This is for a new club house to be erected in this city.

Vancouver, B.C.—The city council have accepted the recommendation that tenders be called for the paving of Seaton Street, which will involve the construction of an expensive sewer.

Winnipeg, Man.—Tenders for the manufacture and delivery f.o.b. at the power house, Point du Bois, Man., of one 300 k.w. 3 phase transformer, will be received until noon of August 14th, 1912. Specifications, etc., at the office of the City Light and Power Department, 54 King St., M. Peterson, secretary, Board of Control office, Winnipeg.

Winnipeg, Man.—The Chairman, Board of Control, will receive tenders [illegible] of August [illegible], for the supply of [illegible] Specifications, etc., may be obtained at the office of the City Engineer, [illegible] James Avenue. M. Peterson, secretary, Board of Control office, Winnipeg.

County of York, Ont.—Tenders for the construction of [illegible] River at [illegible], in the County of York, will be received up to noon of Saturday, August [illegible]. Plans and specifications at the office of Frank Barber, Esq., county engineer, 57 Adelaide St. E., Toronto. (See advt. in Canadian Engineer.)

Township of York, Ont.—Tenders for the construction of [illegible], Township of York, will be received at the office of Frank Barber, Esq., township engineer, 57 Adelaide St. E., Toronto, up to noon of August [illegible]. Plans and specifications at the office of the engineer. (See advt. in Canadian Engineer.)

CONTRACTS AWARDED.

Buchanan, Sask.—Messrs. Hanks and Bertram, Canora, Sask., have been awarded the contract to erect a school building in this municipality.

Calgary, Alta.—Messrs. John Gunn and Sons, of Winnipeg, have secured the contract for the Canadian Northern bridge across the Bow River inside the city of Calgary limits at a price said to be $150,000.

Georgetown, Ont.—The tender calling for the erection of a combined bridge and dam over the Credit River has been awarded to Frank Barber, 57 Adelaide St. E., Toronto. The contract is let on a cost basis plus a fixed extra for professional services.

High River, Alta.—The John McDougall Caledonian Iron Company, Montreal, have been awarded the contract to build and install the pump in a new pump house that will be constructed by this municipality by day labor.

North Toronto, Ont.—J. T. Connolly, 606 Avenue Road, Toronto, has been awarded a contract to lay 30,000 square yards of asphaltic concrete at $1.90 per square yard, and construct 5 miles of storm sewer at a unit price.

J. H. McKnight Construction Company, Toronto, have been awarded a contract to lay 30,000 square yards of Dolarway pavement at $1.70 per square yard.

J. K. Allen, Toronto, has been awarded a contract to lay 30,000 square yards of Tarvia pavement at $1.25 per square yard.

North Vancouver, B.C.—The city council have awarded a contract to W. Evans Company, to lay a cement sidewalk with gutter, curbs, etc., on Lonsdale Avenue. The price for the work is $3,905.50.

Penticton, B.C.—Messrs. Grant, Smith and Company, of Spokane, have been awarded a contract to construct fifty-seven miles of the Kettle Valley Railway.

Regina, Sask.—Messrs. Wilson and Wilson have been awarded the contract to erect an addition to the Regina Institute at a cost of $88,500. Other bidders and their tender prices were: R. J. Lecky and Company, Regina, $109,962.; Parsons Building Company, Limited, $95,580.; Smith Bros. and Wilson, $90,000.

South Vancouver, B.C.—The contracts for the four new schools in the municipality were let by the school board to Messrs. McPhalen Bros., whose tenders were the lowest received. The total cost of the construction of the schools will be $142,000, divided as follows: Sexsmith, Sixty-first and Ontario, $35,300; Secord, Victoria Road and Sixty-first, $36,200; Gordon, Ferris and Knight Roads, $35,700; Norquay, Ferguson Road, $35,200.

Vancouver, B.C.—The recommendation of the city engineer for the awarding of the contract for the paving of Broadway Bridge to Laurel, to La Placa Bros., at $47,636 was accepted, as well as another recommendation giving a contract to the same firm for the resurfacing of Main, Hastings to Harris, at $10,340.

Victoria, B.C.—On the recommendation of the Electric Light Committee of the city council the tender of Hutchison Bros. for installing a lighting system on portions of Government Street and Dallas Road was accepted. The contract price for the first mentioned thoroughfare is $10,350 and for Dallas Road, $6,648.

Winnipeg, Man.—The city council has accepted the tender of the Canada Cement Company for from 15,000 to 25,000 barrels of cement to be delivered this year at $2.40 per barrel gross, including sacks.

◆

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta. — The Canadian Pacific Railway will double track about eight miles of its track from the Ogden shops through the city to Sunalta.

Halifax, N.S.—The receipts from the operation of the Halifax Electric Tramway Company, Ltd., for the week ending July [illegible], showed a decrease in comparison with a similar period last year. They are as follows:

1911	1912	Decrease.
$7,591.50	$7,440.07	$151.43

Hamilton, Ont.—A report states that a project calling for the construction of a new incline to carry street cars to the top of the hill behind the city is under way. Mr. T. F. Webb is interested in the project.

Tarvia

Preserves Roads
Prevents Dust–

Main Street, Wolfville, N.S., Constructed with Tarvia X.

Millions of Yards Treated

FOR a hundred years macadam roads have been standard. The motor driven vehicle, however, added a new destructive element to road wear that macadam had not provided for. A stronger binder than stone dust was found necessary to hold the road together under this traffic.

The new conditions brought forth a variety of bituminous binders. Of these Tarvia, manufactured from refined coal tars, was the first to be used and is now standard for this purpose.

Tarvia is made in three grades—"Tarvia X" for road and pavement construction. "Tarvia A" for hot surface application, and "Tarvia B," applied cold, for dust prevention and road preservation.

Millions of yards of macadam have been successfully tarviated in all parts of the country. The use of Tarvia waterproofs the macadam, prevents its disintegration, keeps down the dust and gives a surface that is smooth, well bonded and automobile-proof.

Towns and cities which have used Tarvia for a number of years are proud of their roads and pavements, while the records show that its use has been most economical—the saving in maintenance expenses having generally more than paid for the cost of the treatment.

Booklet showing roads in various parts of the country treated with Tarvia and giving details of the process mailed free on request.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

LIGHT, HEAT AND POWER.

Duncan, B.C.—It is the intention of this municipality to erect a power plant at Skutz Falls, on the Cowichan River.

Moose Jaw, Sask.—The new generator at the Manitoba Street station has been connected with the mains. Many householders and power users are now receiving a normal supply.

Welland, Ont.—The ratepayers voted in favor of spending $45,000 on a hydro-electric service to light the streets, stores and residences. The vote was 329 for and 183 against. D. Black, town engineer.

◆

GARBAGE, SEWAGE AND WATER.

North Vancouver, B.C.—The municipal council have decided to finish the Rice Lake tunnel. Ald. Dick is chairman of the Water Works Committee.

Ottawa, Ont.—The municipal council have started negotiations with Mr. Allen Hazen, of New York, regarding the erection of a mechanical filtration plant on Lemieux Island. Mr. Weston Fuller, Ottawa, is looking after Mr. Hazen's interests in this matter for the present.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Edmonton, Alta.—Plans have been completed for the erection of a new barracks for the R.N.S.M.P in this city. It is to cost $70,000. Messrs. Nesbitt and Miller are the contractors and Rowland W. Lines is architect.

Fort William, Ont.—A company taking the name of the Mount McKay Pressed Brick Company has been formed, and will expend $200,000 on a plant. Mr. James Gowanlock, Dr. W. H. Hamilton, and W. A. Dowler, K.C., all of Fort William, are the organizers.

Lethbridge, Alta.—The federal government will erect a laboratory at the quarantine station for the purpose of veterinary medical research. The plans for the new building are being prepared by Ernest Carver, of this city. The building will be two stories and of brick construction.

Montreal, P.Q.—Messrs. Mackenzie, Mann and Co. will erect construction plants near the site of the new tunnel. These buildings will be of frame covered by galvanized iron, and they will contain steam driven air compressors, steam boilers, steam and electric hoists and derrick and electrical ventilation blowers. The buildings will be surrounded by high fences.

North Toronto, Ont.—The Finance Committee have re- [illegible]

Ottawa, Ont.—A group of Montreal capitalists have se- [illegible] rifle ranges. It is [illegible]

Toronto, Ont.—The Harbor Commissioners have decided [illegible]

Toronto, Ont. [illegible]

Vancouver, B.C. [illegible]

Welland, Ont. [illegible]

BRIDGES, ROADS AND PAVEMENTS.

Fredericton, N.B.—The municipal council has decided to lay more Tarvia pavement than was first proposed, and to cover the Hassam pavement with the same material.

Hamilton, Ont.—At a meeting of the Cost and Material Committee of the projected Toronto-Hamilton highway, the following recommendations were adopted. That the roadway be eighteen feet in width with a space of three and a half feet on each side, the eighteen-foot strip to be constructed with a concrete base and brick or other topping. The cost of this work was estimated at $600,000. T. Kennedy, Dixie, Ont., president of the committee.

Prince Rupert, B.C.—The municipal council have adopted the recommendations of the acting city engineer, Mr. Mason, regarding a sewer system. The plans provide for a system of concrete modern sewers, egg-shaped in section, according to the latest ideas, and calculated to carry off all surface water as well as sewage.

Toronto, Ont.—The Works Commissioner will recommend a steel bridge on St. Clair Avenue to replace the concrete work which was damaged recently.

Vancouver, B.C.—The Railway Commission have ordered the construction of a bridge across the second narrows at a cost of $2,000,000. City Engineer of Vancouver, F. L. Fellows.

◆

FIRES.

Montreal, P.Q.—The premises of the Montreal Abattoirs, Ltd., were damaged by fire to the extent of $200,000.

Vancouver, B.C.—The furniture plant of Max Freed was destroyed by fire with a loss of $70,000.

◆

CURRENT NEWS.

Berlin, Ont.—The ratepayers will vote August 31st on the following proposals: To spend $15,000 for the erection of a tuberculosis sanitarium; to spend $17,000 on an addition to the car barns and for the purchase of two new cars; to spend $5,000 for the erection of a civic abattoir; to spend $6,000 on the erection of municipal barns; to spend $6,000 on a bridge across the Grand River. H. Johnston, city engineer.

Dauphin, Man.—It is reported that local contractors have so much work on hand that the erection of a new church has had to be postponed and that several hundred additional mechanics could find employment here.

Montreal, P.Q.—Mr. Philippe Herbert has had his design accepted by the committee of judges for a memorial to His Late Majesty King Edward VII. The design shows King Edward in his official robes and in a very life-like pose, holding the sceptre of state, and provides for a granite pedestal thirty feet high, of exceedingly handsome and massive design, while the bronze figure of the King will be ten feet high, making forty feet in all.

New Westminster, B.C.—Friction has arisen between the municipal council and the gas company in this city, the former claiming that the franchise of the latter has expired and threatening damage action if pipe laying is continued.

Ottawa, Ont.—The government has received five tenders for the construction of the elevator at Fort William, Ont., as follows:—J. A. Jamieson, Barnett McQueen, the J. S. Metcalfe Co., J. H. Tromanhausen, the Canadian Stewart Co.

St. Catharines, Ont. — Another accident caused by a [illegible] the Welland Canal, caused considerable damage and obstructed navigation for several hours.

Vancouver, B.C.—A report states that the Schaake Ma- [illegible] Company, Ltd. The [illegible]

Welland, Ont. The total building permits for this year [illegible]

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

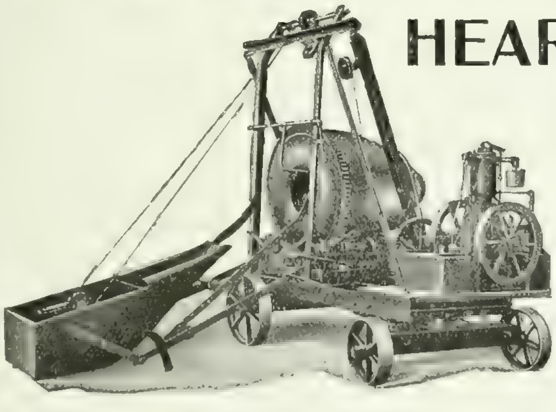
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

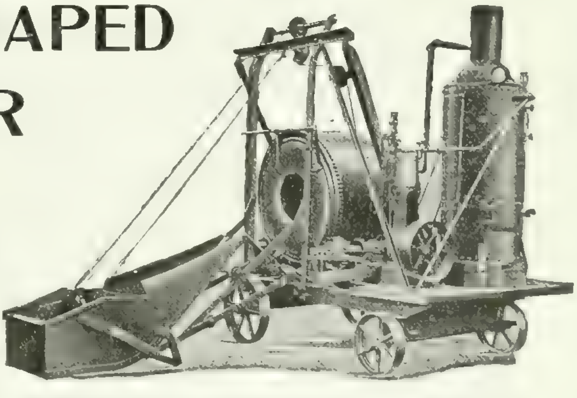
PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER

HEART-SHAPED MIXER



Write for 1912 Catalogues.



The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH. BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.,
316 Lagauchetiere St., W.,
Montreal, Que.

CANADA'S PACIFIC COAST

Mr. E. J. Chamberlin's recent statement that the Panama Canal will not affect the shipment of grain eastward, has caused considerable comment on the coast. Vancouver and New Westminster have been looking for almost immediate shipments of grain, especially in view of the great congestion that annually occurs on the prairie, and which is growing greater with the expansion of production of wheat. Mr. Chamberlin declares that the tropical heat will so affect grain in transit that it cannot be shipped via Canada's western Canadian ports, which will include Prince Rupert, once the Grand Trunk Pacific is completed. This point has been raised before though not by an official and public man of Mr. Chamberlin's standing. As an argument it may be stated that grain is shipped every year and has been shipped for many seasons past from Seattle, Tacoma and Portland, the ultimate destination being Europe. This grain passed through the tropics in transit, and it has not been so ruined that the traffic has ceased.

This point is argued also by Senator R. H. Pope, who was on the coast recently. He says that this danger may be relieved if not entirely avoided by giving the wheat a chance to dry after it is threshed.

He makes the suggestion that the government should advance farmers money on their crop at a reasonable interest to enable them to hold it until they can sell advantageously.

This point will apply further than in reference to quick marketing of wheat for exports. Farmers cannot afford to hold their wheat, for they need the money badly by autumn, and as a result they sell as soon as they can get the grain to the nearest elevator. The result is that they often have to take what is offered, accept the buyer's grading and are subject to many methods whereby they are deprived at times of their full measure. If Mr. Pope's suggestion could be carried into effect it would mean a great deal to the farmer on the prairie who is doing much to give Western Canada stability.

Insofar as quick marketing affects export via the western ports of Canada, those interested in the question here do not anticipate that the flow of grain to the Pacific coast can be stopped. In the meantime, the necessary preliminary arrangements are going ahead to provide facilities for shipment.

This week another railway move has been made. The Pacific Great Eastern has filed its plan through North Vancouver, and makes the announcement that five surveying parties are in the field on the projected route to the north. Mr. D'Arcy Tate, of the Grand Trunk Pacific, is on the coast and the statement is given out that the Grand Trunk Pacific will buy out the new company. When Sir Richard McBride made public his railway policy in the House last winter, The Monetary Times pointed out that the Pacific Great Eastern was really intended for the Grand Trunk Pacific's accommodation between Fort George and Burrard Inlet. This was denied at the time, but present developments seem to show that the statement was right.

It looks as if coal will be extensively mined in the northern part of the province within the next year or two, though it is hardly probable that mines will be in operation before the completion of the Grand Trunk Pacific, which would provide facilities for shipment to interior points. Eastern Canadians and London financiers are interested in the British Columbia Anthracite Syndicate, which has large coal land holdings in Groundhog Basin in the Skeena district. This company obtained a charter at the last session of parliament to build a [illegible]. A route map has now been filed with outlet for the railway on Portland Canal. Sir [illegible] has acquired options on coal fields in the same basin, and has had [illegible] in the coal fields. Development of these coal measures on the coast will aid the proposal to establish iron works on the Pacific shore. The iron ore is here, and all that has been wanting is coke at a price low enough to warrant the initiation of the enterprise.

Timber as an investment has been recognized during the past two or three years, and it is realized that it will greatly increase in value during the next five years. That is why a considerable amount of money from Europe has come into British Columbia. Visiting timbermen from the United States are quick to tell what is going to happen for they can see conditions of fifteen or twenty years ago in the middle states being duplicated on the Pacific coast. For that reason, Mr. Hans Dierks, of Kansas City, who was here recently, advises owners to sit tight, for lumber manufacturers will have to come to British Columbia, and this opinion is held by other prominent lumbermen.

GRAIN GROWERS GRAIN COMPANY.

The Grain Growers Grain Company, which is the organization of the Western Canadian Farmer, held their meeting in Winnipeg on July 16th, under the presidency of Mr. T. A. Crerar. The years' statement showed a net profit of $121,614, against $69,000 the previous year and but $790 five years ago. The paid-up capital is $568,000, and, after paying a ten per cent. dividend, $60,000 was added to the reserve fund, which now stands at $200,000, this despite the difficulty in handling last year's crop, owing to low grades, tough wheat and traffic congestion.

The president said that the company had practically closed with the Canadian Pacific Railway a deal whereby they would lease the big terminal elevator "B" at Fort William, Ontario, and with the Manitoba Government for leasing its extensive system of internal elevators, both of which projects the meeting was asked to ratify. The company had also acquired timber limits in British Columbia estimated to contain 300,000,000 feet.

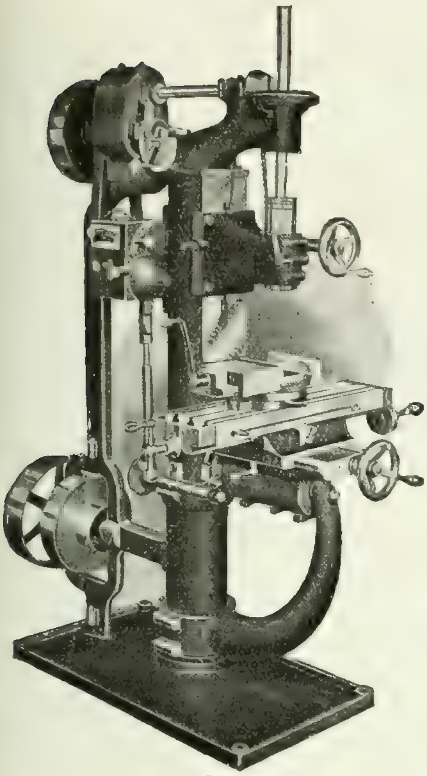
The profits of the company for previous years were as follows: 1911, $69,575.46; 1910, $59,663.78; 1909, $53,000; 1908, $30,190.24; 1907, $790.54.

Speaking of future developments, Mr. Crerar favored the local unit method as practised by the farmers' elevators of Minnesota and the Dakotas, whereby other classes of merchandise were successfully handled by country elevators. It was necessary to secure best results to maintain the staffs all the year round, and lumber, binder twine and implements could be profitably handled during the summer months. He advocated the securing of a good coal area, as coal and lumber were rapidly going under control of combines. He favored selling to everyone, but giving a discount to their shareholders. Units would be built up by issue of stock to local subscribers, and there was no reason why in time the successful merchandising of the British co-operative societies should not be duplicated.

The company might further secure connection with a mortgage corporation and secure cheap money for farmers. The money power in Canada, he said, was becoming a menace and its evil possibilities might largely be overcome by co-operative credit societies.

NEW GAS ENGINE AGENCY.

Messrs. Richard Hornsby and Sons, Ltd., of Grantham, England, makers of the well known Hornsby-Stockport gas engines and suction plants, have just opened a Canadian office in the Cartier Building, 212 McGill Street, Montreal, in charge of Mr. [illegible] H. Anderson. For a number of years now this firm has been selling their engines in Canada with considerable success and in order to further develop their trade throughout the Dominion the Montreal office has been opened so as to render still more efficient service to intending purchasers in various parts of the Dominion.



You Need a Machine Like This on a Dozen Different Jobs

It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows:—Spindle of crucible steel, ground bearings; working surface of table, 29 × 8½ inches; feed, longitudinal and transverse; floor space, 60 × 68 inches; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

TRADE ENQUIRIES.

The following among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending July 22nd, 1912:—

The commercial manager of an English firm manufacturing a patent lighting system is about to visit Canada with a view to appointing agents in each province.

A London firm stated to have a regular market for from three to four thousand tons of soft, smooth graphite per annum, desire to be placed in touch with actual mine owners in Canada.

A Johannesburg correspondent desires to secure agencies for Canadian manufacturers open to do business in South Africa.

From the branch for city trade enquiries, 73 Basinghall Street, E.C.

A Yorkshire company manufacturing petrol and paraffin engines, also a large variety of machine tools, wish to arrange for their sale in Canada.

◆

MINERALS IN QUEBEC.

The annual report of the Mines Branch of the Province of Quebec for 1911 has been issued, showing that last year the value of the production of the Quebec mines amounted to $8,679,786. This is an increase of $1,356,505, as compared with the preceding year. From about two million dollars in 1899, the value of minerals has climbed up to over eight and a half million dollars. In 1911, the mines of the province produced asbestos, copper ore, iron ores, mica, graphite, magnesite, and all kinds of structural materials.

Dr. J. A. Bancroft, professor of geology at McGill University, Montreal, reports on the region between the Kinojovis and the Harricanaw Rivers.

◆

A BOG PATCH NOT TAKEN INTO ACCOUNT.

A patch of boggy ground near Ardley on the line of the Great Northern Railway about five miles out of Vancouver, B.C., has been giving the engineers and maintenance-of-way men trouble during the last few days. The spot has got so soft during the last few days that it was considered unsafe to run trains over it and consequently passengers are being transferred at that point until the trouble can be remedied. Soundings in this particularly boggy spot have developed the fact that it is possible to go down nearly 300 feet before the underlying country hardpan is reached or any other kind of a firm foundation. The trouble is said to have developed through the piling up of material for the laying of a double track at that point, the extra weight causing the soft foundation to sink. The engineers are puzzled as to just what to do but meanwhile filling-in operations are being continued with a view of securing a substantial foundation.

◆

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible] Board of Railway Commissioners [illegible] date [illegible]

[illegible]

[illegible] Ry. between mileage 82.8 and 121.51 northerly from Hobon, on C.P.R. main line.

[illegible]

17053—July 17—Authorizing Campbellford, L. Ont. & W. Ry. to cross highways from mileage 128.9 to 131.23, in Twp. of Hope, County of Durham, Ontario.

17054—July 17—Authorizing Atlantic, Quebec & Western Ry. to open for carriage of traffic its line between Grand River Station, mileage 51½, and Gaspe Station, at mileage 102½.

17055—July 17—Naming express delivery and collection limits for city of Estevan, Sask.

17056—July 16—Authorizing C.P.R. to construct spur for Saskatoon Tent & Mattress Co., Saskatoon, Sask.

17057—July 17—Authorizing C.N.R. to cross 9 highways on its Alsask Southeasterly Branch.

17058—July 17—Authorizing James Bay & Eastern Ry. (C.N.R.) to construct bridge across Salmon River, mileage 22.1.

17059—July 17—Authorizing V.V. & E. Ry. to open for carriage of traffic its line from Abbotsford to Kilgard, B.C.

17060—July 17—Authorizing C.P.R. to construct spur for Winnipeg Supply Co., Ltd., Winnipeg, Manitoba.

17061—July 19—Authorizing C.P.R. to revise grade of present main line and construct additional main line track from mileage 17.35, Farnham S.D., to Iberville Jct., thence to mileage 41.8 to Highlands, Que.

17062—July 18—Authorizing C.P.R. to construct spur for Roofer's Supply Co., Ltd., Toronto, Ont. (Esplanade Street).

17063—July 18—Authorizing C.N.Q. Ry. to cross public road in Parish of St. Eustache, Que., County Two Mountains.

17064—July 5—Galt Interswitching, providing for same by G.T.R. in Galt, Preston and Hespeler, etc., Berlin and Waterloo.

17065—July 15—Authorizing C.N.O. Ry. to cross Jacques-Cartier and Union Ry. (G.T.R.) near Jacques Cartier Jct., Que. Interlocker to be installed.

17066—July 20—Re C.N.R. and G.T.P. spur to Tuxedo Park Co., Winnipeg, Man., apportioning cost of work, etc.

17067—July 17—Authorizing C.N.R. to cross public road on its Alsask Southeasterly Line.

17068—July 19—Authorizing G.T.R. to construct certain bridges on its Holmedale Branch, Brantford, Ontario.

17069—July 19—Directing G.T.R. to file within 15 days plan of location of station proposed at level crossing between tracks of G.T.R. and G.M. & S. Ry. at St. Gregoire; that St. Gregoire be established as regulation station with telegraph communication between Doucet's Landing and Victoriaville; that the Q.M. & S. Ry. be required to construct platform at proposed station for the transfer of passengers from G.T.R. to Q.M. & S. or vice versa.

17070—July 15—Approving of the C.P.R. station (proposed change) at Bredenbury, Sask.

17071—July 15—Approving of proposed change in location of C.P.R. station at Merritt, B.C.

17072—July 20—Directing the C.P.R. to appoint and maintain a permanent watchman, day and night, at crossing at mileage 101.6, Boundary Subdivision, near Fisherman, B.C.

17073—July 19—Authorizing Toronto Eastern Ry. to cross public road between Townships of Pickering and Whitby, in Concession 2 of each of the said Townships.

17074—July 19—Authorizing the C.L.O. & W. Railway to construct bridges 180.2 and 180.13, at Little Rouge and Big Rouge Rivers.

17075—July 19—Authorizing C.P.R. to construct spur on premises of Provincial Reformatory, on Lot 3, Con. 1, Twp. of Guelph, Ontario.

17076—July 19—Approving of proposed shortening of track circuit in connection with crossing bells at Argyle Street, Renfrew, C.P.R.

17077—July 19—Approving of proposed interlocking and signal device to be used in operating over the Lachine Canal by C.P.R.

17078—July 19—Authorizing C.N.O. Ry. to cross public road between Cons. 16 and 17, Township of Ferris, Dist. of Nipissing, Ont.

17079—July 19—Approving of C.N.O. Ry. station grounds at Smith's Falls, Ont., subject agreement between town of railway company, dated June 3, 1911.

17080—July 20—Authorizing C.N.O. Ry. to cross G.T.R. near Davenport Road, Toronto, question of taking of lands left to Chief Engineer of Board.

[illegible]—July [illegible]—Directing G.T.P. Ry. to repair approaches to crossing within 30 days under penalty of $25 on property of Donald McKenzie, Kirk, Alberta.

[illegible]—July [illegible]—Authorizing Lachine, Jacques Cartier & M. Ry. (G.T.R.) to take lands of Montreal, Park & Island Ry. in Parish of St. Laurent, Montreal, 597 ft. 100-ft. wide.

[illegible]—July [illegible]—Approving C.P.R. plan for steel trestle of bridge No. 26.8, and reconstruct bridge 109.4 on its Suffield-Kipp and Muskoka Subdivisions.

[illegible]—July [illegible]—Authorizing G.T.R. to construct spur for New Burford Canning Co., Ltd., County of Brant, Ontario.

17086—July 22—Approving proposed station and site of G.T.P. B.L. Co. at [illegible] Boundary Branch, Sask.

17087—July 20—Directing Dominion Atlantic Ry. to install gates at Gerrish Street, Windsor, N.S.; 20 per cent. from Railway Crossing Fund.

17088—July 23—Dismissing application Board of Trade, Pelly, Sask., re delay to shipments of freight C.N.R.

[illegible]—Directing C.N.R. to within [illegible] days to file plan for station at [illegible], Ont.

17090—July 22—Authorizing Toronto Suburban Ry. to cross C.P.R. Sudbury Division, by means of an undercrossing in Twp. of Vaughan, County of York, Ontario.

[illegible]—Authorizing C.N.O. Ry. to construct its line of railway across [illegible], District of Nipissing, Ontario.

[illegible]—Authorizing Campbellford, Lake Ont. & W. Ry. to cross Whitby, Port Perry and Lindsay Branch of G.T.R. at mileage 163.46, from [illegible].

17091—July 22—Authorizing C.P.R. to construct bridge No. 170.57 over [illegible] C.L.O. & W. Ry.

[illegible]—Approving [illegible] C.P.R. station on Lot 18, Con. [illegible], [illegible] C.L.O. & W. Ry.

Volume 23 Toronto, August 15, 1912

Contents of this issue on page 321

The Canadian Engineer

An Engineering Weekly

THE HIGH TENSION TRANSMISSION SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

FOURTH ARTICLE.

Dundas Station.—The Dundas station (Fig. 25) is the main interswitching station of the present system, and from here the outgoing transmission lines radiate to the various sub-stations.

The station equipment consists of four 750 kv-a. oil insulated, water cooled, 110,000 to 13,200-volt Westinghouse step-down transformers, employed to supply the city of Hamilton and vicinity; seven 110,000-volt Westinghouse electrically operated circuit-breakers equipped with condenser type bushings; six sets of outdoor type, 110,000-volt, electrolytic lightning arresters and two sets of 13,200-volt, electrolytic lightning arresters.

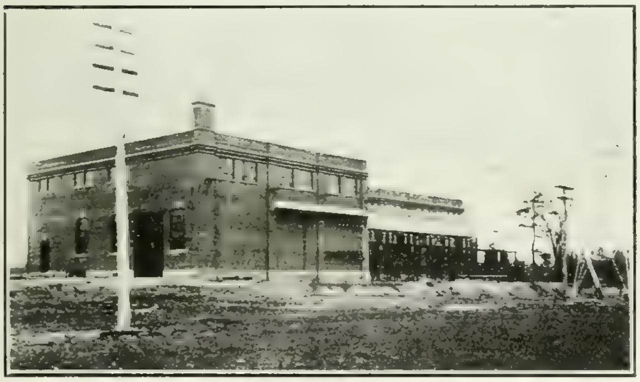


Fig. 25.—The Dundas Inter-switching Station.

Seven 110,000, three-pole automatic solenoid-operated oil switches, one for each incoming and outgoing line and one for each bank of three 750-kv-a. transformers are also installed. Two sets of 110,000-volt buses are supported on horizontal I-beams near the roof, in a manner similar to those at the Niagara Falls station. Disconnecting switches are provided on the line side of the oil switches, while on the station side two sets are installed and so arranged that any of the lines may be connected to either set of buses. (Fig. 26).

The same method of installing and removing transformers is employed as at Niagara. In fact, the same arrangement is in all stations in the system. The transformers are connected star delta with low-tension winding potential of 13,200 volts. A spare transformer is provided to replace the transformers of the connected bank, in case any of them become disabled.

The 13,200-volt switches and busbars are enclosed in concrete cells. The present structures accommodate the transformer switch, two line switches, and the service transformer switch. They are all automatic, electrically controlled oil switches, each provided with relays best suited for the requirements of the service for which they are employed. Service transformers are provided to supply light and power to the station. Three oil-insulated, self-cooled, 75-kv-a. transformers, stepping down from 13,200 to 2,200 volts serve the town of Dundas. (Fig. 27).

The apparatus in the station is operated from an enclosed control room situated at one end of the high-tension switch room, in which are located the main control and service boards, similar to those at Niagara. The control switchboard carries all the control switches operating at 110-volt d.c. for the remote control of the high and low-tension power switches, and also the meters. The service board is a regular switchboard employed to distribute the power to the different lighting and power circuits in the station.

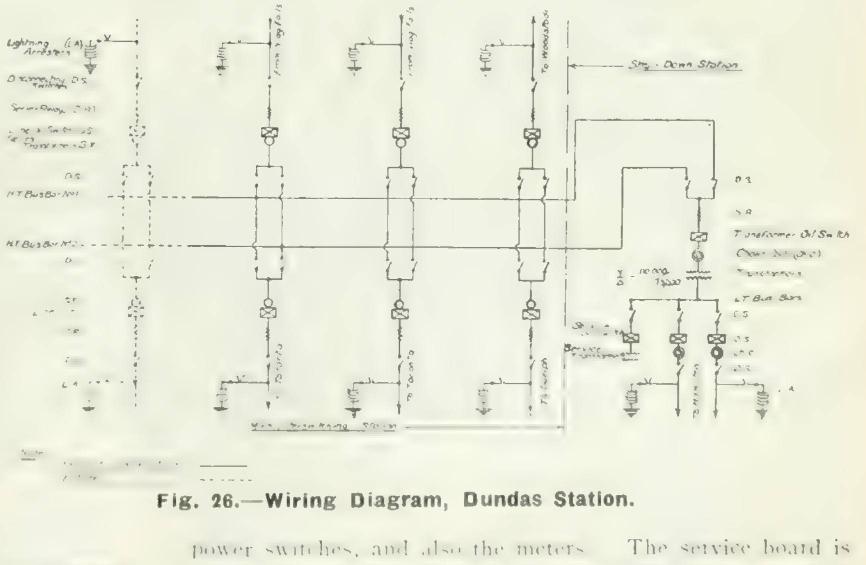


Fig. 26.—Wiring Diagram, Dundas Station.

The mechanical and cooling equipment in general is the same as in the step-up station.

Condenser bushings are used in both the Niagara Falls and the Dundas stations on all high-tension switches and transformers. The Canadian Westinghouse Company furnished and installed the entire equipments, with a few exceptions, of these two stations. Arrangements are being made at the present time for the installation of an additional bank of transformers and the necessary switches. (Fig. 28).

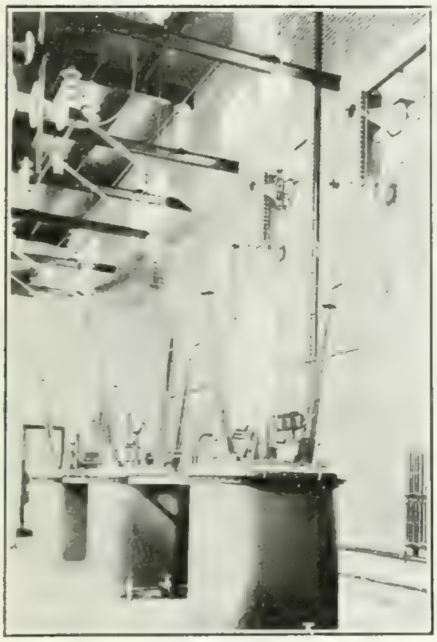


Fig. 27.—110,000-Volt Breaker Unit, Dundas Station.

Toronto Station.—This station (Fig. 29) is divided into three rooms, each running the entire length of the building, and consisting of the high-tension switching, transforming, and the low-tension switching sections.

The incoming lines are protected by electrolytic arresters placed within the building, and provided with horn gaps mounted on steel structures outside. The hoods for the outlets are built with a floor, upon which the entrance bushings, consisting of stacked porcelain rings with a pronounced petticoat, are mounted. The different sections of the bushings are clamped together with a brass bolt extending through the centres, the intervening spaces between the brass and porcelain being filled with concentric fibre rings and insulating compound. Since the arresters are placed inside and the horn gaps outside the building, six bushings are required for each line. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] on the inner side of the arresters.

The [illegible] oil switch equipment [illegible] [illegible] [illegible] [illegible] [illegible] bushbar circuits. The [illegible] [illegible] [illegible] [illegible] [illegible] are similar to those at Niagara Falls and Dundas, with the exception that the [illegible] [illegible] are of a [illegible] [illegible] type. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] built of annular ringed sections of compound clamped together, the interior space being filled with concentric cylinders of treated fibre compound. (Fig. 30).

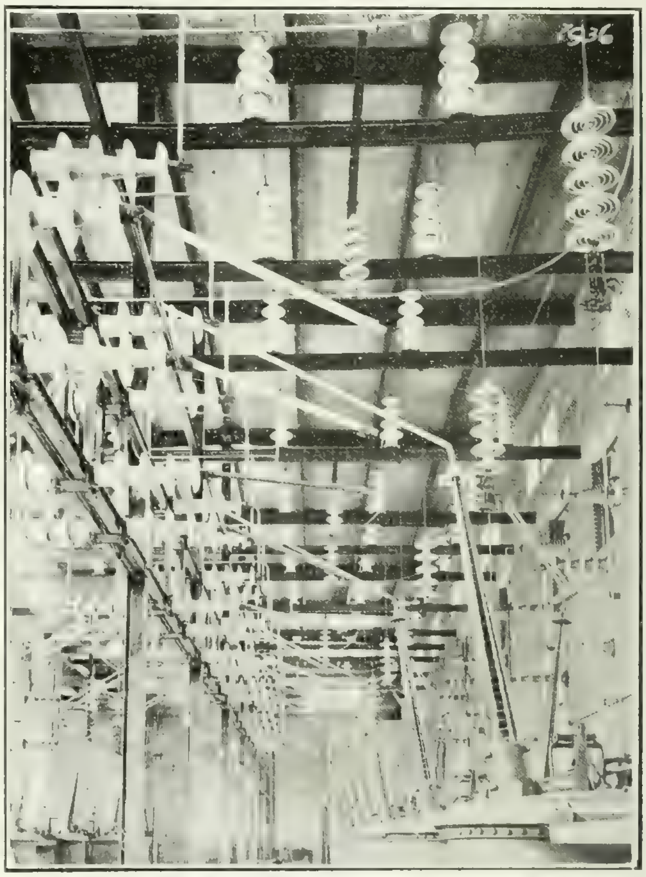


Fig. 28.—General View of 110,000-Volt Layout, Dundas Station.

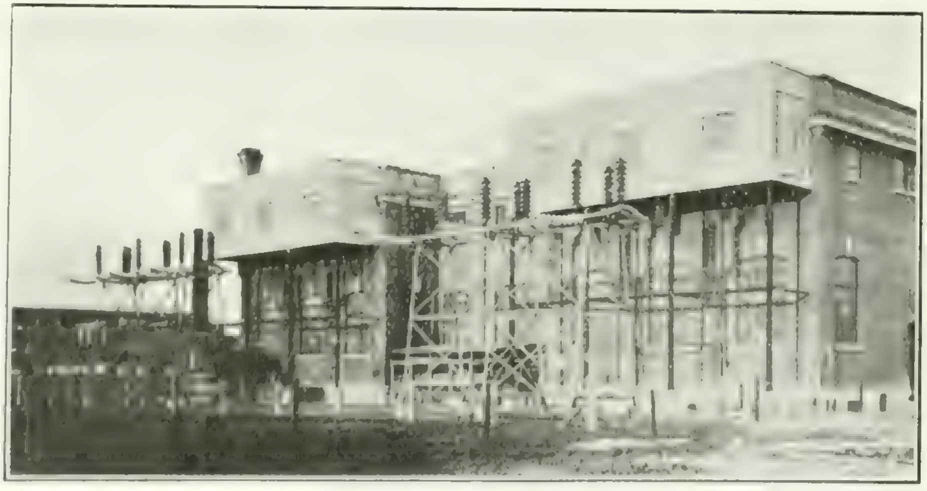


Fig. 29.—Toronto Station.

The transforming equipment consists of two banks of 1250 kv-a. transformers stepping down the transmission voltage to 13,200 volts. The low-tension leads branch and run through the oil switches to two sets of buses, each of which is divided into two parts. The cell work is built with pressed brick walls and concrete shelves. Ultimately, two ring buses will be installed, each being divided into four sections. At the present time there are eight feeders installed, each provided with automatic oil switches for connecting to either set of buses. The oil switches and buses are located in two rows on a gallery while the potential and series transformers are placed in compartments on the main floor immediately beneath the [illegible] [illegible]. The buses are protected by aluminum cell surge protectors. The outgoing feeders to the five municipal substations in different parts of the city leave the building by underground ducts. These municipal stations are located in such a manner that they may be electrically connected in a "loop" circuit.

The city of Toronto is at present installing transformers stepping down from 13,200 to 2,200 volts in the basement of the station, which will be used for city service, mainly to supply energy for the factory load of the city, a large part of which is located within one-half mile of the station. (Fig. 31).

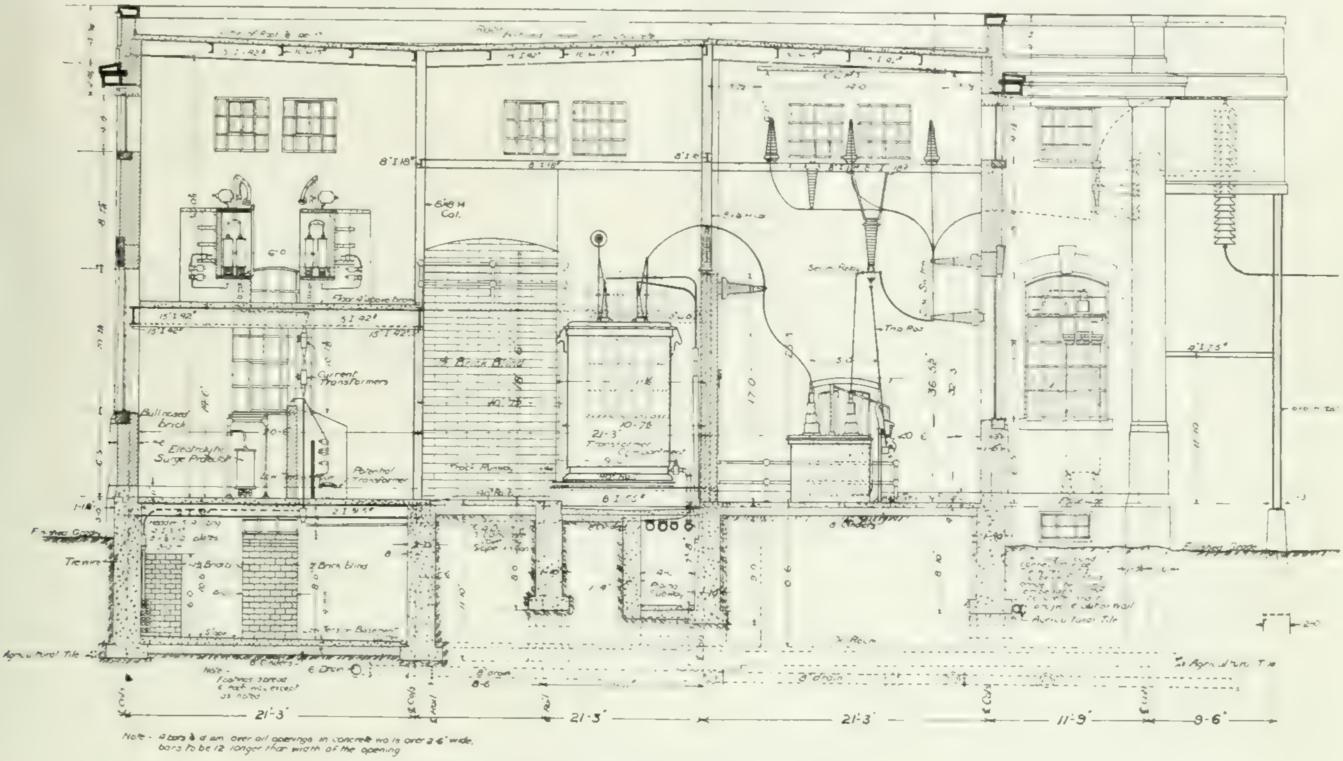

Current Transformers
Electrolytic Surge Protector
Potential Transformer
Bullnosed brick
Brick Blind
21'-3"
21'-3"
21'-3"
11'-9"
9'-6"
Note - 4 bars ½" diam. over oil openings in concrete walls over 2'-6" wide, bars to be 12" longer than width of the opening

Fig. 30.—Transverse Section, Toronto Station.

The control switchboard is located on a small gallery. All 110,000 and 13,200-volt switches are operated from the board. Curve drawing meters are mounted on the feeder panel for recording both the load and power factors.

A concrete pump house has been constructed a few hundred yards distant on the shore of Lake Ontario with an intake pipe extending 500 feet into the lake to provide cold water for cooling purposes. Duplicate motor-driven pumps and a service equipment similar to that at the Niagara Falls station is employed.

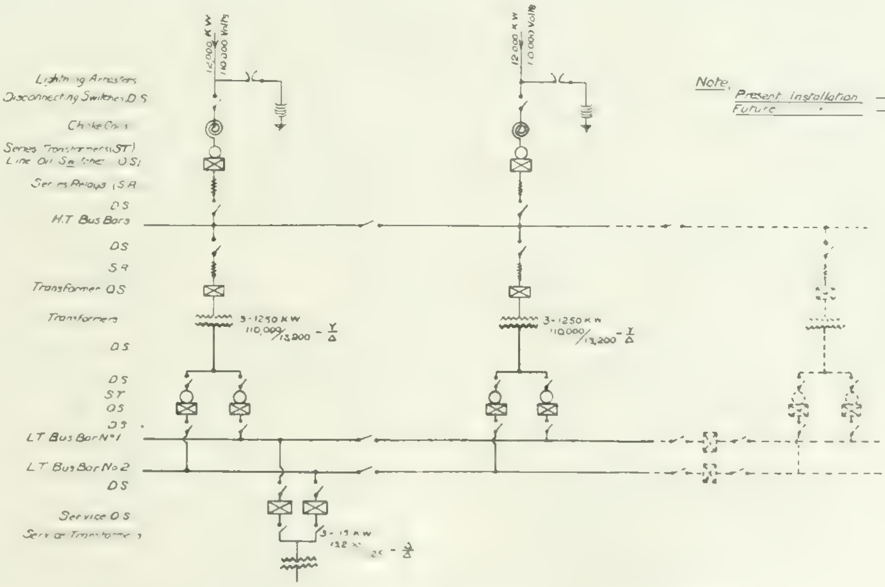


Fig. 31.—Wiring Diagram, Toronto Station.

Loop Stations.—The 110,000-volt equipment is similar in each of the "loop" stations. The lines enter the stations through automatic oil switches to the buses, and pass out through similar circuit-breakers. The incoming and outgoing lines in each station are provided with electrolytic arresters. The transformers are supplied with current at high potential, from the buses through automatic oil switches. Disconnecting switches are installed on either side of the oil switches, except on the transformer side of the transformer oil switch.

Each station is equipped with a bank of three single-phase 750 kv-a. oil-insulated, water-cooled transformers and also a spare unit available for use in case of an emergency. The low-tension winding potential is 13,200 in every case with the exception of Preston, where the greatest transmission distance is only six miles, and 6,600 volts potential was adopted for distributing purposes. All transformers are supplied with taps for both 6,600 and 13,200 volts.

The low-tension equipment is similar, and the general arrangement the same in all stations, the only difference being in the number of outgoing feeders. All feeders are equipped with automatic, hand-operated oil switches, disconnecting switches, switchboard panels containing indication and recording meters, relays and handles for operating the switches, and protected by electrolytic lightning arresters.

Provisions were made for six outgoing feeders at each of the present stations. Preston, Berlin and

Woodstock are now utilizing their full complement of feeders.

The service equipments, both electrical and mechanical are in general the same as those employed in the stations previously described, except that no storage batteries or motor generator sets are required because the switches are hand-operated. Duplicate water-pumps are provided to circulate the water employed to cool the transformers except in instances where city water service has been secured.

The spare transformers in any of these, as well as in London and St. Thomas stations, may be quickly connected in a bank in place of a disabled one.

London Sub-Station.—This station is a "loop" station with a branch line running off the main bus. The high-tension equipment is practically the same as that in the other "loop" stations just mentioned, with the addition of an oil switch connecting the buses and line supplying St. Thomas. There are four 110,000-volt and six 13,200-volt electrically operated oil switches, and three 1,250 kv-a. transformers installed in the station. A spare transformer is also provided for use in case of emergency. Four 13,200-volt feeders supply energy to the city of London's distributing station and to the provincial asylum.

St. Thomas Sub-Station.—This station will ultimately be a "loop" station, although it is a terminal station at the present time, and consequently has no 110,000-volt outgoing line equipment. The building, however, is constructed similar to the other standard "loop" stations.

Operation of System.

The Dundas station, because of its location, was designed as controlling station for the entire system. The chief operator and his assistants, who act in the capacity of load despatchers, are located at this point and by means of the private telephone system are able to keep in constant communication with the operators at the other stations. The switching equipment which has been provided makes it possible to cut out a section should trouble occur and yet supply energy to all the stations on the high-tension line. Since the Niagara station is the source of supply for the entire system it is essential that communication be maintained between this and Dundas station at all times, and a duplicate telephone line has, therefore, been provided.

Energy was first delivered to the Niagara transforming station for testing purposes on August 25th, 1910. The load and power factors of the system are both fairly high, while the voltage regulation is less than 2 per cent.

◆

THE PRODUCTION OF PIG-IRON IN THE ELECTRIC FURNACE.*

Extensive experiments have been carried out from time [illegible] "electrically fired" blast furnace. The coal supply of these countries [illegible] electric power being available, the subject has become of [illegible] Trollhattan, the site being particularly suitable by reason of [illegible]

Principles Governing the Design of the Furnace.—The following special considerations had to be carefully taken into account in the design:—

1. Working with high temperatures produced electrically, means must be taken to obviate current losses through the linings of the furnace, particularly because the materials in question increase in conductivity with the rise in temperature.

2. The construction must make allowance for decrepitation of the walls due to the intense heat and the contact with the charge.

3. The hot substances in the hearth must not exert pressure on the electrodes, as, in such a case, only very low voltages could be employed. This would, of course, necessitate excessive dimensions of electrodes and connections.

4. The combustible material does not "burn" in the ordinary sense of the word; therefore, to obtain uniformity in the quality of the products, the hearth must be made of large dimensions and must also act as a mixing chamber.

In order to fulfil these conditions, the hearth (K in Figs. 1 and 2) is made in the shape of a large crucible with a domed cover. The electrodes pass through this dome but do not come into actual contact with the hot substances in the hearth. The body is so designed that the descending substances discharge into the hearth as through a cone, leaving a clear space above the level of the slag, and surrounding the electrodes. The usual method of regulating the heat by raising or lowering the electrodes, for constructive reasons cannot be adopted here, and for the first time the heat regulation has been achieved by independent regulation of the voltages on each of the two phases of the current employed.

Construction of the Furnace.—The furnace is designed to produce 7,500 tons of pig-iron during 11 months of the year, or about 23 tons per diem. The following data were established as basis for calculation:—

(a) 1 cb. m. of wood charcoal weighs 150 kg.

(b) To produce 3 kg. of iron, 1 kg. of charcoal is required.

(c) 1 kg. of pig-iron can be obtained from 1.725 kg. ore.

(d) Specific gravity of ore employed = 2.5 kg./cu.dcm.

(e) Half of the mineral charged will fill the interstices between the pieces of charcoal of the same charge.

(f) The daily amount charged is 1.55 times the cubic contents of the furnace.

To produce 23 tons of pig-iron under these conditions, 51 cb. m. of wood charcoal must be mixed with 7.9 cb. m. of ore—say 59 cb. m. in all; this, divided by 1.55, gives a capacity of 38 cb. m. capacity for the furnace, divided roughly into 13 cb. m. for the hearth and 25 cb. m. for the body.

The building which contains the furnace covers a piece of ground 24 m. x 15½ m. The overall height of the building is [illegible] m. and the height from the ground level over the throat of the furnace is 13.7 m.

The furnace is composed essentially of two parts, the body C and the crucible or hearth K.

The outer part (shell) of the former varies in thickness from [illegible] mm. at the top to [illegible] mm. round the cone; it also carries all the iron supports for the fire-brick lining. The whole structure is supported on two girders by means of an octagonal channel-iron framework riveted to the shell. Thus the greatest part of the furnace, the dome of the crucible, is relieved of all stress, and independent expansion is possible for each of the essential parts. The joint between them is made with sand. The maximum internal diameter of the body is [illegible] mm., tapering to [illegible] mm. at the throat. The charging cone is actuated by a [illegible] h.p. motor, and the charges of ore and charcoal are raised to the charging stage by a 16-h.p. motor.

---

* [illegible]

The crucible hearth or melting chamber rests on a solid concrete bed, and like the body is encased in boiler plate, which here is 15 mm. thick. At the point where the weight of the dome is taken, the shell is reinforced by a steel band having a section of 200 mm. x 18 mm. The lining of refractory material is covered with magnesia bricks, and the floor of the hearth is formed of magnesia bound with tar. Fig. 3 shows the original section of the hearth, and its appearance after six months' working.

Four electrodes, (E, Figs. 1 and 2) two to each phase of the two-phase current used, pass through asbestos-packed gas-tight openings in the dome, making an angle of 65 deg. with the horizontal. Each electrode is made up of four pieces of carbon, has a total section of 660 x 660 mm. and weighs 1,300 kg. The average loss in weight by burning away is 5 kg. per ton of iron produced, but to this must be added an equal amount rendered unfit for any further use. Outside the crucible the electrodes pass through copper water jackets. Connection with the cable leads is made by cast-steel terminals, which clamp the cables to the carbons.

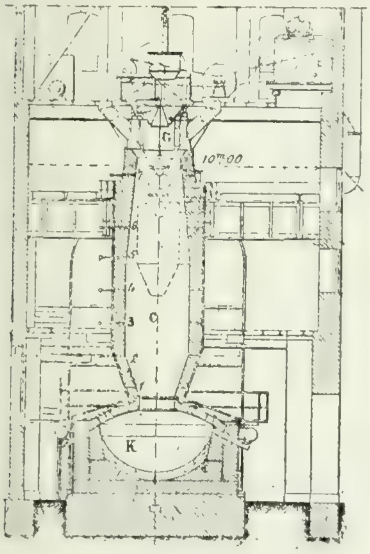


Fig. 1.

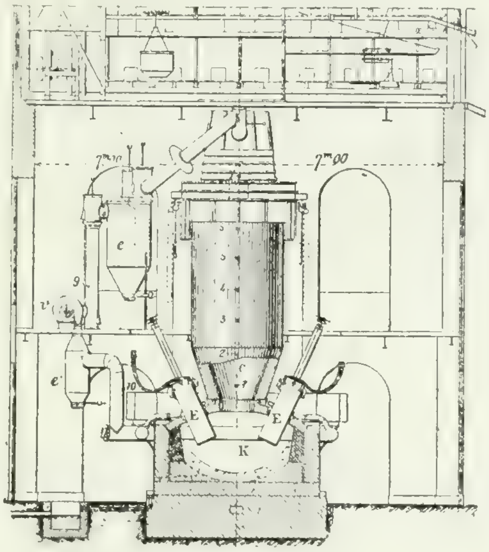


Fig. 2.

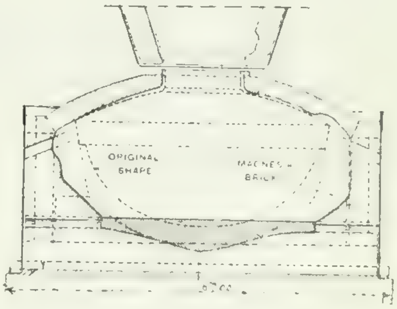


Fig. 3.

A quantity of gas extracted at the throat is drawn through a dust screen by a centrifugal fan, and is blown again into the space which exists between the molten mass and the dome. Four adjustable twyers or nozzles are used to distribute this gas, being arranged at intervals of 90 deg. apart round the crucible. This supply of waste gases into the crucible serves a double purpose: the gases are heated up in the crucible, and give off the absorbed heat as they pass into the upper zones, thus materially assisting the reduction; further, they cool the dome, and thus prevent its too rapid destruction. With gases at 200 deg. C., and containing equal volumes of CO and CO_2, 70 cb. m. per minute at a pressure of 325 mm. water gauge are blown into the crucible by the 8-h.p. electric fan. There are the usual fittings for drawing off the slag and the iron.

Electrical Equipment.—The supply is three-phase at 10,000 volts, and is transformed to two-phase current with a pressure variable in each phase from 50 to 100 volts. From the transformers the energy is led to the furnace by four leads, each lead consisting of six copper strips 200 mm x 8 mm. in section. Each strip, again, is connected to eight cables, each having 185 sq. mm. section; thus 48 cables having a total section of 8,800 sq. mm. are connected to each electrode.

Electric measuring instruments of various kinds are supplied, including platinum and platinum-rhodium pyrometers.

The current varied between 3,000 and 18,000 amperes, with a pressure variation of between 50 and 100 volts per phase. The power used varied considerably, the load ranging from 300 to 2,000 kw.

Conclusion and Results.—Three series of experiments were made by Messrs. Leffler and Nyström, of the "Jern-Kontoret," in the six months referred to, and the results are tabulated below:—

Number of experiment	I.	II.	III.
Mean primary load, kw.	1,319	1,717	1,680
Mean secondary voltage—			
Phase I.	65.2	75	81.9
Phase II.	65.9	83	88.2
Mean secondary amperes—			
Phase I	13,731	13,564	11,922
Phase II.	13,416	11,817	10,406
Kw.-hours per ton cast	2,296	2,481	2,241
Kw.-hours per ton cast, useful work	1,454	1,686	1,595
Kw.-hours per ton cast, losses	842	795	646
Efficiency, per cent.	62.33%	67.96	71.77%
Losses—			
Transformer losses	1.83	2.74%	2.12
Secondary losses (including leads)	3.31	3.83	3.03%
Absorbed by cooling water	6.53%	6.57%	6.53%
Radiation and other losses	26.00%	18.90	16.55%
	100	100	100
Calorific value of waste gases per cubic metre	2,786 cal.	2,892 cal.	2,544 cal.
Of this 80 only can be utilized	2,230 cal.	2,315 cal.	2,035 cal.
Consumption of charcoal in hectolitres per ton cast	25.02	22.88	21.10

The average consumption of charcoal in other furnaces is 62.8 hl. per ton.

In conclusion, it is interesting to note that the most serious incident in the six months' work was an explosion in the crucible due to the rapid descent into the molten mass of a quantity of powdered ore which had not been thoroughly dried.

SOME FALLACIES AND FACTS CONCERNING ENGINEERING WORKS IN GREAT BRITAIN.

By W. A. MARTIN,
Late Assistant General Manager of the Toronto Electric Light Company.

(Continued from last issue.)

Messrs. Willans and Robinson, Rugby.

A few years ago a visitor to any of the electric power supply stations in the United Kingdom would have expected to find in almost every power house long rows of vertical steam engines, all exactly alike, direct coupled to electric generators. The generators in the different power stations would have been constructed by a number of different makers, but the engines would almost invariably have been the then [illegible] Willans central valve high speed vertical engine. The output of each individual unit would generally have been less than 1,000 h.p. and the total power required would have been obtained by running [illegible] units together.

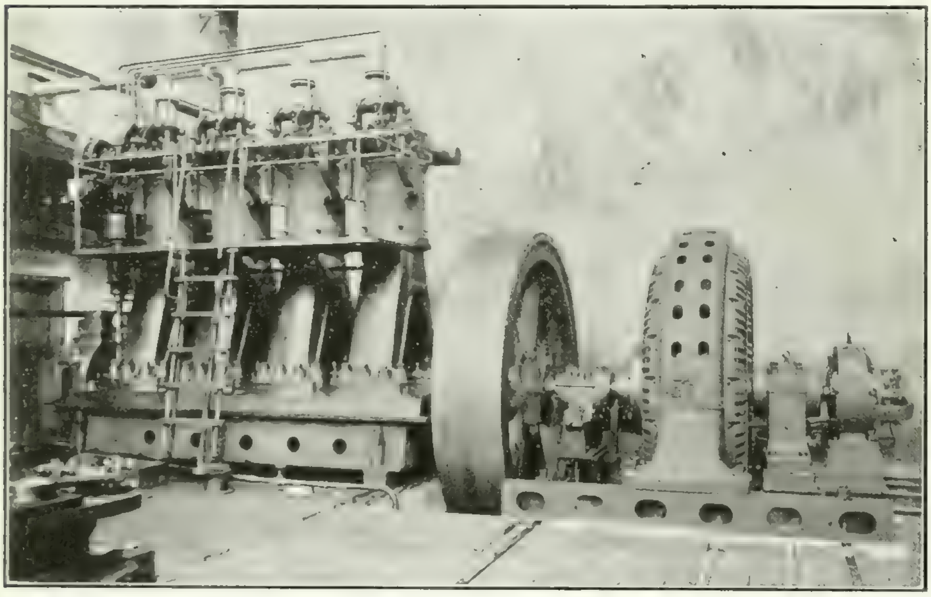


Fig. 6.—200-kw. Diesel Oil Engines Manufactured by Willans & Robinson, Ltd., for the Chilian Oil Fields.

The perfecting of the steam [illegible] compete with the Willans steam tur-[illegible]

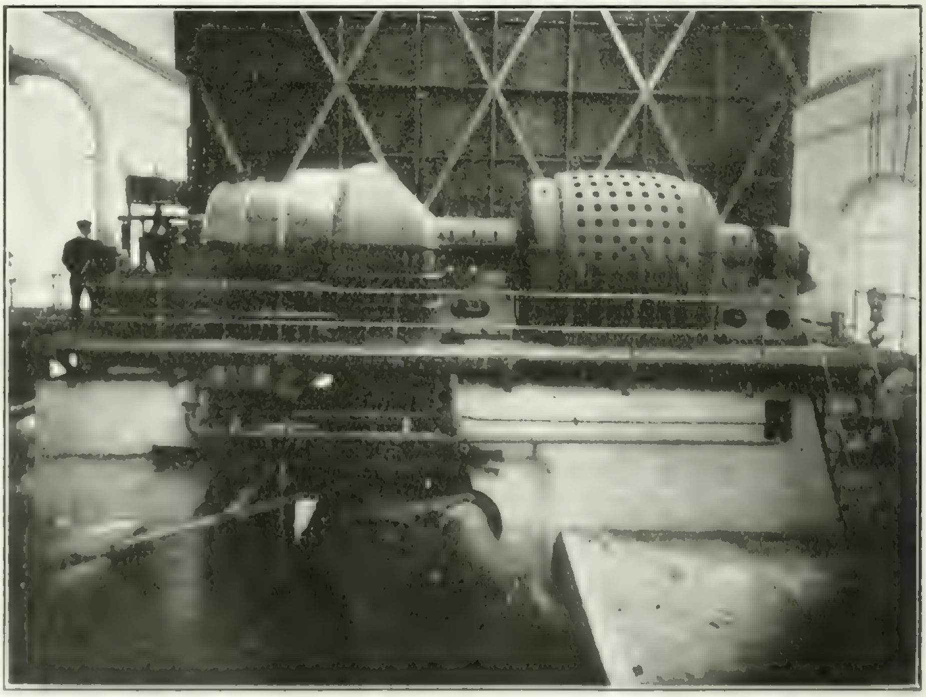


Fig. 7.—8000-kw. Disc and Drum Steam Turbine Built by Willans & Robinson, for the Sheffield Corporation.

[illegible] a source of trouble in steam turbines. Such troubles as were still encountered were due to the excessive unsupported length of the shaft and the admission to the turbine body proper of steam at high temperatures. The firm's latest disc and drum design overcomes these difficulties entirely. It embodies the impulse principle at the high pressure end and retains the reaction principle at the low pressure stages. A further advantage of this design is that it occupies considerably less floor space than the earlier types.

Messrs. Willans and Robinson have recently executed an order for one of their new disc and drum type 8000-kw. turbo generators for the Sheffield corporation electricity department, and through the courtesy of Mr. S. E. Fedden, the city electrical engineer, I was afforded an opportunity of seeing this plant in operation. It appeared to be running perfectly in every respect, and the engineer in charge spoke very highly of its performance, which, he informs me, was in some respects better than called for in the specifications.

The condensing plant is of the surface type with vacuum augmentor and Edwards type air pump, built by the turbine makers.

A 400-kw. set of the maker's earlier design has been working for a number of years, in the same power station in Sheffield with equally satisfactory results.

Messrs. Willans and Robinson are amongst those who believe that the prime mover of the future is the Diesel oil engine. I saw a number of these interesting engines in course of construction at their works. The firm's great experience in building high speed vertical steam engines particularly qualifies them for constructing engines of this type, which calls for specially careful workmanship and the use of the highest class materials. Here again I was struck by the large amount of work being executed for shipment, and was pleased to see steam turbines and Diesel engines being built for Canada.

The illustrations show the Sheffield disc. and drum turbine coupled to a Dick Kerr alternator. The Diesel engine shown is one of four 200-kw. sets sent last year to the Chilian nitrate fields.

Since returning to Canada I have been informed that the Electric Power Company has ordered a Diesel engine of about 600 h.p. capacity for their Oshawa plant from Messrs. Willans and Robinson after very thorough investigation by their consulting engineers, who sent an engineer to Europe for the purpose.

This firm has also, I am informed, recently received an order for a large steam turbine of some 9,000 k.w. capacity for shipment to British Columbia.

Messrs. The Sandycroft Foundry Company.

The Sandycroft Foundry Co., which is probably the oldest established concern of its kind in Great Britain, at their works near Chester specialize in the manufacture of mining machinery of all descriptions, including ore crushers, stamp mills, cyanide plants, winding engines, haulage gear, etc. They have also perfected an interesting alternating current motor known as the "Hunt Cascade Motor," which possesses the valuable property of being able to develop an output approaching its maximum over a very wide range of speeds. The Sandycroft Company have carried out a large number of contracts for complete mine equipment in India, South Africa, Spain, the Australian Colonies, South America and in other parts of the world. They are particularly interested in the prospects of mining developments in Canada, and intend to cater vigorously for this market.

They had a large amount of plant in course of construction at the time of my visit to their works and showed me, among other things, parts of an 8,000-h.p. steam engine they were building for one of the mines in South Africa. I was informed that the shipping weight of this engine, when completed, would be 280 tons.

Messrs. Mather and Platt, Limited.

This well-known firm was established nearly one hundred years ago and has recently built entirely new works on the most up-to-date principles, which are fitted with most modern machinery. They employ somewhere about 3,000 work-people, and the concern is the foremost in the world for the manufacture of machinery for the bleaching, printing, and finishing of cotton cloth; in fact, I was informed that almost all the machinery used in these processes of textile manufacturing owes its origin to them, and wherever cotton cloth is made the name of Mather & Platt is known in connection with the supplying of machinery for the finishing processes.

They are also very large electrical engineers, who have carried through the earliest railway traction work in Great Britain; and I was shown an immense amount of apparatus in course of construction in their electrical shops.

They were also the original manufacturers of the centrifugal turbine pump, now so widely known throughout the world.

Amongst their other departments those for the manufacture of fire appliances and plants for the purification of water are the most important.

A visit to these new workshops impresses one with the idea that the concern is full of enterprise and vigor, and is by no means falling behind in the engineering race, notwithstanding the long time it has been established.

Messrs. Dorman, Long & Company, Limited.

The Britannia Works of Messrs. Dorman, Long & Co., Limited, comprise steel furnaces, rolling mills and constructional and bridge shops. The steel is made by the basic open hearth process and is rolled into sections of all descriptions for use in engineering, shipbuilding, general constructional work and allied trades. The steel plant consists of ten basic open hearth steel furnaces and two large hot metal mixers and all operations in handling the material required for the manufacture of the steel are controlled by modern overhead electric cranes and charging machines. The output of ingots from this plant is approximately 20,000 tons per month. The hot ingots are delivered direct into the soaking pits of four rolling mills. The 32-in. and 31-in. reversing mills are steam-driven and the equipment is perhaps notable for the three-cylinder type of marine engine driving the finishing mills which is of 16,000-h.p. capacity. The entire mills are equipped with fast traveling electric cranes covering all operations. The output of sections of all kinds from these two mills is approximately 14,000 tons per month. The company have recently put into operation a new exhaust turbo station for the generating of electricity. The exhaust from the steam-driven mills is delivered through steam accumulators to four 1280-kw. mixed-pressure turbo-generators. This power station is of a most up-to-date and modern construction. The current from this station, in addition to driving two electric mills, supplies the power for the whole works. The electric mills consist of one 18-in. reversing mill and one 11-in. three high direct-driven mill. The sections rolled in these two electric mills are rounds, squares, flats, angles and bars of all kinds required in the engineering and shipbuilding trades. The output of these mills is approximately 6,000 tons per month.

The constructional and bridge department is the best equipped of its nature in Great Britain and has no equal on the Continent of Europe. The shops are 540 feet in length and consist of four bays with several lean-to buildings for special work. Each bay of the main shop is served by fast-traveling overhead electric cranes. Many novel features and improvements have been incorporated quite recently, all of which have independent motor drives. The shops are equipped with pneumatic and hydraulic appliances and are entirely closed in and well lighted. The output of bridge and building materials is approximately 3,500 tons per month. The current for both lighting and power purposes is generated at the company's central power station above mentioned.

At the Clarence Steelworks of the company the melting shop department consists of a gas-heated metal mixer capable of holding 400 tons of molten metal, and nine open hearth steel furnaces, of which eight are of 50 tons capacity and one of 60 tons. The bulk of the steel manufactured at these works is for special purposes in various carbons ranging from 0.08 per cent. to 1.5 per cent., a few of the specialties being soft steel for high conductivity wire and locomotive tubes, and hard steel for saws, picks, wire ropes, files, edge tools, etc. The ingots are taken from the steelworks and placed in coal and gas-fired soaking pits by two five-ton electrically driven cranes, from whence they are taken to the rolling mills, which are three high and consist of three trains of rolls, viz., cogging, roughing and finishing, the diameter of all three mills being 32 inches. The product of these mills is principally high carbon steel rails and billets, bars and slabs for the purposes above described.

A 100-ton electrically driven overhead crane is provided for changing rolls, so that the mills can be readily changed to roll various sections. Duplicate standards are also provided and a set is always ready fitted up with rolls and guides for the next section to be rolled. The blooms are cropped and cut to the required lengths by a pair of specially designed hydraulic shears. The blooms then go on to electrically driven lifting-tables which move them to each pass in the rolls. When the finished bar is rolled it is taken by live rollers, also electrically driven, to the hot saws. There are three "hot banks" and two saws, the second one being placed 291 feet from the rolls.

The wire department consists of wire rod rolling mill, wire drawing, annealing and galvanizing mills. The product is chiefly high-grade wire rods and wire for wire ropes. The department carries on a large export trade in wire rods and rope wire.

The sheet works department comprises eight sheet mills, four galvanized baths, eighteen puddling furnaces, and two ball furnaces. The capacity is 25,000 tons per annum of finished sheets, mostly iron, for roofing and other purposes.

The total number of men and boys employed throughout all the works is 4,500.

Dorman, Lang and Company are already catering for Canadian business and I was informed that they were manufacturing several sizes of structural steel beams in what is known as American sections and had shipped some two thousand tons of structural steel to Canada in the past year.

Messrs. Reavell & Company.

Messrs. Reavell & Company, of Ipswich, have concentrated their attention upon the perfecting of air compressors for all purposes. Their leading specialty is a 4-cylinder machine in which the cylinders are arranged radially in a [illegible] a perfectly even turning effort [illegible] efficiency, [illegible] in the small space taken up.

They are [illegible] used for directly coupling to electric motors.

There should be a considerable demand for compressors [illegible] where cheap electric power can be [illegible] have been installed in this country.

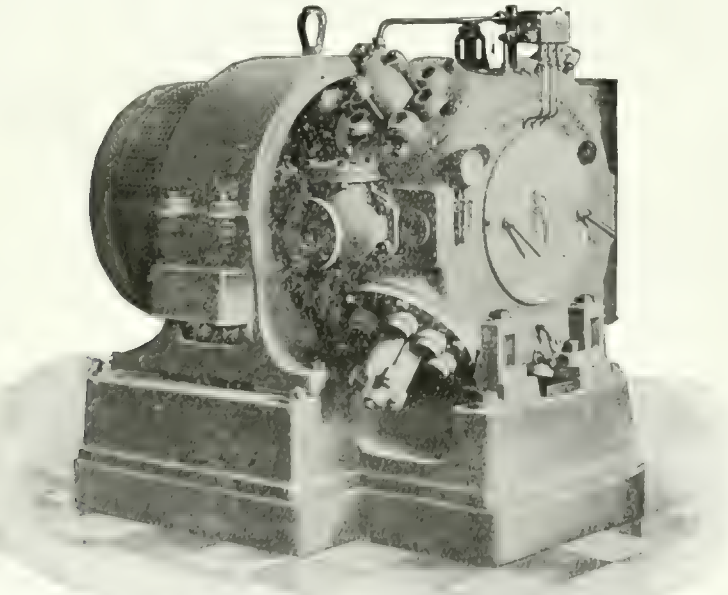


Fig. 8.—Four-Cylinder Reavell Air Compressor, Manufactured by Reavell & Co., Ipswich, Eng.

Messrs. Reavell also make ordinary straight line compressors, and for very large capacity plants the vertical type of compressor. I was particularly interested to see a large number of special compressors of very high pressure in course of construction for use with Diesel oil engines.

Ransomes, Sims & Jefferies, Limited. The Orwell Works, Ipswich, England.

This great business was established as far back as the year 1789 by Mr. Robert Ransome, and its history has been one of steady and continuous growth and expansion. At the present time about three thousand men and boys are employed at the Orwell Works.

Not only in Great Britain, but throughout the Continent of Europe and in all parts of Asia, South America, Africa and Australasia, where machinery can be used, is the name of Ransomes, Sims & Jefferies, Ltd., famous for the best steam engines and threshing machines the world has ever seen, as well as for stationary engines, ploughs, implements and the other specialties named.

The Orwell Works cover about thirty acres and consist of a group of four separate factories, comprising:—

(1) Engine and boiler works, foundry and smith shops.
(2) Threshing machinery and tea machinery works.
(3) Plough and implement works.
(4) Lawn mower works.

The various shops are well laid out and lighted by a first-class system of high-pressure gas, and in winter time warmed by steam for the comfort of the workmen.

The works are equipped with remarkably fine installations of the most modern machine tools and labor-saving appliances of all kinds, enabling the highest possible degree of accuracy to be attained in the production of work. The machine tools are so arranged as to ensure a continuous flow of work from the entrance of the raw material to the assembling and erecting shops.

Standardization and interchangeability of parts are carried to a high art in the Orwell Works, Ransomes, Sims & Jefferies, Limited, fully recognizing the great importance of this matter in connection with the supply of extra parts for their manufactures. Purchasers in distant countries have always the assurance, therefore, that no difficulties will occur in the adaptability of duplicate parts subsequently ordered.

In the threshing machinery works, where timber is necessarily largely employed, the most perfect system of wood-working machine tools prevails, thus ensuring rapidity of production combined with the highest degree of accuracy. Powerful electrically driven fans are provided in this department, which, by means of a system of exhaust pipes, extract all dust from the wood-working and grinding machines, thus maintaining the various floors in a clean and pure condition, conducing greatly to the comfort of the men. All threshing machines are thoroughly tested before leaving the works, being driven during the trial by electric motors.

The numerous types of threshing machines manufactured by the company are such as to fully meet the many different conditions of all the agricultural countries of the world, the threshing machines being equally suitable for dealing successfully with practically all kinds of cereals grown in both eastern and western countries. For countries where the threshed straw is utilized as food for animals, Ransomes, Sims & Jefferies' threshers are provided with a special apparatus, which reduces the straw to very short lengths, bruising it at the same time, thus facilitating mastication.

The plough and implement works, the largest factory of its kind in Great Britain, is one of the latest additions to the Orwell Works. This department comprises immense and magnificently laid out shops on the ground level, where thousands of types of ploughs and implements destined for all the agricultural countries of the world may be seen in various stages of construction.

The lawn mower works consist of a very perfect self-contained establishment, where the most modern and approved system prevails for the rapid, accurate and economical manufacture of motor, horse-power and hand-power lawn mowers of all kinds, together with well equipped stores where enormous quantities of these machines are kept in stock.

The Orwell Works include extensive stores for engines, threshing machines, ploughs and implements of various types, this being a matter of the highest importance in connection with prompt deliveries.

Electric cranes are in use in all the chief departments of the works, and the larger machine tools are driven independently by their own electric motors, which, together with the cranes, are supplied with current generated in the company's power house.

I visited a number of other engineering works while in the Old Country, notably those of Sir William Arrols & Company, Glasgow, the builders of the Forth Bridge; the Electric Construction Company, Wolverhampton, manufacturers of electrical apparatus; Callender's Cable and Construction Company, Erith, manufacturers of lead and paper insulated cables, anti-friction metals, alloys etc., and Galloways, Limited, Manchester, manufacturers of large gas engines, rolling mill engines, boilers and pumping plant, but space will not permit of my describing them here.

My entire visit convinced me that Great Britain is still able to hold its own as the premier manufacturing centre of the world and that in the design and manufacture of engineering apparatus and allied appliances is keeping quite abreast of the times.

I would strongly advise Canadian buyers who are contemplating making any large purchases of engineering plant to give full consideration to British-made goods before purchasing, and preferably to pay a visit to the works of some manufacturer in Great Britain who has specialized in the particular line of machinery required. Where buyers take the trouble to do this it almost invariably results in the purchase of British-made goods. Such a visit cannot but inspire confidence in the mind of the buyer that he is being shown methods and practices which can have but the one result, viz., the turning out of apparatus of the highest quality.

◆

A double roof of reinforced concrete is one of the features of the ice palace recently built in Hanover, Germany. The barrel arch of this roof, which, as a span of about 69 feet, is supported on nine reinforced concrete rafters, and the thrust is taken up by the rods placed beneath the floor of the structure and anchored to the concrete of the haunches. The panels between the rafters form a thin interior reinforced concrete ceiling, and, being a continuation of the compressing slabs of the barrel arch rafters, they form virtually a complete unit. The second reinforced concrete roof, which rests on the square rafters of the barrel arch, is of heavier construction, and is covered with a layer of waterproofing felt. The air confined between the two roofs acts as an insulating material, and is said to reduce largely the influence of outside temperature

SOME MECHANICAL CONSIDERATION OF TRANSMISSION SYSTEMS.*

By T. A. Worcester.

In any transmission system each of its elements, the supporting structures, the insulators and conductors, has a vital mechanical function and on each may rest the success or the failure of the system. In the early days of high voltage transmission these points were not given due consideration and there were many cases of the destruction of lines due to washouts, sleet and wind storms and frequent breakages of wires due simply to contraction at low temperatures. During later years, however, engineers have profited by these experiences and a greater study has been made of the details of mechanical construction, resulting almost entirely in the elimination of disasters except in cases of most unusual and severe conditions.

The purpose of this is to review in a general way the stresses which must be considered in the various elements of a transmission system and to point out some of the means which have been resorted to to meet certain special conditions. Consideration will be given chiefly to steel tower structures since they are by far the most important type of support for higher voltages. The wooden, steel and concrete poles have their field in the lower voltage range where they are able to compete against the built-up structure.

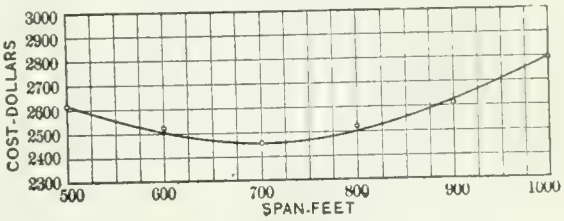


Fig. 1.—Cost per Mile of Towers and Insulators Erected.

Stresses.—The stresses which a tower must be designed to withstand are (a) those acting in a vertical direction, due to the dead weight of the conductors and insulators, plus an allowance for ice covering; (b) in a horizontal direction at right angles to the line, due to wind pressure; (c) in a horizontal direction parallel to the line due to wire breakages. All of these loads are applied at the ends of the cross-arms except a portion of (b) which is distributed over the entire tower.

The vertical load depends on the size, material and number of the conductors and ground wires, length of span and thickness of ice coating; the horizontal load at right angles to the line depends on these same elements which determine the exposed surface, and the wind velocity; the horizontal load in the direction of the line depends on the size and number of conductors, the amount of ice and the number of wires which may break at any one time. Each of these governing factors will be briefly discussed.

The size of conductor depends on electrical considerations except where the length of span is the governing feature.

The length of span, except in river or gorge crossings, is dependent upon the designer and must be chosen so as to give the line the least cost. As the span increases, the number of towers and insulators per mile decrease, but on the other hand the height of the towers must be increased to care for the greater sag and at the same time they must be made proportionately stronger and heavier to care for the greater loads per span. The effect of these changes on the cost of a line is shown by the curve, Fig. 1. The length of a span affects the loads in the vertical direction and in the horizontal direction across the line and not that parallel to the line, since the latter is governed by the size of the conductor, it being necessary to adjust the sag so as not to exceed the safe stress for the wires.

---

*A paper presented to the American Institute of Electrical Engineers, May 17th, 1912.

For every size of conductor there is a practical limit of the length of span beyond which the sags and height of tower becomes excessive and there is danger of the wires swinging together. For the smaller sizes of conductor this limit is quite low (300 ft. (91 m.) for No. 4 cable) and in many cases it will be found more economical to increase the size of conductor so as to permit using a greater span. The following tabulation illustrates this:—

	Size of Conductor	Span feet	Sag feet	No. of towers per mile	Cost of towers and insulators per mile erected	Cost of wire and freight per mile	Total per mile
Case I.	No. 4 B.&S.	300	10.5	17.6	$3080	$322	$3402
Case II.	No. 2 B.&S.	360	10 5	14 7	2570	514	3084
					Saving per mile. .		$318

These figures are based on the assumption that the same towers and sags would be used in both cases, giving the same clearance to ground. The sag in Case I is the minimum sag at which wires may be strung on the basis of 0 deg. Fahr., 8 lb. (3.6 kg.) wind, and ½ in. (1.27 cm.) sleet and with these same conditions and sag the span for No. 2 wire is calculated and found to be 360 ft. (109 m.) With this tower spacing and No. 2 cable the cost of the line is $318 less than with No. 4 cable and 300 ft. (91 m.) span. It is allowable to assume that the same towers can be used in the second case as in the first since the lightest tower which it is practicable to build would be sufficiently strong for the second case. However, it would be possible to put $20 more into the cost of each tower and still have the cost of the second line a trifle less than that of the first and the gain would accrue from the electrical advantages of the larger size of conductor.

A span of 360 ft. (109 m.) is not necessarily the most economical span for the No. 2 conductor. Further calculation indicates that a 500-ft. (152 m.) span could be used with only a very slight increase in the cost of the towers. This limit cannot be extended beyond 500-ft. (152 m.) even though the line with greater spans would have a less cost. Here again the limit depends on mechanical considerations rather than on costs and is governed by the danger of lashing together of the wires in gusty winds.

In long spans over rivers, etc., the standard main line towers and conductors are frequently used. This practice may be permissible in some instances where the spans are not very much greater than normal but when the towers have been designed to closely meet the demands of the standard spacing it becomes dangerous to use them for any appreciably longer spans. It is advisable in these instances to use dead end anchor towers with strain insulators and thus isolate the crossing span and prevent any trouble in other parts of the line from [illegible].

For such long spans it [illegible] necessary to use conductors of greater mechanical strength than are used in the main part of the line and the supporting structures must likewise be made correspondingly stronger. Too great care [illegible] should be used in the design of the steel work.

Ice and Wind.—The amount of ice which will form on [illegible] will probably never be settled to the satisfaction of all concerned. However, the various engineering bodies have about agreed that it is safe to consider ½ in. (1.27 cm.) ice in conjunction with 8 lb. (3.6 kg.) wind pressure and 0 deg. Fahr. as the worst combination of conditions likely to occur in the United States. It is conceded that there have been thicker formations of ice and greater wind pressures, yet the probability that they will occur simultaneously and with low temperature is so remote as to make it seem unnecessary to consider them. There is little doubt, however, that those engineers who have experienced destruction of their lines by sleet and wind storms will never use anything but the most conservative allowances. For spans crossing rivers, highways or railroads more liberal allowances are always made, the standard being ¾ in. (2 cm.) ice, 11 lb. (5 kg.) wind and 0 deg. Fahr.

Ice and wind on the cables work together to increase all of the loads on a tower structure; the vertical load and the horizontal load in the direction of the line, by giving increased weight to the conductor, and the horizontal crosswise load by giving greater surface for the wind to act upon.

Wind on Towers.—There is a great difference of opinion as to just how much wind pressure shall be allowed on the tower itself. It is certainly not sufficient to base this allowance on the same assumptions as are used for the conductors. Those assumptions are for wind velocities likely to occur simultaneously with heavy loading of ice and low temperature. Greater velocities may occur independent of these last factors. It is, therefore, advisable to allow for at least the highest recorded value. This value, as indicated by the Government anemometer is very nearly 100 mi. per hr., which corresponds to an actual velocity of 76.2 mi. per hr. and a pressure of 23.2 lb. (1005 kg.) per sq. ft. (=0.09 sq. m.) ($0.004 \times V^2$ for flat surface). The government anemometer records the velocities only at intervals and does not give all instantaneous values and these instantaneous values may be somewhat greater than those at the moment the record is taken, due to the gusty character of winds. It has been estimated that these gusts cause velocities 50 per cent. greater than those which are recorded. Another feature enters, however, to somewhat counterbalance this effect, viz., the height above the earth surface. The anemometer records are taken well above the earth surface, while transmission structures are seldom higher than 75 ft. In consideration of these variables and uncertainties it is not possible to give one value of pressure to be used on all lines. A safe range of pressure though would be from 20 to 35 lb. (9 to 16 kg.) per sq. ft. (=0.09 sq. m.) depending on the general character of the country which the line traverses, i.e., whether it is exposed to sweeping winds or protected.

It will usually be found that the maximum wind pressure acting on the bare towers and wires will have a greater overturning moment than that caused by the maximum wind assumed to accompany ice formation, acting on the ice-coated wires and towers, i.e., the greater pressure due to the higher velocity of the wind, even though exerted on a smaller surface, will overbalance the less pressure acting on the greater surface. For this reason the side pressure on towers should be figured for both conditions and the design should be based on the loads caused by the worst of the two.

In calculating the wind on the towers the entire projected area of the two lateral faces should be used as the surface over which the wind acts.

Wire Breakages. The most serious stresses which a transmission tower is called upon to withstand are those due to the breaking of conductors. Lines are put up with a view of not having the conductors break but there are certain unavoidable conditions which frequently produce breaks. The most usual of these are [illegible] burning of the conductors due to short circuits or grounds started by lightning, large birds, swinging together of wires, etc., or through malicious intent; (b) breaking of conductors due to crystallization or fatigue of the metal produced by kinking during erection or by insufficiently rounded edges of cable clamps and (c) by overloading of conductors during extreme conditions of temperature, wind, etc.

The causes in (a) have been overcome to a great extent by the use of various devices, principally the arcing ground suppressor, the ground ring and metal sleeve. The swinging together of conductors occurs only when light conductors are used in too long a span where they will be likely to lash in the wind. Ordinarily in well designed spans the wires swing in unison so that there is no danger of their coming together.

The breaking of wires due to kinking is frequently not given due consideration and many lines erected by careless workmen have suffered from this cause. The elasticity and strength of the metal on the inside of the bend is decreased enormously by a short bend and when the wire is straightened out and drawn taught by frequent strains in the line it will finally weaken to the point of rupture. Likewise, many breaks have been caused by repeated bending of the conductor at the wire clamp on the pin type of insulator. The localization of the stress by a hard metal clamp finally makes the metal of the conductor brittle and rupture occurs well below the average tensile strength. A clamp may have well rounded edges and still cause trouble. It is the rigidity of the clamp as well as too sharp an edge which is harmful.

When all of the wires of a transmission line are intact there is no pull on the towers in the direction of the line (i.e., on the intermediate towers, not the dead end or other special structures). As soon, however, as a conductor is broken the strain which it took to cause the break is thrown on the adjacent towers. Obviously, therefore, the maximum load which the cross arms must stand in the direction of the line is equal to the tensile strength of the conductor which is used. For the smaller sizes of conductor this rule is usually observed but for the larger sizes less liberal allowances are usually made. It is customary with the larger sized conductors to allow for a stress equal to one-half of the ultimate strength of the cables. This value is chosen since it is the maximum safe working stress, above which the cables are likely to stretch permanently.

With the suspension type of insulator the full length of an insulator string is thrown into the line when a break occurs and the strain in the conductor and on the cross arms is greatly reduced. But little consideration should be given to this fact, however, since there is a severe jerk when the insulator is drawn to its new position and the effect on the tower is not less and may be more than occurs when the pin type of insulator is used.

A question which naturally arises is how many conductors may break at any one time. This depends to a large extent on the cause of the breaks. If due to lightning or large birds it is probable that not more than one or possibly two conductors would break; but if due to poorly designed wire clamps, injury of wire during erection, or to excessive sleet and wind, it is conceivable that all might break. It is very rare, however, for all of the conductors to break, and further, it is hardly practicable to make such an assumption when considering main line towers since it would raise the cost of the line to a prohibitive value. It is usual to compromise by allowing for the breakage of only two cables of a three or six conductor line and to safeguard the system by interposing anchor towers at frequent intervals. These anchor towers would be capable of withstanding the strains due to the breakage of all of the cables and would thus divide the line into isolated sections so that any trouble in one could not be communicated to the other.

In the rigid type of tower practically all of the stress caused by the breaking of several conductors is cared for by the tower itself, i.e., the movement of the top of the tower is not sufficient to permit an even distribution of stress between the unbroken cables of the damaged span and those in the adjacent spans. With the flexible type of tower, however, the effect is different. The tower is designed to be rigid in the plane across the line and flexible in the direction parallel to the line so that it will bend and allow an even distribution of stresses in the adjacent spans. For instance, consider a three-conductor system with one ground wire and assume that each cable has an ultimate strength of 6,000 lb. (2,721 kg.) and is strung to have a tension of one-half of its ultimate strength under the worst conditions likely to occur, and assume that these conditions prevail. Suppose that one of the conductors has been injured or is defective and that it breaks under this load. The tops of the towers on either side of the break will be pulled over by the four cables in the next span until the total tension in them would be just balanced by that in the remaining conductors of the damaged span. The tension would amount to very nearly 12,000 lb. (5,443 kg.), i.e., 4,000 lb. (1,814 kg.) per cable or 33 per cent. more than the allowable stress. This load would not break the cables but it would stretch them beyond the elastic limit and permanently weaken them.

Suppose that two cables had broken instead of one. Each of the remaining two would be strained with nearly 6,000 lb. (2,721 kg.), an amount almost equal to its ultimate breaking strength. The stress would not be quite 6,000 lb. because the tension in the adjacent spans would decrease rapidly as the cables in the damaged span are stretched to greater length. However, the example serves to illustrate that it is necessary to use very much greater factors of safety in stringing conductors in a flexible tower system than would be used in a rigid system.

Foundations.—The foundations of a tower are of prime importance, yet under average normal conditions they offer but a small problem. In ordinary straight line work, over fairly level country, where the soil is hard or rocky and where the smaller sized conductors are used no special foundations are necessary; the ground stub with cross piece or foot may simply be buried in the ground with a little rock filler and if the spread of the tower legs is normal there is little to fear from tilting. With the larger sizes of conductor and longer spans the overturning moment frequently reaches such proportions as to make it advisable to use concrete foundations and thereby eliminate the need of spreading the tower legs an excessive amount. When towers must be placed where the soil is loose or marshy or where they may be endangered by floods or landslides it is essential that special consideration be given to the design of their foundations. It may be necessary to resort to any one of several types of construction; steel or timber piling, crib work, rock filling or concrete, or a combination of two or more of these. Fig. 4 shows one of the best types of foundation, used to meet a very special condition where it was necessary in order to gain entrance to a city to extend the right-of-way along the lake front and place the tower footings in the water.

Angle, hillside and anchor on long spans present serious problems from the foundation standpoint and must be carefully and liberally designed so as to allow no motion or slip whatever. It frequently pays to make a long detour in order to avoid bad hillsides or crumbly crests.

It must be remembered that a very slight tilt at the base of the tower means large displacement at the top which may exert considerable extra tension in the conductors and in the case of the suspension insulator may bring the conductors dangerously near the tower.

Factors of Safety.—In the design of all mechanical structures it is customary after assuming certain conditions of loading to allow a factor of safety; in other words, to design the parts so that their ultimate strength will be several times their assumed loading. The amount of this factor of safety depends on (a) the character of the load—whether steady, intermittent, or otherwise—(b) on the knowledge one has relative to the amount of load; (c) on the ease or difficulty of calculating the structure to care for the assumed loadings; (d) on the possibility of faults in construction and (e) on the risk to life and property. In a transmission structure the load is intermittent and reversing and our knowledge as to its amount is not definite. These features tend to demand a relatively large factor of safety. However, this tendency is more than counterbalanced by the facts that it is not difficult to calculate the stresses when a definite load is assumed, that the chance for faults in manufacture are but few and that the risk to life and property is a minimum.*

Another feature which makes it possible to use a small factor of safety is that a sample tower may easily be tested with the assumed loadings and with ultimate breaking loads. obviously if a factor of safety is used which will permit the tower to be strained with the assumed loads without being permanently deformed then such factor of safety will be satisfactory, provided the assumed loads correspond with the actual loads. The factor of safety for these conditions would be two if it is considered that the elastic limit of the metal is one-half of its ultimate strength. Many transmission towers have been built on this basis with a consequent saving in the cost of the line. On the other hand more conservative engineers have used values three and even four, these higher values being chosen to care for the uncertainty of load conditions. In one line recently built a factor of safety of 4 was used for all of the main line towers and three for all the strain or dead end structures. This at first sight seems illogical, but it is justified, since the strain towers are figured for a very definite condition, i.e., of all cables being broken in one span and with a maximum load of wind and ice on all those in the next span; whereas the intermediate towers are figured on an indefinite assumption; i.e., of having only two cables break while the others are heavily loaded. The use of these large values, however, makes the cost of the line excessive and for this reason it is common practice to use smaller values, two, two and one-half, or three for the intermediate towers and three or three and one-half for the strain towers. With this arrangement the main part of the line will be safe except in case of some unusual condition which produces worse loads than those assumed and in event of such an accident the strain towers will prevent the trouble from travelling to the next section of the line.

For the conductors themselves a factor of safety of two is [illegible] which [illegible] greater allowance is made for ice and wind than in other parts of the [illegible]

Flexible Towers. [illegible]

in using such a system in preference to the six-conductor single tower system, the principal ones being that there is less liability to complete shut-down in case of accident to a tower and that there is greater safety for linemen when repairing damaged towers, conductors or insulators. The reason for the present limited use of double tower lines is the high cost of such a system when made up of the rigid type of tower. If engineers would look more into the possibilities and cost of the flexible structures there would undoubtedly be a more general use of double tower lines.

THE FIRE HYDRANT.*

By C. W. Wiles, Delaware, Ohio.

In setting hydrants at least 6 in. of broken stone or brick should be placed at the bottom of the hydrant, and for at least 6 ft. along the supply pipe. Of course, if the hydrant is set in gravel or sandy soil this is not so necessary, but it will do no harm and may prevent trouble at some time.

In order to facilitate examination and make easy repairs, a gate-valve should be placed on each hydrant. Often this will save shutting off the supply from several streets.

Inspect carefully all hydrants, at least in the fall, before cold weather comes on, and again in the spring. First see that they are empty; if not, see if they have been properly closed. Often the rubber packing valve is defective and should be removed. Sometimes stones get between the valve and the seat, so that no amount of pressure will make it tight, even if there is no water in the hydrant chamber. It is well to test a leak at the valve by listening at the nozzle, or applying an aquaphone to see if there is not a small leak which escapes through the waste. Roots and grass often grow in the bottom of hydrants and prevent drainage.

If, upon examination, the hydrant is found empty and no apparent leakage at the valve, it is well to blow lightly to remove any sediment or mud that has accumulated in the branch supply line, and then close down and watch through the nozzle for it to drain. If all is in proper order, it should empty in five or ten minutes. If it does not, roots may partially obstruct the waste, or the earth may be so closely packed at the bottom as to leave no escape for water.

One of the most frequent causes of frozen hydrants is the opening and closing by inexperienced persons, who fail to fully close it, allowing the barrel to remain full of water. Every hydrant used at a fire or for any other purpose should be carefully examined immediately after its use by a competent person who fully understands its working.

The rule allowing no one but fire department employees, and then only at fires, or experienced waterworks employees to open or close any hydrant should be firmly enforced at all times, and even firemen should be fully instructed as to the methods of opening and closing hydrants, especially which way to open and close. Strange as it may seem, there are cities that have hydrants some of which open right and some left.

Stones, [illegible] and even calking hammers, have been found in hydrants after their use, preventing closing. Of course, this is the result of carelessness in laying mains, and the remedy is obvious to all waterworks men.

Pipe [illegible] along a street is a temptation to children and others to fill with stones; we understand from the pipe-[illegible] people that the size and variety of relics they find in mains would [illegible] a museum.

---

*Paper read before American Waterworks Association.

THE DUNMURRY SEWERAGE SCHEME.

By James Hunter.*

The results of the recent census lately published in Great Britain go to prove that the tendency of the wealthier portion of the population of all the large towns is towards migration to the suburbs....... It is chiefly due to this tendency of the population of cities to overflow and enrich the suburban areas near Belfast that caused the construction of a new drainage scheme for Dunmurry.

Dunmurry lies close up to the city of Belfast, and being delightfully situated as a residential area, the building speculators soon became alive to its possibilities in this direction, and in a short time what was formerly a sleepy country village began to develop into a township. Villas were built all round, a new church and new school buildings erected, and later on a factory, with its attendant new laborers' cottages.

The new population, fresh from the city where they had the advantage of the very best sanitary arrangements, were not long contented with the antiquated sanitary arrangements, which had for ages done duty about Dunmurry, and an appeal was made to the council to have Dunmurry put into a proper sanitary condition. After much discussion and many adjournments the council asked me to make a careful inspection of the Dunmurry district, and a report as to what should be done to remedy the grievances complained of. My report was adopted, and I was instructed to prepare a sewerage scheme along the lines indicated in my report, and Mr. Donald Cameron, of Exeter, was appointed consulting engineer. Accordingly, plans, etc., were prepared, passed by the council, and submitted to the Local Government Board, and, after the usual inquiries, were approved by that board.

The tender of Messrs. H. and J. Martin ($44,365), being the lowest, was accepted, and the work was started in November, 1909.

The scheme itself consists of the usual main and branch sewers, with septic tanks, filter-beds, and irrigation area. The main sewer, 12 ft. diameter, begins at the County Bridge, close to Dunmurry Station, and, following the course of the river, extends to the works at Glenburn, a distance of 2,000 lineal yards, crossing the river twice. At the river crossings the main is constructed with cast-iron piping carried on steel girders, the girders resting on concrete abutments, with concrete waterway between.

Where it approaches the works the main is also iron piping carried across a hollow at the river bank on concrete piers, and thence across the river on the parapet of the new approach bridge to works. Most of the main was laid in open cutting, but we had a rather difficult length of tunneling across the main road and under the mill-race, as the bottom for the entire length was through running sand. Indeed, everywhere in the trenches when we got below 9 ft. from surface we came into the same objectionable bottom.

The length of branch sewers is 3,090 yards, and covers all the outlying portions of Dunmurry.

For proper ventilation and cleansing, ventilating columns and Adamez patent flushing syphons have been fixed at the upper end of all branch sewers, while at the lower levels air inlet chambers have been formed at the side of the manholes and opening into same. These chambers are fitted with open covers and have flap valves of thin hammered copper, hung in narrow strips on metal frame, fitted to opening between chamber and manhole. For the cleansing of the main sewer we were able to utilize the river by constructing a concrete chamber with penstock, etc., in the wall at the upper end of main, close to railway station. We found this arrangement very useful and economical during the testing of the works and in the recent dry weather.

The scheme is designed on the separate system, and practically all street surface drainage has been excluded; however, ample provision against congestion has been made by fixing storm overflows at suitable positions along main and large branch sewer.

The Purification Works.—The purification works are situate about one mile from Dunmurry, in a secluded glen lying between the Dunmurry river and the river Lagan, and well away from any possible residential area. The council purchased three acres at this place from the Northern Banking Company, Limited, and that body very generously made a free gift of six acres additional, being the remainder of the field, together with a free bottom for the approach road. The approach is half a mile long, and is carried over the Dunmurry River at two places by bridges of 22-ft. span. Arches of bridges are of Staffordshire blue brick in cement mortar, and the abutments, waterway, wings, and parapets are of concrete. At the bridge close to works concrete training walls have been constructed to prevent erosion in heavy floods.

The Dunmurry River, I may here state, having its source in the hills, is very liable to sudden spates, and rises very rapidly, and is dangerous in flood, as the contractors found to their cost during the progress of the work.

The works consist of four septic tanks, with grit chambers and storm tank, etc., eight filters, and an irrigation area four acres in extent.

The septic tanks are all arched over with the exception of a 6-ft. length at each end, which is covered with planking, on top of which is a thick layer of peat-moss litter. By means of these lengths at each end the tanks are very easily examined and cleaned out. There are also the usual sludge lagoons and an irrigation area for storm water.

The filters are 4 ft. 9 in. deep, and filled 4 ft. deep with washed cinders: top, 12 in., ½ in. to ⅛ in.; bottom, 12 in., 1½ in. to ⅜ in.; and centre portion, ¾ in. to ⅜ in. The filters are worked by automatic gear supplied by the Septic Tank Company, London, and this is at present working satisfactorily.

The irrigation area is laid out level, and is under-drained by agricultural drain pipes laid at an average depth of 1 ft. 9 in. under the surface. These under-drains are joined to a 9-in. main pipe running the entire width of the area and discharging into the Lagan.

The effluent from the filters is distributed over the irrigation area by means of stoneware channels, 9-in. feeders and 6-in. carriers.

At the upper end of the 9-in. main at irrigation area a weir has been constructed in the river so that the main can be cleansed of sediment as often as necessary.

The septic tanks are designed to accommodate a population of 2,500, or double the existing population at the time the scheme was promoted.

The daily water consumption was taken as 25 gallons per head, and allowance has been made for treating three times this quantity, or 180,000 gallons. The dry-weather flow to works during recent dry spell averaged about 30,000 gallons daily.

An analysis of effluent taken on June 23rd last shows that the works, after twelve months' service, are acting well. Two samples were submitted for analysis, one from the gear chamber of effluent from septic tanks, and a second from the outfall pipe at river Lagan of the final effluent. Taking the standard of purity as the oxygen absorbed test, sample

---

* Paper read at the Royal Sanitary Institute Congress at Belfast.

No. 1 gives the amount of oxygen absorbed after four hours at 80 deg. Fahr., as 0.57 per 100,000 parts, and sample No. 2 gives 0.16 parts under similar conditions. The suspended solids the analyst gave as practically nil.

Under a separate contract carried out by the Messrs. Martin, the council have spent a sum of almost £2,000 in connecting up all the houses to the new system....... The district, from being the most insanitary, is now perhaps the most sanitary in the North of Ireland.

In conclusion, I may state that the pipes used in the system were supplied by Messrs. Candy & Co., of Newton Abbot, and have given great satisfaction. The manhole and lamphole covers were manufactured by Messrs. Adams, of York, and the automatic gear by the Septic Tank Company, of London.

◆

STATISTICS OF RAILWAYS IN THE UNITED STATES FOR THE YEAR ENDED JUNE 30, 1911.

The statements in this preliminary abstract are based upon compilations for the Twenty-fourth Annual Statistical Report of the Interstate Commerce Commission, covering the fiscal year ended June 30, 1911, and these advance figures, which do not cover switching and terminal companies, may be slightly affected by revision before final publication.

Mileage.—Substantially complete returns were rendered to the commission for 246,124.40 miles of line operated, including 11,006.86 miles used under trackage rights. The aggregate mileage of railway tracks of all kinds covered by operating returns was 362,710.18 miles. This mileage was thus classified: Single track, 246,124.40 miles; second track, 23,451.26; third track, 2,414.16; fourth, fifth, and sixth tracks, 1,747.10; yard track and sidings, 88,973.26. These figures indicate an increase of 10,943.59 miles over corresponding returns for 1910 in the aggregate length of all tracks, of which increase 3,391.33 miles, or 30.99 per cent., represent yard track and sidings.

Equipment.—It appears that there were 61,327 locomotives in the service of the carriers on June 30, 1911, indicating an increase of 2,380 over corresponding returns for the previous year. Of the total number of locomotives, 14,301 were classified as passenger, 36,405 as freight, and 9,324 as switching, and 1,297 were unclassified.

The total number of cars of all classes was 2,359,335, or 69,004 more than on June 30, 1910. This equipment was thus assigned: Passenger service, 49,818 cars; freight service, 2,195,511; and company's service, 114,006. The figures given do not include so-called private cars of commercial firms or corporations.

It appears that the average number of locomotives per [illegible] miles of line was [illegible], and the average number of cars per 1,000 miles of line was 9,586. The number of passenger-miles per passenger locomotive was [illegible], and the number of ton-miles per freight locomotive was 6,913,246.

The returns indicate that the number of locomotives and cars in the service of the carriers aggregated [illegible], of which [illegible] per cent. [illegible] were fitted with train brakes, and [illegible] per cent. [illegible] were fitted with automatic couplers. Of the 2,195,511 cars in freight service on June 30, 1911, the number fitted with train brakes was [illegible], and the number fitted with automatic couplers was [illegible].

Employees.—The total number of persons reported as on the pay rolls of the steam roads of the United States on June 30, 1911, was 1,669,809, or an average of 678 per 100 miles of line. As compared with returns for June 30, 1910, there was a decrease of 29,611 in the total number of railway employees. There were 63,390 enginemen, 66,376 firemen, 48,200 conductors, 133,221 other trainmen, and 40,005 switch tenders, crossing tenders, and watchmen.

The total number of railway employees (omitting 93,718 not distributed) was apportioned among the six general divisions of employment as follows: To maintenance of way and structures, 493,926; to maintenance of equipment, 344,112; to traffic expenses, 22,246; to transportation expenses, 629,654, to general expenses, 52,201; and to outside operations, 33,952.

The complete report will include summaries showing the the average daily compensation of 18 classes of employees for a series of years, and also the aggregate amount of compensation reported for each of the several classes. The total amount of wages and salaries reported as paid to railway employees during the year ended June 30, 1911, was $1,208,466,470.

Capitalization of Railway Property.—On June 30, 1911, the par value of the amount of railway capital outstanding, according to the returns of the companies filing reports with the commission, was $19,208,935,081. This amount includes capital held by the railway companies as well as by the public.

Of the total capital outstanding, there existed as stock $8,470,717,611, of which $7,074,917,559 was common and $1,395,800,052 was preferred; the remaining part, $10,738,217,470, representing funded debt, consisted of mortgage bonds, $7,825,269,102; collateral trust bonds, $1,183,766,188; plain bonds, debentures, and notes, $951,377,816; income bonds, $261,777,220; miscellaneous funded obligations, $195,430,395; and equipment trust obligations, $319,596,749.

Of the total capital stock outstanding, $2,740,467,285, or 32.35 per cent., paid no dividends. The amount of dividends declared during the year (by both operating and lessor companies) was $460,195,376, being equivalent to 8.03 per cent. on dividend-paying stock. No interest was paid on $755,449,047, or 7.25 per cent. of the total amount of funded debt (other than equipment trust obligations) outstanding.

Public Service of Railways.—The number of passengers carried during the year ended June 30, 1911, was 997,409,882. The corresponding number for the year ended June 30, 1910, was 971,683,199. The increase in the number of passengers carried during the year over 1910 was 25,726,683.

The number of passengers carried 1 mile, or the passenger mileage, as compiled for 1911, was 33,201,694,699. The corresponding return for 1910 was 863,198,370 less. The number of passengers carried 1 mile per mile of road was 139,101.

The number of tons of freight shown as carried (including freight received from connections) for the year ended June 30, 1911, was 1,781,637,954, while the corresponding figure for the previous year was 1,849,900,101, the decrease being 68,262,147 tons.

The ton mileage, or the number of tons carried 1 mile, as shown for the year ended June 30, 1911, was 253,78[illegible]. The total ton mileage as reported for the year ended June 30, 1910, was 255,016,910,451, from which it will be seen that the decrease in the ton mileage for the year ended June 30, 1911, under the return for 1910 was 1,233,208,612. The increase in the number of tons carried 1 mile in 1910 over 1909 was [illegible]. The number of tons carried 1 mile per mile of road for the year 1911 was [illegible]. The number of tons per train mile was 383.10.

The average receipts per passenger per mile, as computed for the year ended June 30, 1911, were 1.974 cents; the average receipts per ton per mile, 0.757 cent. The passenger service train revenue per train-mile was $1.30.921; the freight revenue per train-mile was $2.89.548. The average operating revenues per train-mile were $2.24.824. The average operating expenses per train-mile were $1.54.338. The ratio of operating expenses to operating revenues was 68.66 per cent.

Revenues and Expenses.—It should be noted that the following figures under the heading of revenues and expenses exclude returns for a few small roads because of deficiencies in their reports. For the year ended June 30, 1911, the operating revenues of the railways in the United States (average mileage operated, 243,433.61 miles) were $2,789,761,669; their operating expenses were $1,915,054,005. The corresponding returns for 1910 (average mileage operated 236,986.51 miles) were: Operating revenues, $2,750,667,435; operating expenses, $1,822,630,433. The following figures present a statement of the operating revenues for 1911 in detail:—

Freight revenue	$1,925,950,887
Passenger revenue	657,638,291
Mail revenue	50,702,625
Express revenue	70,725,137
Excess baggage revenue and milk revenue (on passenger trains)	15,430,683
Parlor and chair car revenue and other passenger-train revenue	5,274,450
Switching revenue	27,665,997
Special service train revenue and miscellaneous transportation revenue	9,479,809
Total revenue from operations other than transportation	24,707,757
Joint facilities revenue—Dr.	647,247
Joint facilities revenue—Cr.	2,833,280
Total operating revenues	$2,789,761,669

The operating revenues stated above averaged $11,460 per mile of line.

Operating expenses, as assigned to the five general classes, were:—

Maintenance of way and structures	$ 366,025,262
Maintenance of equipment	428,367,306
Traffic expenses	59,166,364
Transportation expenses	987,382,108
General expenses	73,689,373
Unclassified	423,592
Total operating expenses	$1,915,054,005

The foregoing operating expenses averaged $7,867 per mile of line.

MAGAZINES AND THAW HOUSES FOR EXPLOSIVES.

"Magazines and Thaw Houses for Explosives" is the title of Technical Paper No. 18 just issued by the United States Bureau of Mines. The authors, Clarence Hall and S. P. Howell, present the advanced practice abroad and in the United States on the use of material for the construction of magazines and thaw houses and strongly recommend the use of a lean cement mortar consisting of 6 parts of sand and 1 part of cement as the material to be used in the walls, roof, and doors of these buildings in order that the explosives within them may be properly protected, also in order that life and adjacent property may not be jeopardized when magazines and thaw houses are constructed the proper distances from other buildings.

In order that the explosives in magazines may be properly protected they must be guarded against bullets, fire, lightning, and unlawful entry. Different fireproof materials were experimented with to determine their resistance to the penetration of rifle bullets. Sand offered some advantages, but was rejected because it would eventually flow out on the floor of the magazine through the cracks in the walls and could not be depended upon to remain in the structure permanently; moreover, gritty materials of any kind are objectionable on the floor of a magazine. Mineral wool overcame this objection but had little value as a medium for resisting the penetration of rifle bullets. Therefore, in order to overcome the objectionable features of sand, Portland cement was mixed with it in order to form a lean cement mortar and thus enable the sand to be retained within the walls of the magazine, and still be friable enough to crumble readily under a blow. Tests to determine these two features were so satisfactory that a magazine having this cement mortar as a filling was constructed by the Bureau of Mines at a cost of $400 and having a capacity of 20,000 to 30,000 pounds. A working drawing showing the dimensions and necessary sections are included in the publication. The means provided for ventilation in the magazine of the Bureau of Mines has been found to be adequate and, accordingly, the storage of explosives in respect to their keeping qualities is favorable.

The cement mortar construction is effective in resisting the penetration of rifle bullets and owing to its friable nature offers an additional advantage for the reason that, in the event of an explosion in or near the magazine, the large masses of material would not be projected over the surrounding country. The galvanized iron covering is fire-resisting and at the same time it serves as an excellent medium for protection against lightning when the four corners of the building are properly grounded with metal rods.

The method of selecting a magazine site is emphasized and suggestions made. The permissible distance which must obtain between magazines and other structures in England, Prussia, Austria, Italy, Massachusetts, and also the proposed American table of distances are contained therein.

The proper method of thawing explosives in either small or large quantities and a suitable method of transporting them to the place where they are to be used is described in this Technical Paper.

A temperature not exceeding 90 deg. Fahr. is recommended in thawing explosives. In all cases explosives must be protected against moisture and high temperatures and for this reason thawing explosives by placing them before a fire or near a boiler or on steam pipes or by putting them in hot water is condemned.

Copies of this Technical Paper may be obtained by writing to the director of the Bureau of Mines, Washington, D.C.

TELEGRAPH LINES DAMAGED BY DYNAMITE EXPLOSION.

While attempting to loosen dirt for the steam shovel, used in the excavation of the Canadian Pacific Railway station extension in Vancouver, by a charge of dynamite the telephone and telegraph lines of the system were badly damaged. Two poles were cut in two and a third driven into the ground at an angle.

COMPARATIVE STRENGTH AND RESISTANCE OF VARIOUS TIE TIMBERS.

The following series of tests were conducted in the physical laboratory of the Armour Institute of Technology, under the supervision of engineers representing the track department of the Board of Supervising Engineers, Chicago Traction, and were published in the third annual report of the board recently issued. The purpose of the tests was to determine the comparative strength and resistance of various tie timbers used in the construction of street railway track under the board's supervision.

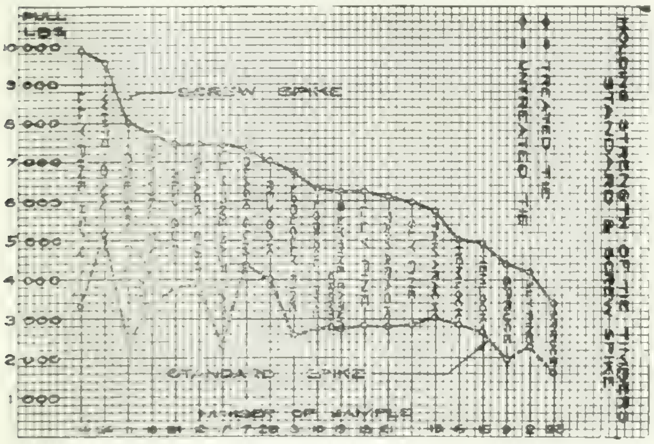


Fig. 1.
Comparative Holding Power of Standard Screw Spikes in Various Timbers.

Spike-pulling Tests.—The special object of these tests was to determine the comparative holding power of the standard track spike and of the screw spike developed by the Board in various timbers. Three spikes of each kind [illegible] samples were used [illegible] [illegible] in the same depth [illegible] [illegible] track construction. These spikes were then withdrawn at right angles to the face of the tie by [illegible] at a speed of [illegible] per minute. The [illegible] [illegible] [illegible]

The [illegible] the screw spike [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Indentation Tests.—Tie plates were placed on a tie as in track construction. A steel casing with a face equal to that of the base of the standard rail (6 ins.) was mounted on the plate and then loads were applied at right angles to the tie plate, directly from the compression head of the testing machine, at a speed of 1/16 in. per minute, and an initial load of 500 lbs. was used in all tests, to which load frequent returns were made from the higher loads. All indentations were measured by a deflectometer reading to 1/1,000 in., fastened under the compression head of the testing machine.

The materials used in the test timbers were as follows: Short leaf yellow pine (untreated); loblolly pine, treated with chloride of zinc; short leaf yellow pine, early growth, treated with chloride of zinc; long leaf yellow pine, half sap, treated with chloride of zinc; long leaf yellow pine (untreated); black gum, treated with chloride of zinc; white oak (untreated); hemlock (untreated); spruce (untreated); long leaf yellow pine heart (untreated); red gum (untreated); red oak (untreated). All of these ties were well seasoned and dry. The screw spike was of the Board of Supervising Engineers' standard, and the track spike was of the standard railway type, 5½ ins. by 9/16 in. The tie plates tested were of the Board of Supervising Engineers' standard, one with a flat bottom, 6 ins. by 9½ ins., and the other having a corrugated bottom of the same size.

Results of Tests.—The results of the tests as presented in the accompanying tables and curves may be summarized as follows:—

(1) Although the holding power of the screw spike is approximately three times that of the standard 5½-in. by 9½-in. track spike in any given timber, the relative holding power in the different timbers is such as to make the screw spike in treated pine timbers fully equivalent to the standard track spike in good white oak.

(2) In reference to the resistance of the fibre of the wood to the indentation of a tie plate, the ratio of this resistance for a flat bottom plate to that for a corrugated bottom plate is decidedly greater than the ratio of the bearing area of the flat bottom plate to that of the corrugated bottom plate. In other words, for the same unit load per square inch of actual surface contact, the indentation with the corrugated plate is considerably greater than with the flat bottom plate.

(3) The chloride of zinc treatment used for preservative purposes on the loblolly and short leaf yellow pine ties has the additional feature of increasing the fibre strength of these timbers to such an extent as to make

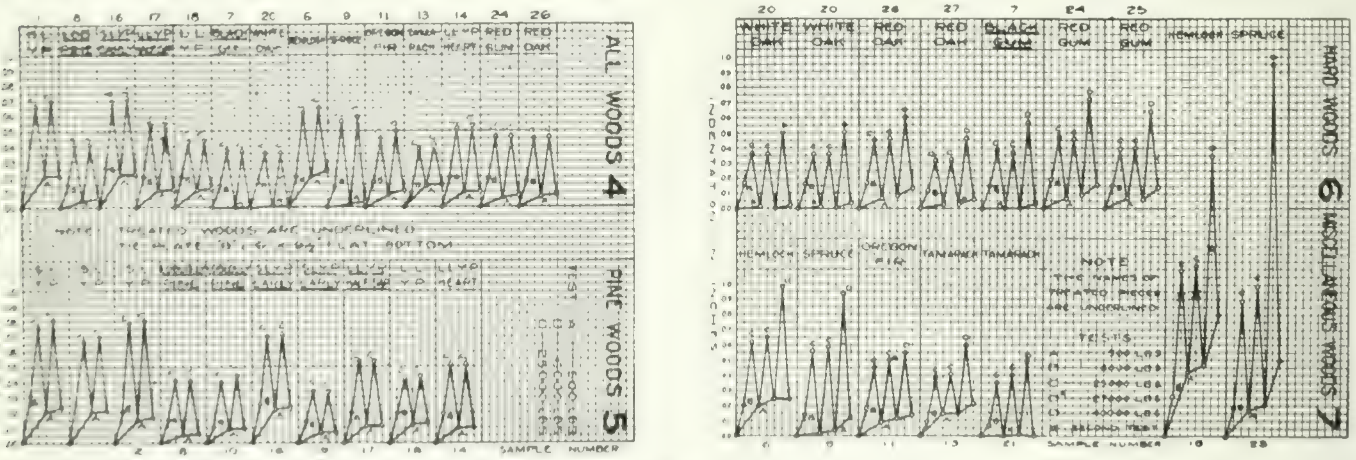


Fig. 2.
(4, 5) Comparative Deformation of Tie Timbers with Flat Tie Plate, for All Woods and for Pine Only.
(6, 7) Comparative Deformation of Hard Woods and Various Woods—Flat Tie Plates.

them compare favorably with the long leaf yellow pine ties in resisting indentation of a tie plate.

(4) The adoption of a flat tie plate with its increased bearing area as a remedy for track deflection, due to permanent deformation of the timber fibres, was fully warranted by the results of this investigation.

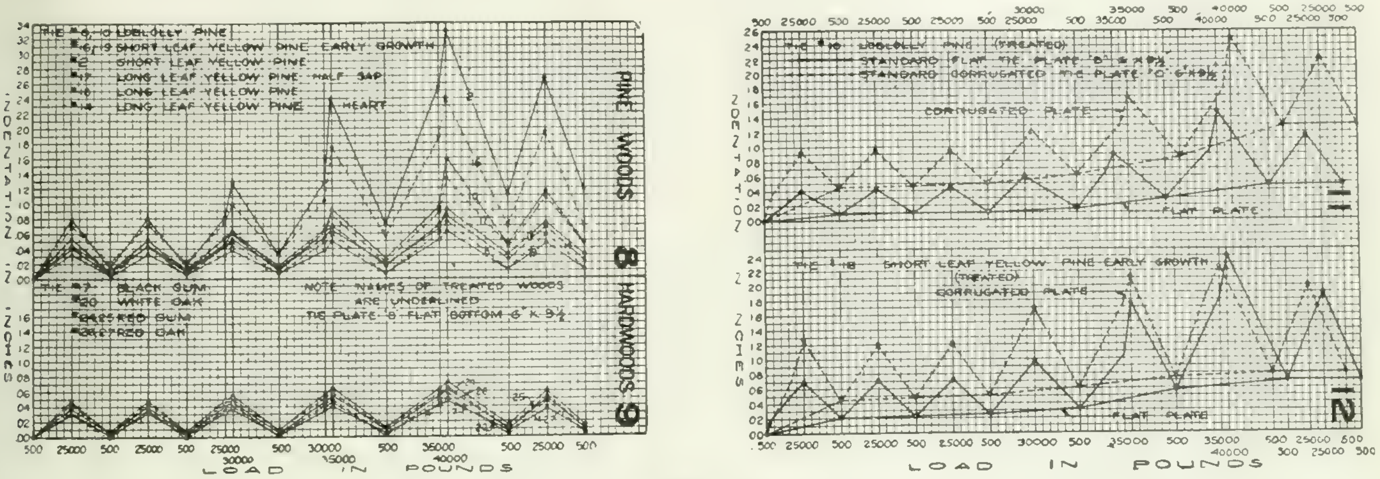


Fig. 2.

(8, 9) Comparative Deformation of Pine Ties and Hard Wood Ties Under Successive Load—Flat Tie Plates.
(11, 12) Comparative Deformation of Loblolly and Short Leaf Yellow Pines, with Flat and Corrugated Tie Plates.

Comparing the results of these spike-pulling tests with those previously recorded by the board, it is of interest that in all cases the preliminary data relating to the holding power of screw spikes were independently confirmed by the results of the 1909 tests, and were shown to be very conservative.

Holding Power.—Fig. 1 compares the relative holding power of standard and screw spikes in various timbers, these timbers being ranked according to the relative holding strength with the screw spike. The lower curve indicates the relatively less holding power of the standard spike observed in all cases. With few exceptions, this relative proportion holds throughout the test. It is apparent from the curves that the softer woods have not over one-half the strength of the harder woods, or of long leaf yellow pine, mostly heart.

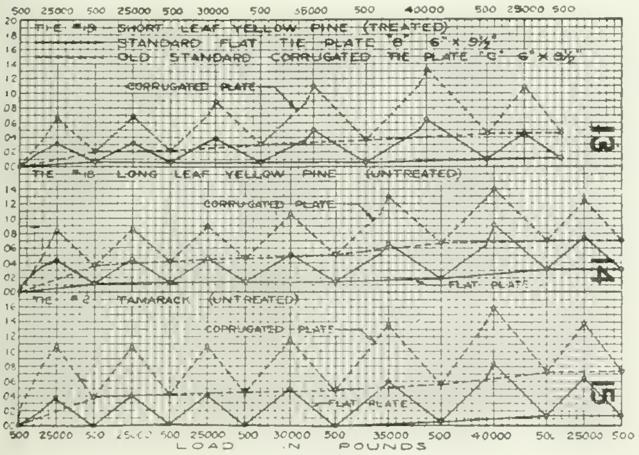


Fig. 2.

(13, 14, 15) Comparative Deformation of Short Leaf and Long Leaf Yellow Pines—Flat and Corrugated Tie Plates

Indentation.—The indentation tests, Figs. 2 (4, 5), are represented in the two forms; plates 4, 5, 6 and 7 summarize the results on typical timber samples with two or three applications of maximum pressure; plates 8 and 9 may be regarded as the deterioration tests indicating the permanent deformation of fibre and cumulative injury under excessive maximum loads; plates 11 and 15 represent typical deterioration tests, on various timber, showing, in addition, the fatigue curve resulting from the use of the corrugated tie plate as compared with the flat tie plate. The so-called fatigue manifests itself in the fact that with successive applications of the same pressure, the fibres did not show complete recovery. Gradual assent of the fatigue curve, therefore, indicates permanent deformation of the wood fibres, and in all cases, that of a corrugated tie plate is considerably greater than the flat plate, owing to the smaller bearing area.

During none of these indentation tests was the load entirely removed, as the resulting possible change in tie plate contact might have entirely vitiated the results indicating abnormal recovery at minimum load; consequently, the load was not reduced below 500 lbs. Plate 4 shows clearly recovery from load C to load A in succession, thus with short leaf yellow pine, untreated, permanent deformation resulted only from the first application of 25,000 lbs. load, but the second application showed practically no further deformation. Hemlock, untreated, on the other hand, showed continued deformation, while white oak showed practically complete recovery with no deformation. In these tests, load B represents approximately the tie plate load, such as would result from the passing of an ordinary car. In plate 7, some of the softer woods were tested to practical failure. Tests on hard woods (plate 9) are remarkable in the coincident of the results and the complete recovery.

Deterioration of Screw Spikes.—Examination of track built in previous years showed that where screw spikes have been inserted in ties treated with zinc chloride, a deterioration of the spike resulted. The reason for the damage is believed to be local, chemical and galvanic action in the bored spike hole, which usually contains water, each spike hole forming a single cell containing a strong solution of zinc chloride in which the screw spike is immersed. Free chlorine and hydrochloric acid gases assist in the destruction. While there seems to be no immediate remedy at hand which might be applied to stop or partially suspend the deterioration which is going on apparently at all times, the obviation of this difficulty in the future will be obtained by abandonment of zinc treated ties for ties treated with creosote.

MANUFACTURERS' STANDARD FOR FLANGED FITTINGS AND FLANGES, STANDARD AND EXTRA HEAVY PRESSURES, ADOPTED JULY 10, 1912, EFFECTIVE OCTOBER 1, 1912.

By W. H. Douglas, Secretary Committee of Manufacturers on Standardization of Fittings and Valves.

The standard recently adopted jointly by the Master Steam and Hot Water Fitters' Association and the American Society of Mechanical Engineers, and known as the "1912 U.S. Standard," is the outgrowth of an effort on the part of these two societies to establish a universal standard for flanged fittings and flanges for working steam pressures in ordinary use at the present time.

Without question, a universal standard is necessary and highly desirable; but any standard to be commercially successful must be designed to bring about the desired uniformity with the minimum inconvenience and expense, both to consumers and to manufacturers.

Before the "1912 U.S. Standard" was adopted by the two societies mentioned, there existed among the majority of manufacturers, in the United States, a generally accepted standard for flanged fittings and flanges. Most of the large flanged fittings manufacturers in this country had the entire pattern equipment necessary to build this line of goods and many had list prices and dimensions published for general distribution to the trade; in fact, these dimensions have been published in Kent's Pocket Book, 8th Edition.

After having thoroughly investigated the conditions which induced the two societies to adopt the "1912 U.S. Standard," the manufacturers of flanged fittings and flanges throughout the country realized that certain changes in the generally accepted standard were desirable. The tendency of modern engineers to use higher steam working pressures than was their practice some years ago has demonstrated the necessity for an increase in the strength of extra heavy end flange bolting in the larger sizes. In drafting up the "1912 U.S. Standard," the American Society of Mechanical Engineers provided an increase in the bolting of large extra heavy flanges; but this increase seems out of proportion [illegible] steam engineering practice. The manufacturers have, therefore, adopted a happy medium and have increased the bolting on these extra heavy flanges, but have been more practical in this increase than the "1912 U.S. Standard."

So far as the strength of the "Manufacturers' Standard," not considering the bolting, is concerned, the "1912 U.S. Standard" has no advantage whatever over the manufacturers' standard.

While the "1912 U.S. Standard" provides longer centre [illegible]

[illegible]

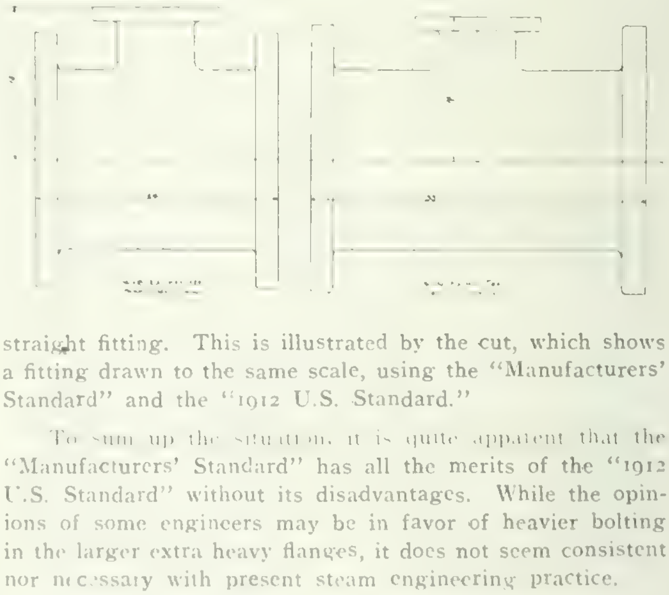
[illegible]

While the "1912 U.S. Standard" provides much heavier bolting on the very large extra heavy flanges, this excessive increase does not seem necessary, as the "Manufacturers' Standard" bolting is just as strong as the "1912 U.S. Standard" on the sizes which include the great majority of pipe lines; namely, the ten-inch size and smaller.

The "Manufacturers' Standard" is much more economical for the consumer of the future, in avoiding mistakes when making changes and additions to his plant, as no change is made in the centre to face dimensions from the present "Manufacturers' Standard." This standard is also economical for the manufacturer, as he can use his present equipment, which, to a large extent, is made up in very substantial fashion and cannot be changed without involving a very high expenditure.

Furthermore, the "1912 U.S. Standard" will naturally create a great deal of confusion to the consumer, jobber and manufacturer alike, as it would necessitate carrying two stocks of fittings for several years, or until the new standard is fully in effect. The "Manufacturers' Standard" will not cause this difficulty.

The "Manufacturers' Standard" for reducing fittings is a much better design than the "1912 U.S. Standard," as the fittings are more in proportion with the straight sizes. The "1912 U.S. Standard" has the same dimensions on the run of reducing fittings as the straight sizes, regardless of reduction. It will be readily seen that the proportions of a reducing fitting will not be in harmony with those of a straight fitting. This is illustrated by the cut, which shows a fitting drawn to the same scale, using the "Manufacturers' Standard" and the "1912 U.S. Standard."



To sum up the situation, it is quite apparent that the "Manufacturers' Standard" has all the merits of the "1912 U.S. Standard" without its disadvantages. While the opinions of some engineers may be in favor of heavier bolting in the larger extra heavy flanges, it does not seem consistent nor necessary with present steam engineering practice.

It would seem apparent that the excessively large bolt diameters specified in the "1912 U.S. Standard" for the larger flanges are much too cumbersome and inconvenient from the steam fitters' standpoint, while the bolt sizes specified in the "Manufacturers' Standard" are more in accordance with general practice. In a standard of this nature convenience as well as strength should be a governing factor.

We feel confident that the public at large will express their preference for the "Manufacturers' Standard," and while the manufacturers may be accused of not taking an interest in the "1912 U.S. Standard" from its inception, their recent action in adopting a universal standard which is fully in accord with the requirements of the engineering trade, will demonstrate that they are acting with absolute sincerity and with a fair-minded attitude towards all interests involved.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, AUGUST 15, 1912. No. 7

CONTENTS OF THIS ISSUE.

Editorial: PAGE

Coal Dust Explosions 321
Canada's Fire Losses 321

Leading Articles:

The High Tension Transmission System of the Hydro-Electric Power Commission of Ontario 303
The Production of Pig Iron in Electric Furnace 306
Some Fallacies and Facts Concerning Engineering Works in Great Britain 308
Some Mechanical Consideration of Transmission Systems 311
The Fire Hydrant 314
The Dunmurry Sewerage Scheme 315
Statistics of Railways in U.S. for the Year Ended June 30, 1911 316
Magazines and Thaw Houses for Explosives 317
Comparative Strength and Resistance of Various Tie Timbers 318
Manufacturers' Standard for Flanged Fitting and Valves 320
New Floating Dock for Montreal 324
New Method of Testing Rivet Steels 325
Some Considerations in the Choice of Pavements 326
Methods of Testing Clay 329
Standard Specifications for the Refractory Material 331
Gasoline Railway Motor Cars 332
Laying Subaqueous Water Mains at Rome and Meridian 333
Tensile Tests of Species of Reinforced Bars 334
Personals 335-6
Coming Meetings 336
Engineering Societies 336
Market Conditions 24 26
Construction News 67
Railway Orders 74

COAL-DUST EXPLOSIONS.

The first report of the Explosions in Mines Committee, of which a summary appeared in the London Times recently, confirms some of the opinions which have already been expressed regarding the deterrent influence of stone-dust upon explosions, and it is satisfactory to observe that the committee are making progress with an investigation which must of necessity be developed by a step-by-step process upon the basis of direct experiment. From the programme of their prospective researches it appears that they have to examine the nature and condition of the coal-dust in mines, the amount and purity of the oxygen supply, and the character of the initial conditions that result in ignition. They have, moreover, to determine the comparative violence of coal-dust explosions, and the modifications of the destructive forces depending upon the general dimensions and layout of the mines. It is an investigation in which theory is singularly impotent to give direction to the research. Theory, in fact, must play the secondary part of interpreting results and suggesting certain safeguards, and the reason is that the committee are dealing with a set of phenomena that concern the break-up of the substance in a fraction of time altogether too small for the calculation by ordinary means of a series of constants representative of the successive stages of the explosions. Their investigation is, in fact, as far removed as can be imagined from the ideal conditions and the "perfect gas" relationships of thermodynamics. Since 1824, when Sadi Carnot published his remarkable contribution to the problem of the expansion of gases, the internal combustion engine has forced engineers to extend their tests far beyond the conditions of stability which he assumed into the region of explosion and disassociation; nevertheless, there is still a disposition to assume relationships between temperature, volume, and pressure applicable only to the gas in Carnot's engine, which was always brought back to its original condition. Briefly, therefore, the complexity of the task before the committee arises from the circumstance that they have to take account of the intrinsic energy of the working substance, which the laboratories have too often eliminated. The experimental station which has just been established at Eskmeals is destined to play an important part in that investigation, and every engineer will hope that it will rapidly reveal the means of safeguarding the lives of miners and of improving the physical conditions under which they work.

◆

CANADA'S FIRE LOSSES

The fire losses in Canada for the first six months of the current year total $14,740,499, an average of $2,456,750 per month. This is equal to a daily loss of $81,891. In other words, $3,412 worth of property has been burned every hour since the new year dawned, or nearly $57 every minute.

This is an appalling fire loss, and little is being done to check such extravagant waste of capital. The losses during 1909, 1910 and 1911 are as follow:—

	1909.	1910.	1911.
January	$1,500,000	$1,275,246	$2,250,550
February	1,203,005	750,025	941,045
March	851,000	1,070,253	852,380
April	720,050	1,717,237	1,317,000
May	3,358,276	2,735,536	2,564,500
June	1,300,275	1,500,000	1,151,150

	1909.	1910.	1911.
July	1,075,600	6,386,674	5,384,300
August	2,582,915	1,667,270	920,000
September	1,615,405	894,125	1,123,550
October	2,208,718	2,195,781	580,750
November	935,191	1,943,708	1,506,500
December	1,433,813	1,444,860	2,866,950
Total	$18,905,538	$23,593,315	$21,459,575

Adding to these figures the total loss for the first six months of 1912, we have a fire loss in forty-two months of $78,698,927, an average monthly loss of $1,873,785. In addition there has to be recorded a disastrous list of fire fatalities. During June in Canada six people met their deaths in fires. During the first six months of the year 101 people were sacrificed in the same manner. In the forty-two months since January, 1909, no less than 893 persons lost their lives in fires, a monthly average of almost 22 persons. The following table gives the details:—

	1909.	1910.	1911.	1912.
January	16	27	27	27
February	8	15	12	11
March	16	20	18	24
April	18	37	20	15
May	21	15	28	18
June	16	52	13	6
July	4	15	110	..
August	17	11	22	..
September	10	10	13	..
October	26	16	17	..
November	34	19	20	..
December	33	19	17	..
Total	219	256	317	101

In June, burning buildings were responsible for three deaths and three were caused by clothes set on fire.

The presumed causes for fires during June and the number of fires for which they accounted were as follows: Four, lamp explosions; three, children playing with matches; two each, cigarette stubs, incendiary, sparks, friction; one each, oil stove explosion, defective chimney, overflowing of a pot of soap grease. Forest fires did much damage and many fires were reported as of unknown origin.

The structures damaged and destroyed during June were 70 residences, 9 business sections, 5 stores, 4 each lumber mills, factories, 3 foundries, 3 each stables, barns, 2 each churches, hotels, freight sheds, 1 each rolling mill, flour mill, railway depot, roundhouse, power house, club house, ice-house, telephone exchange, pool room, barber shop, college, soda water works, grain warehouse, gasoline container, electric plant.

There were 500,000 staves, 15 tons hay, 6 horses, 2 miles wire fencing, 1 each buggy, motor launch, gasoline truck destroyed.

The National Board of Fire Underwriters of the United States, continuing its plan of education on the need of better protection, issued an exhaustive classification of fire losses recently, showing why the insurance companies are forced to ask higher rates in America than in Europe, and why rates in America itself necessarily vary. Taking thirty of the largest cities of the United States, the per capita loss in 1909 was shown to vary from $1.[illegible] in St. Louis to $4.55 in Kansas City. Higher per capita loss was shown in some of the smaller centres, like the city of Racine, where it ran to $24.29. The total annual fire loss is estimated at $200,000,000, and the underwriters go so far as to assert that $150,000,000 of this is waste from negligence or lack of precautions. The table of comparisons drawn up by the underwriters from consular returns in 1905, the only recent year in which statistics of the kind were gathered in Europe, showed an average loss of 61 cents per capita for thirty European cities as against $3.10 for 252 American cities Taking the number of fires to each 1,000 of population here and in Europe, it was found to be 4.05 in the United States against .86 in Europe.

The annual average losses for six nations in Europe were compiled from records of varying years and years grouped, with this result:—

Country.	Annual fire loss.	Loss per capita. Cents.
Austria	$ 7,601,389	29
Denmark	660,924	26
France	11,699,275	30
Germany	27,655,600	49
Italy	4,112,725	12
Switzerland	999,364	30

Or an average loss per capita of 33 cents.

The fire loss per capita in the Dominion last year was $3.02.

On Berlin, where the losses amount annually to less than those of one moderately large fire in the United States, the excellent conditions are due to the attention paid to the methods of construction. Building police have authority to compel the use of iron and steel girders, fireproof stairways and roofing, heavy fireproof ceilings, and all details that may diminish the risk of conflagration.

Canada cannot claim to be making untrammeled progress until its fire record has been improved considerably.

◆

LETTERS TO THE EDITOR.

Editor Canadian Engineer:

Dear Sir,—In your issue of June 27th, 1912, you published an article by Mr. F. M. Griswold on "Standard Hose Couplings and Hydrant Fittings," being a review of the progress made in introducing a standard in the United States; strange to say, little or nothing has yet been done in Canada in regard to this important matter.

Some time ago the question was taken up by the Western Canada Fire Underwriters' Association, whose jurisdiction extends over the Provinces of Manitoba Saskatchewan and Alberta. It was our intention at first to attempt to introduce the "National Standard," but the suggestion met with opposition from fire chiefs. Our next step was to find out what couplings are used in the towns and cities throughout this territory, and we found that two towns use five threads per inch; seventeen use six threads per inch; four, including two very small places, use seven threads per inch, and three use eight threads per inch. The list includes all the cities and towns which have waterworks systems in this territory, with the exception of four or five small places. We found that fire chiefs are almost unanimously in favor of the six-thread coupling, as it will stand more wear than the finer thread and is not so easily crossed; it is also a heavier coupling, being 3 3-16 inches outside diameter over the male end. After some discussion we came to the conclusion that, as the six thread coupling is so largely used, it would be very difficult, if not impossible, to have a change made to something else, and we decided it would be best to follow the line of least resistance and make this coupling a standard throughout our territory. As these three provinces extend from the rocky country of Western Ontario on the east to the Rocky Mountains on the west, it is improbable that there will ever be any large cities close to us on either side, and to have a uniform thread all through this territory will be almost as good as a standard for the whole country. One non-standard town in Saskatchewan has practically agreed to change, after which all the towns in that province will be standard.

If you will kindly publish this letter, it will be the means of bringing the matter to the attention of engineers who may be engaged in the installation of water supply systems in this part of the country.

H. STAINTON,
Inspector W.C.F.U.A.

* * * *

THE BLOOR STREET VIADUCT.

Sir,—It is with the greatest degree of satisfaction that I have noted the editorial in your number of the 8th instant protesting against the official statement of the Commissioner of Works of the city of Toronto in a report to the Board of Control that "concrete bridge design is not well understood, while that of steel is upon an assured basis."

The statement is made, apparently, with reference to the type of construction to be adopted for the proposed Bloor Street viaduct in Toronto, but its connection therewith is quite secondary in importance to the statement itself. That such a statement should be officially made by the chief works officer of the second city of our fair Dominion is amazing, and in the interest of truth and in justice to our profession you do well to take issue with the person who made it.

The commissioner must know, if he has studied the subject at all, that the greatest stride made by the engineering and architectural professions in structural design since the development of the great orders of architecture is in reinforced concrete construction. Its adaptability to structures of all kinds is proven beyond all doubt as regards both strength and design. Its permanence equals that of the everlasting hills.

The success or failure of isolated examples of any type of structure as a result of errors in workmanship or design proves nothing. One type is no better than another if errors have crept in anywhere. For the information of the commissioner I would join with you and emphasize your statement that "the analysis of stresses and the knowledge of the action of concrete is to-day on as high a plane as any other branch of structural design."

For myself, I cannot think that the commissioner has had any engineering training, and I feel quite certain Mr. Power never made such a statement as that which is contained in the report to the Board. To let such a statement go unnoticed would reflect discredit on the excellent work already done by the civic staff of Toronto, and on the work done by Canadian engineers throughout this broad Dominion. It would hold us up to ridicule before the Dominion, and the profession to ridicule before the world.

Such questions as that with which the report deals cannot be answered lightly. I know of no engineer who would decide such a question for the reasons given in the report. There exists no engineer who would make the statement so manifestly one-sided and at variance with the facts as "concrete bridge design is not well understood, while that of steel is on an assured basis."

WALTER J. FRANCIS,
M.Can.Soc.C.E. M.Am.Soc.C.E.
Montreal, August 12, 1912.

GENERAL NOTES.

The distribution of precipitation during July varied considerably with the district, but speaking generally, the amount recorded from British Columbia, to and including Manitoba, also Eastern Quebec, and the Maritime Provinces was considerably above the average, while in other districts the fall was deficient. Locally in the Lower Mainland of British Columbia, Southeastern Alberta, Southwestern Saskatchewan, and Southwestern Nova Scotia, the registered value was subnormal, while in parts of the Peninsula and Central Districts of Ontario, the fall exceeded the normal. In many parts of the Western Provinces the precipitation was nearly double the normal and heavy thunderstorms were of frequent occurrence.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for July, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	5.2	+2.6
Edmonton, Alta.	4.7	+0.95
Swift Current, Sask.	2.3	—0.21
Winnipeg, Man.	6.1	+2.77
Port Stanley, Ont.	4.0	+0.64
Toronto, Ont.	1.95	—0.98
Parry Sound, Ont.	1.4	—1.73
Ottawa, Ont.	4.9	+0.80
Kingston, Ont.	1.6	—1.26
Montreal, Que.	2.3	—1.66
Quebec, Que.	2.0	—2.43
Chatham, N.B.	6.5	—2.78
Halifax, N.S.	4.7	+1.14
Victoria, B.C.	1.1	+0.85
Kamloops, B.C.	3.5	+2.24

The value of the material used in the slack cooperage industry in Canada in 1911, according to figures prepared by the Forestry Branch, Department of the Interior, was $1,465,702, or about $130,000 less than the value in 1910. The amount of material consumed, outside of a large element of waste, which cannot be accurately determined, is estimated at 62,353,190 feet, board measure.

Ontario leads in this industry, with the production of 64 per cent. of the total number of staves, 70 per cent. of the headings and 76 per cent. of the hoops. Nova Scotia, with a large proportion of fish-barrels, was next with 29 per cent., 24 per cent. and 20 per cent, respectively, of the total number of staves, heading and hoops. The other provinces produce very limited quantities.

Imports exceeded exports of $135,463 by $194,529. White oak staves form an important part of the imports, numbering, in all, 7,293,000, whereas only 2,768,000 were cut in Canada. The Canadian supply of oak, which alone is suitable for the manufacture of containers for alcoholic beverages, is so nearly exhausted that this branch of the tight cooperage industry will practically cease in a few years.

The cost of materials for slack cooperage averaged as follows per thousand pieces: Staves, $6.91; heading, (sets) $54.77; hoops, $7.62. Figures on the cost of tight cooperage materials were not available.

NEW FLOATING DOCK FOR MONTREAL.

An interesting event, during the presence of the Canadian Ministers in London, England, was a visit paid by some of them to the English Lake District, for the purpose of inspecting and naming the "Duke of Connaught," which is the large floating dock that has just been completed by Messrs. Vickers, Ltd., Barrow-in-Furness, for service at Montreal.

The party left by special train on Saturday afternoon, the 20th July, for Furness Abbey, which is situated a few miles from Barrow. The event took place on Monday morning, when the visitors were driven to the new dock, which was then inspected, and the naming ceremony successfully completed by Mrs. J. D. Hazen, wife of the Minister of Marine.

The new dock, which has been named after the Governor-General, with his permission, has been constructed for the firm of Canadian Vickers, Ltd., which is establishing at Montreal, large works for the construction and repair of battleships up to such large vessels as the [illegible] type and also for other sea-going ships.

It is generally considered in England that this is a great step in connection with the naval policy of Canada, and that it will mean a great deal, not only to the citizens of Montreal but also to the Dominion as a whole. It was pointed out that [illegible] Halifax before repairs [illegible] could be undertaken. This condition would be [illegible] by the presence of a floating dock in the St. Lawrence. The advantage of a floating dock [illegible] it may be towed to any point on the Atlantic seaboard of the Dominion for the purpose of [illegible] any ship which [illegible] damaged by running aground.

The dock is capable of dealing with some of the largest [illegible]

[illegible]

has ever been built in the British Isles, can be better understood from the fact that it will accommodate ships having 100 feet beam, whereas the length is immaterial due to the dock having open ends.

The works are to be situated at Maisonneuve, Montreal, on the banks of the St. Lawrence River; they will cover an area of over 30 acres, including a basin of 12 acres, and will have a quay frontage of 2,500 feet, and it is estimated that 2,000 men will be employed. At this point the river is over one mile wide.

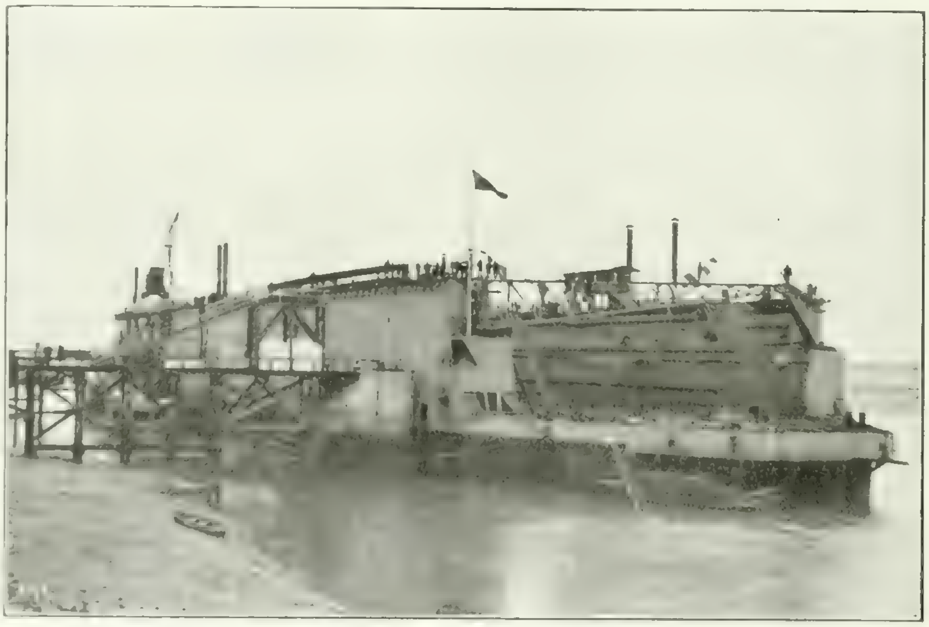
The Harbor Commissioners have offered excellent railway facilities.

On completion of the ceremony the Canadian Ministers made a tour of inspection of the works of Messrs. Vickers, Ltd., and had the opportunity of going inside some submarines.

The company then gathered together at the office when speeches were made by Sir Trevor Dawson, the Hon. J. D. Hazen, Hon. C. J. Doherty, and Mr. C. G. Ballantyne (representing the Montreal Harbor Commission.

The dock is capable of taking the largest existing ship in the British Navy and the heaviest ship trading to Canada.

The building of such a dock has been preferred to the construction of masonry or concrete graving dock, because, although normally it will be utilized within the basin of the new extensive and well-equipped ship-building works of the firm at Montreal, it can be towed to any point on the Atlantic freeboard of the Dominion, to assist in the raising of any ship which may get damaged by running aground, and, in view of the hazards to which the Royal naval and merchants ships are exposed, this will confer very considerable advantage. A feature in the design, too, has been the aim to economize in the working of the dock; thus, although it is capable of taking the heaviest ships afloat, it will more frequently be used for vessels of quite moderate size, and on such occasions it will not be necessary to use the whole of the dock or to run the machinery at its fullest power. In structural details, everything has been done to make the dock continuously reliable. One instance alone need be mentioned: steam heating is provided to prevent water in the compartments from freezing and to preclude the machinery from becoming affected by frost. This is most important because the dock may have to be sunk under a ship in the most severe winter weather, and it is imperative that the water in the compartments [illegible] required. All the [illegible] in the dock [illegible] in duplicate, and [illegible] to facilitate the docking of a ship.



View of the New Floating Dock for Montreal.

The length of the dock is 600 feet, and the width over all 135 feet, the depth of the pontoons at the bottom being 17 feet, while the side walls rise to a height of 42 feet from the pontoon deck, so that the over-all depth is 59 feet. Ships of 100 feet beam can easily be docked, and as the ends are open, a vessel of any length can be accommodated. There are bridges at both ends, for the conveyance of workers. The dock will mark an important development in Canada's association with naval defence as well as in merchant shipping. The name of "Duke of Connaught" has been given to it.

It may be added that the Canadian Shipbuilding and Engineering Works of the Vickers Company are situated at Maisonneuve, a township adjoining Montreal, on the banks of the St. Lawrence. The works, which cover an area of over 30 acres, also include a basin of about 12 acres, having a quay frontage of 2,500 feet, and, when fully working, will employ over 2,000 men. The site is admirably situated and the land has been in a great measure reclaimed from the bed of the St. Lawrence, which, at this portion, is over one mile in width, and the dredging has considerably increased the depth of the river channel where it passes the works. Excellent railway facilities have been afforded by the Montreal Harbor Commissioners. The general construction of the buildings is such as to suit the climatic conditions of Canada, where there is such a vast difference in the temperature of the seasons, and was only decided on after the Canadian Vickers Company had sent their representatives there to study the general conditions, in association with the Montreal architects and contractors. Generally the buildings will be constructed of steel framing, the sides instead of being covered with corrugated sheeting, as is the usual practice in British yards, will be formed of brick, which besides being warmer during winter should be cooler during the summer months. The building berths are so arranged that vessels up to 1,000 feet in length can be built. In the meantime, a covered berth has been erected, so that the work may not be stopped during the winter months. The directors of Canadian Vickers Limited, are:—Albert Vickers (chairman), Sir A. Trevor Dawson, Sir Vincent Caillard, F. Orr Lewis (president Canadian Board), Sir H. Montague Allan, Preble MacIntosh, James G. Lewis.

After the ceremony at the dock, the Minister of Marine and the general company of guests made a long tour of inspection of the most important departments of the Vickers works under the guidance of the directors of the company.

The party included:—The Hon. J. D. Hazen and Mrs. Hazen, the Hon. C. J. Doherty, Miss Doherty, Mr. G. J. Desbarets, Admiral and Mrs. Kingsmill, Mr. and Mrs. C. G. Ballantyne, Mrs. R. C. Smith, Mr. MacArthur Smith, Mr. J. T. Hackett, Dr. Hackett, Mr. G. Heidmann, Mr. and Mrs. F. Orr Lewis, Mrs. Grant, Mrs. W. Beardmore, Col. John Hughes, Miss McKeard, Mr. and Mrs. James R. Nelson, Mr. C. B. Reilly, Mr. B. W. Gonin, Mr. Nugent M. Clougher.

◆

NEW RUSSELL MOTOR FACTORY.

The Russell Motor Car Company are building an addition to their plant, consisting of a four-story machine shop, equipped with the latest machinery for automobile manufacture. The cost of the building will be approximately $100,000. This increase to the plant of the company will result in the employment of about 200 more skilled workmen, and bring the total number of employees to over 1,200. The company has now completed and occupies its new office building.

NEW METHOD OF TESTING RIVET STEELS.*

By G. Frémont, Paris.

(Translated by C. Salter, London.)

In order to avoid serious errors in calculating the strength of materials, prudence demands that one should take as a basis only the lowest elementary strengths indicated by experience, and in addition apply a sufficiently low coefficient of safety.

Thus, as regards the strength of riveted members, it is usual in calculating to allow only for the shearing strength of the rivets; but in practical construction work it is essential that riveted members should act solely by the adhesion of the plates, and never merely by the resistance to shearing of the rivets, since, in the latter event, these undergo gradual shearing and soon wear out. The same applies to receptacles which have to keep staunch: boilers, tanks, etc., because if there is insufficient adhesion they become leaky.

When engaged in experimental investigations on riveting I was led to isolate each of the factors influencing the holding power of the rivet; and in order to study the influence of the elastic limit of the metal, forming the rivet, on the adhesion strength, I devised in 1904 a new method of determination based on the rotary slip around the rivet, the latter serving as axis. I used plates with unworked surfaces, which gave different results at each test.

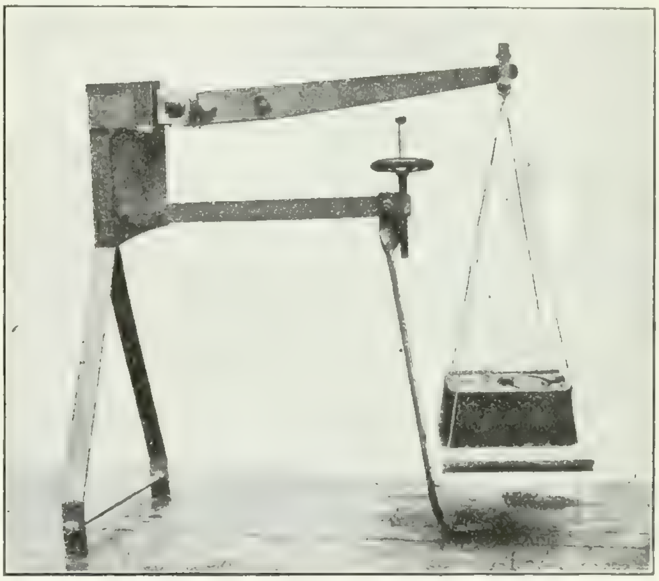


Fig. 1.—Machine for Measuring the Adhesion Produced by a Rivet.

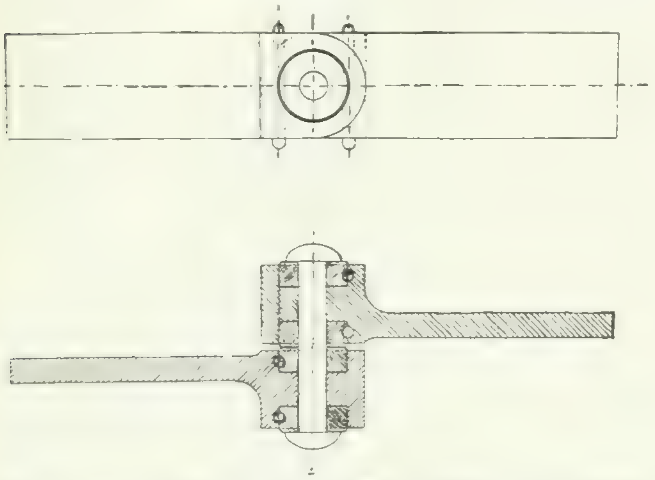
The Western Railway Company of France was good enough to prepare plates for me in which the thickness of the metal was reduced beyond the confines of the circular surfaces, concentric with the rivet, which alone were to remain in contact under the pressure of the rivet; but the finish and roughness of the natural surfaces of the plates, varying in each test, prevented me from ascertaining the influence of the elastic limit of the metal of the rivet, and in November, 1905, I was obliged to publish the first part of my report without giving the results of these tests. My failure was due to the mistake I made in following the conditions of practice; and since then the only way in which I have been able to obtain a satisfactory result has been by working with sliding surfaces that could be easily brought into uniform condition in all cases.

---

* Paper to be delivered at sixth Congress of the International Association for Testing Materials.

These results, moreover, have merely a relative value, since they were obtained with worked, uniform sliding surfaces, but they vary solely under the influence of the effective grip of the rivet. For this it is sufficient that my apparatus should provide—as can easily be done—a smooth cylindrical hole for the insertion of the rivet.

The results of my experiments have been published in a paper on the strength of riveted members ("De la résistance des pièces rivées") in the Bulletin de la Sté. d'Encouragement, April, 1909.



Figs. 2 and 3.—Cheeks of the Testing Machine Connected by the Rivet the Grip of which Produces the Adhesion.

Strength of adhesion being the predominant quality in the case of rivets, it is necessary to ascertain the adhesion that the metal is able to give under certain definite conditions.

For carrying out these adhesion tests I have designed a small machine which is shown in Fig. 1.

I have described it as follows[1]):—Two members, provided with cheeks (Figs. 2 and 3) are connected by a rivet, 16 mm. in diameter, of the metal under examination. The total thickness of metal held by the rivet is 100 mm. The bearing pieces between the cheeks, and between the latter and the rivet heads, consist of four cylindrical tool-steel washers, turned, tempered and polished, in order to obtain sliding surfaces which can be accurately reproduced in all cases with ease.

The effort of adhesion is ascertained by the aid of weights which are placed on the platform at the end of the lever until slip is produced between the contact surfaces be- [illegible]

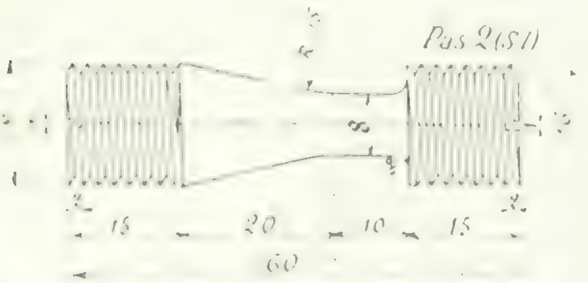


Fig. 4.—Truncated Test Piece for Tensile Test with Determination of the True Elastic Limit.

[illegible]

distance between the axis of the rivet and the knife edge of the balance is 0.594 m.

These data enable the moment of resistance to be calculated.

The value of the effort of adhesion per square millimetre of sectional area of a rivet 16 mm. in diameter is P 0.2.

P is the load formed by the weights placed on the platform, plus the weight of the lever itself, which in this instance is 2.850 kilos.

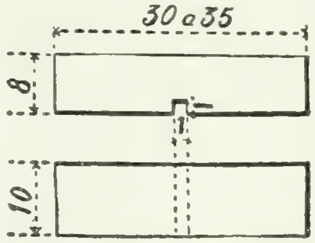


Fig. 5.—Nicked Prismatic Test Piece for the Impact Bending Test.

A screw stop, operated by a small handwheel, limits the travel of the lever, and enables several slip tests to be performed in succession.

In these tests it is important to standardize the method of riveting the specimen of steel; and the conditions must be less favorable than those occurring in practice.

After the adhesion test the rivet is taken out by removing one of its heads, and the metal is tested. The thickness of the rivet shank: 100 mm., enables a test piece to be prepared in the shape of a truncated cone (Fig. 4) for the tensile test with determination of the true elastic limit, and a prismatic test piece (Fig. 5) 8 x 10 mm., nicked with a saw cut, for impact bending tests to ascertain the brittleness or toughness of the metal.

◆

SOME CONSIDERATIONS IN THE CHOICE OF A PAVEMENT.*

By Prof. Leonard S. Smith, University of Wisconsin, Madison, Wis.

What is the best pavement? is a question which citizens, city officials and even some engineers are not infrequently guilty of asking, forgetful of the plain fact that such a question admits of no ready or simple answer. As well might it be asked what is the best bridge or the best house to build. It is a most hopeful sign that the past year has seen many papers read at engineering society meetings discussing this question of considerations affecting the choice of a pavement.

It cannot be too emphatically stated that in each case the best structure for a pavement depends upon the particular service required of it and also, too, upon the widely varying local conditions. These modifying factors naturally divide themselves into two general classes. The first of these govern the conditions to which the pavement will be subjected. Chief among these factors are the quality, nature and even the direction of the traffic, the character of the district served by the pavement, the grade of the street and the presence of car tracks.

On the other hand, the second class of factors which may determine the selection have reference to the character of the pavement itself, such as durability, smoothness, noiselessness, slipperiness, cost, etc.

The best pavement for some particular street, then, would be the one which would give the greatest and most needed service, using the word service in a broad way. The limits of this paper will not allow of a full discussion of this [illegible] question, but my point can be most clearly explained by giving a few applications of the principle. For example, if the street had a steep grade, all such considerations as smoothness, noiselessness, cost, etc., must needs give way to the single governing quality of non-slipperiness. Again, if the street in question were on a moderate grade in a high-class residence district or in the office-building district of a large city, the factors of smoothness and noiselessness might properly determine the final selection. Such a selection, while involving a very expensive pavement, has repeatedly been shown to fully justify itself by the added value and earning capacity of the property. As a third example, considering the choice of a pavement in a wholesale district, subject to concentrated heavy traffic, the qualities of durability and non-slipperiness would here naturally receive the greatest consideration.

---

* A paper read before the Engineering Society of Wisconsin.

The above statements are so obviously based on common sense that it may seem to some useless to take up valuable time in their presentation. Repeated inspection of the pavements in a score of our largest cities has shown the writer that the choice of pavements has too frequently been left to chance or prejudice. Our growing vision of municipal efficiency discerns a much-needed reform in the choice of our pavements, a reform certain of realization.

But while there is great economic need that the best fitted pavement for each particular street should be thoughtfully and carefully chosen, it is at least of equal importance that all such paving improvements should proceed in accordance with some well-considered plan—some comprehensive system for future improvement of the entire city, ward or region. For example, pavement improvements should be so planned as to provide several parallel routes for through traffic. If this be not done, the single route becomes congested and the pavement is prematurely worn out. Again, pavements should be continuous, both for the convenience of traffic and for ease of maintenance.

In the case of country highways, it is necessary to construct disconnected stretches of pavement, but even here it it of prime importance that such construction should proceed in accordance with a systematic plan, so that disconnected stretches may eventually become a part of a complete system. For example, in our own State it would be easy to select a few trunk roads leading from the metropolis of the State to the adjoining cities, and still others connecting the largest city or county seat of each county, as being certain to attract the heaviest traffic. Portions of such trunk roads should be improved with reference to sustaining heavy traffic and also with a view of becoming a part of an intra-state system.

Unhappily the city paving program is too often determined by the ward politician or the opposition or favor of short-sighted real estate owners. A few cities which have tried this plan of adopting a paving program extending over ten years will soon occupy an enviable position. Our cities cannot do better in this respect than to follow the example of the most successful railroad companies.

While future traffic conditions may render necessary here and there a change in the detail plan, the city is certain to gain largely in the end because of having a carefully prepared plan for all street improvements, including water, sewer and gas as well as pavements.

The charter of many American cities provides that the abutting property owners shall pay for the first pavement, while the city must pay for all repairs and renewals. As might be foreseen, this has resulted in the selection and construction of many cheap and inferior pavements, where much more permanent construction would have been justified. But this abuse has not stopped here. Long time bonds have been commonly issued to secure the payment of such temporary pavements, in many cases falling due twenty-five years or more after such pavement has utterly worn out.

Such a system of financing pavements cannot be characterized as anything short of dishonest. It simply transfers to the backs of our children the burdens we of right should bear ourselves. For the future will doubtless have sufficient burdens and problems of its own without being required to shoulder in addition those of to-day.

Already legislatures are considering corrective legislation. The writer knows of at least one eastern legislature which in 1910 passed a law prohibiting a city from paying for short-life pavements out of the proceeds of any bond sales. This principle of "pay as you go" deserves a wide adoption.

It is worthy of restatement that cheapness does not necessarily mean a cheap price of the pavement when laid; indeed, such a pavement may likely prove the most expensive in the end. The other governing elements which determine the actual cost of a pavement are the annual cost of repairs and the term of life of the pavement. Permanent pavements may properly be paid for out of the proceeds of bond issues payable during the life of the pavement. In such cases the public will eventually have to pay for the following items: Interest on the bonds, cost of repairs and annual sums for a sinking fund, which by the time the pavement is worn out will pay off the bonds. Such a plan may be shown by the following formula:

$$S + CI + \frac{R}{L} = \text{annual cost,}$$

where S = the yearly amount put in the sinking fund
C = first cost of the pavement
I = the rate of interest
L = the life of the pavement in years
R = the total cost of repairs.

Obviously, the cheapest pavement is the one involving the least annual cost. If, for example, macadam pavement be chosen for a street having traffic, the last term $\frac{R}{L}$ would be so large as to make such a pavement the most expensive type that could be chosen. This fact is an added illustration of the importance of a wise selection of a pavement for the traffic conditions.

New York State for several years has been making the colossal mistake of issuing many millions of long-time bonds in payment of some form of macadam even on heavy traffic trunk highways, where they very frequently have failed after a comparatively short term of service. Such is the judgment of well qualified engineers who have had charge of the construction and maintenance of such roads. The seriousness of this situation will not be fully realized until after the officials responsible for this error have passed to their final reward. Other States nearer home have made similar mistakes.

The construction of some form of the macadam road fulfills at a minimum cost all reasonable demands on streets or country highways carrying a moderate traffic, especially if such roads have the added protection of continuous maintenance. This class includes over half of our country roads.

But if such improved highways happen to connect two or more large cities, the unusually heavy traffic which such a road at once attracts results in certain and speedy failure. The advent of automobile and other forms of motor traffic, while it has lengthened the life of hard city pavements, has been the chief cause of the destruction of macadam roads.

The seriousness of this problem of the choice of proper road material is realized when we reflect that the demands made by this new form of motor traffic are certain to greatly increase in the near future. Highway engineers of every land are looking for an adequate remedy, but so far with only partial success. While constructional methods in nearly all other lines of engineering have been satisfactorily perfected and standardized, we find present highway construction on main trunk roads grossly inadequate for even the traffic of to-day, thereby causing needlessly large charges for maintenance.

It has seemed to the writer that real progress would be made by breaking away entirely from macadam construction on heavy traffic main highways. The improved and more permanent construction best suited to replace the macadam on such roads will here again be largely a local question. Ohio, Indiana and Pennsylvania have taken the first steps toward satisfying the demand for a more permanent construction by building many hundreds of miles of brick pavements laid on a concrete base with a cement grout filler, all supplemented usually by wings of dirt, gravel or macadam. The expense of such a pavement, about $1,000 per foot of width per mile, does not exceed the average price paid by New York State for its wider but short-life macadam roads, while the brick roads, if properly constructed, promise to be in good condition twenty-five years hence.

Wayne county, Michigan, has constructed a good many miles of main highways, leading out of Detroit, of rich concrete, seven inches thick, at prices which also compete with eastern macadam, while giving promise of outlasting the latter by many years. Where the proportion of automobile traffic is not too great, a large amount of traffic has generally been economically provided for by some form of the bitulithic construction. It may be that Wisconsin, with her widely distributed rich deposits of good gravel and other road materials can wisely follow one or all of these forms of permanent construction. Few States are more favorably situated for road building than Wisconsin. We are fortunate also in being able to profit by the experiments of our older sister States. These have shown us that there is no one best pavement and no one best way of constructing it under all circumstances.

We now recognize that the selection of road material and the method of incorporating it into a road is in large part a local question; in fact, that highway construction in city and country obeys the same rules of procedure as do all [illegible]

◆

GRAND TRUNK PACIFIC AFFAIRS

In view of the misleading reports in the daily press respecting Grand Trunk Pacific affairs, Mr. E. J. Chamberlin, president of the road, has issued the following statement:—

"The Grand Trunk Pacific Railway have been operating [illegible] Railway between [illegible] 1911, [illegible] The Government [illegible] the Grand Trunk Pacific execute a permanent lease of that portion of the line [illegible] between the Government and the Grand [illegible] Transcontinental, [illegible] between Moncton and Winnipeg, which was to be constructed by the Government and is known as the eastern division, provides that:—

" 'Pending the completion of the eastern division by the Government the company shall be entitled to lease from the Commissioners to be appointed under the said act, and to operate such portions of the eastern division as may from time to time be completed, upon such terms,' etc., but does not bind the railway company to take over any sections unless they desire to do so, until the entire line is completed.

"Negotiations are in progress between the Government and the company relative to a further lease of the section above referred to when it is fully completed and pending the completion of the whole line. Notwithstanding reports in the papers throughout the country, that portion of the Transcontinental line is not yet completed. There is considerable work to be performed on the entrance into Winnipeg, connecting up the Transcontinental with the Grand Trunk Pacific and the Canadian Northern at the Union Station. There is also considerable other work on the line necessary to be done before the terms of the contract are complied with.

"With regard to the Springfield, or Transcona shops: Major Leonard, chairman of the Transcontinental Railway Commission, has decided that the shops are not part of the contract between the Government and the railway, while the company contend that they are part of the Transcontinental contract. If Major Leonard's contention is eventually sustained, the taking over of the line between Winnipeg and Lake Superior Junction would not include the taking over of the shops by the Grand Trunk Pacific Railway. On the other hand, if the Grand Trunk Pacific's contention that the shops are a part of the Transcontinental Railway is sustained, the taking over of the line would also mean the taking over of the shops and placing them promptly in operation."

◆

LAKE ERIE AND NORTHERN RAILWAY COMPANY.

At a meeting of the directors of the Lake Erie and Northern Railway Company, an agreement was concluded with Messrs. G. W. Farrell and Company for the purchase of the entire issue of $1,100,000 5 per cent. mortgage bonds.

The Lake Erie and Northern Railway was incorporated by a special act of the Federal Parliament in May, 1911.

The Dominion Government has granted a subsidy of $6,400 per mile, or a total grant of approximately $340,000.

The charter provides for the construction of an electric railway from Port Dover on Lake Erie through the towns of Simcoe, Waterford, Brantford and Paris, to the town of Galt, a distance of 53 miles. Connections will be made at Galt with the main line of the Canadian Pacific Railway for an interchange of traffic on completion of the road.

The directors of the company comprise a number of the prominent manufacturers in that district and consist of Messrs. John Muir, Harry Cockshutt, Lloyd Harris and John Sanderson, of Brantford; Richard Thompson, general manager of Penmans, Limited; F. H. Deacon, of Toronto; Martin Todd, general manager of the Galt, Preston and Hespeler Railway, and G. W. Farrell, of Montreal.

Mr. Lloyd Harris, one of the directors of the Lake Erie and Northern Railway Company, stated this week that the directors will call for tenders at once and hope to have construction started this fall.

The towns through which the line will pass—Galt, Paris, Brantford, Simcoe, Waterford to Port Dover—have voted to take second mortgage bonds totalling $500,000.

The directors believe that the field is a most promising one for both freight and passenger business, the 53 miles through which the line will pass being thickly populated.

METHODS OF TESTING CLAY.

A report on the clay and shale deposits of the Western Provinces has recently been printed for the Federal Department of Mines. In this report the authors, Heinrich Rieo and Joseph Keele, give their method of ascertaining the physical qualities of these substances. A report compiled by the following methods is of value in ascertaining the commercial aspect of the raw material. Their method consisted of a determination of plasticity; water required for mixing; tensile strength; air shrinkage; fire shrinkage; color and absorption at different temperatures; and fusing point.

Tensile Strength.—The determination of the tensile strength of the raw material is made because it gives a clue to the clay's ability to stand strains in handling before burning, and possibly also of its bonding power or its ability to stand the addition of non-plastic materials like sand or "grog."

The clays and shales submitted to the physical tests were first thoroughly dried, then ground in a jaw crusher and afterwards sifted through a 20-mesh sieve.

A weighed quantity of the sifted material, sufficient to make the necessary number of test pieces, was mixed with just enough water to give it the greatest plasticity, and thoroughly kneaded and wedged so as to render it perfectly homogeneous and free from cavities. The consistency generally arrived at was about midway in stiffness between a soft-mud and stiff-mud brick in practice.

In making briquettes for the tensile test a small piece of the kneaded clay was clamped into the briquette mould, and struck by the hand until it filled the mould completely, the excess of clay being struck off by a fine wire.

The clay was removed from the mould on a dry clay briquette—a set of them being kept for the purpose—and the wet clay briquette was not handled until it had hardened on its support, so that they were not distorted while soft.

The briquettes when hard were dried to 100° C., the cross section at the waist carefully measured, and then broken in an ordinary tensile strength machine.

Shrinkage.—All clays shrink more or less in drying and burning. The shrinkage that occurs while the clay is drying is termed air shrinkage, while that which occurs during the burning is known as fire shrinkage.

Air Shrinkage.—A portion of the kneaded clay was made into bricklets in a mould 4″ × 1½″ × ¾″ in size. Two fine lines, exactly 3 inches apart, were impressed with a steel stencil on the wet clay bricklet immediately after leaving the mould. When the bricklets were thoroughly dry the distance between these lines was measured, and the percentage of air shrinkage calculated.

Fire Shrinkage.—The burning of the bricklets at the lower cones was done in a down-draft muffle kiln, the fuel used being coke, and the time of burning from 12 to 18 hours. For the higher temperatures a gas-fired muffle kiln was used.

The lines on the burned bricklets were again measured after each successive firing, and the total amounts of shrinkage calculated. The difference between the total shrinkage and the air shrinkage represents the fire shrinkage.

Fusibility.—Small pyramids or cones of the ground clays or shales were burned in the gas-fired furnace until they were deformed or melted (Fig. 1). The temperatures at which the test cones melted are expressed in terms of the standard Seger cones.

A Deville furnace, fired with coke, under air blast was used for determining the fusing points of the more refractory clays, including those which did not fuse until a temperature ranging from cone 18 to cone 32 was reached.

Absorption.—The bricklets were carefully weighed after each burning, and immersed in water to about three-fourths of their thickness. This permits the air from the burned clay body to escape freely, allowing the water to better and more quickly fill the pores. After standing at least 24 hours in water, the saturated bricklets are weighed, the increase in weight recorded, and the percentage of absorption calculated as follows:—

$$\frac{\text{Saturated weight—dry weight}}{\text{Dry weight}} \times 100.$$

Dry-Press Tests.—The clay or shale used for the dry-press test was ground to pass a 20-mesh sieve, and moistened with 5 to 10 per cent. of water. A mould was filled with the damp clay, and pressed in a hand screw-press, the size of the bricklet produced being 4″ × 1½″ × 1″.

Rapid Drying.—For this test the clay or shale was ground to pass a 12-mesh sieve, and kneaded up with sufficient water to a fairly stiff mass, from which a full-sized building brick was made by hand in a wooden mould.

Immediately after coming from the mould the moist brick was placed on a rack in a box open at the bottom and with a perforated top, which stood on a steam-heated radiator. The temperature in this box ranged from 120° to 150° F., which is the heat usually attained in artificial dryers. If the brick cracked under this treatment it was understood that it would not stand rapid drying.

Drying Defects in Certain Clays.—Various Tertiary clays, and some Cretaceous shales found in Alberta and Saskatchewan, have the serious defect of checking while drying.

Clays of this character are usually very fine grained and highly colloidal, absorbing a large percentage of water when tempered for wet moulding. They are exceedingly plastic and sticky when wet, becoming a stiff, soap-like, and sticky mass, which is hard to work.

Generally, within half an hour after leaving the moulds fine cracks appear at the edges of the brick, which quickly spread over the surfaces, and as drying progresses these cracks widen and deepen. In time the outside of the brick becomes bone-dry, but the inside may remain quite moist for several days.

In some clays the cracks which developed in drying closed up completely when the drying was ended, but reappeared again in the burned product.

Several of the clays that displayed this drying defect gave fairly low air and fire shrinkages, were somewhat refractory, and burned to a good, hard body at cone 1.

In several districts they were the only materials available, and, as they might turn out to be sewer-pipe or paving brick clays, it was very desirable to devise some practical method of treatment to make them workable.

Hitherto, whenever brickmakers had to deal with clays which were too "fat" or "strong," as they termed those claps which were highly plastic, they usually added from 10 to 25 per cent. of sand. The sanded clays were found to dry quicker and work easier; the air and fire shrinkages were reduced, and generally a good, burned product is obtained from the mixture.

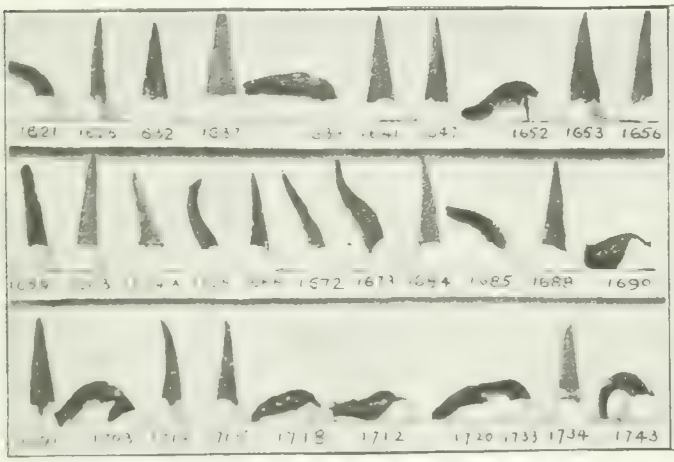
Apparently, then, the proper remedy to cure the objectionable behaviour of the clays being dealt with was the addition of sand. But when 25 per cent. of sand is added to these clays they crack quite as badly as before. They can be dried with the addition of 40 to 50 per cent. of sand, but this amount is evidently in excess of the bonding power of the clay, because the burned brick made from such a mixture is altogether too porous and weak for any purpose whatever.

It was then found by experiment that if any of these clays be ground and calcined or burned to a red heat, that the calcined clay, which has lost its plasticity, can be added to the raw clay in quantities as large as desired to secure the best working quality; that drying at a moderately fast rate can be accomplished with safety, and the properties of the burned clay body are not affected.

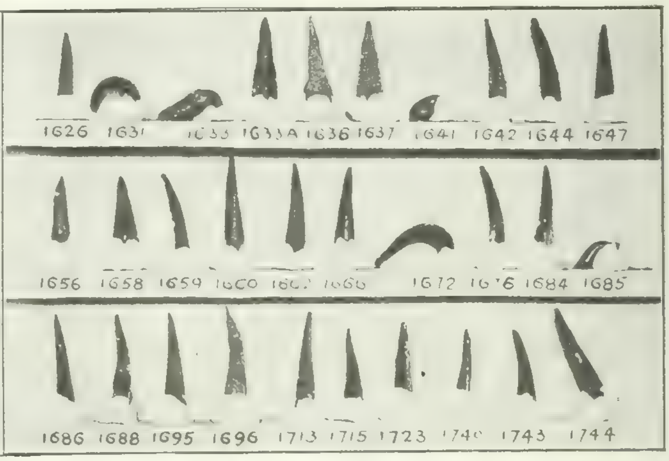
The calcined clay, then, acts as sand during the early stages of manufacture, but when burned it proceeds towards vitrification with the raw clay, and does not remain inert at ordinary burning temperatures as sand will.

Further experiments on preheating clays shows that if the ground clay be heated from 300° to 500° C. that they lose a great deal of their plasticity, and the quality of the clay is changed from a tough, sticky mass when melted to a granular and easily worked body which can be moulded by the stiff-mud process, and will stand fast or moderately fast drying.

How extremely finely divided some of these clays are in the raw state and the change in texture they undergo in preheating is shown in the following mechanical analysis, made by the centrifugal method:—



Pyramids of Clay after Heating to Cone 1.



Pyramids of Clay after Heating to Cone 3.

(The figures under each refer to the laboratory numbers.)

Material.	Percentage retained on 200-mesh sieve.	Percentage of silt.	Percentage of clay.
1 Normal clay	Trace	57.40	38.40
Preheated to [illegible]° C.	[illegible]	[illegible]	15.[illegible]
2 Normal clay	[illegible]	45.[illegible]	4[illegible]
Preheated to [illegible]° C.	13.[illegible]	[illegible]	14.4
3 Normal clay	1.5	4[illegible]	46.8
Preheated to [illegible]° C.	[illegible]	[illegible]	24.5

1. [illegible] Alta. Lab. No. [illegible]
2. [illegible] Alta. Lab. No. [illegible]
3. [illegible] Alta. Lab. No. [illegible]

[illegible] have a diameter from 1-200 to 1-5000 of an inch, and those under [illegible]

[illegible]

Further experiments were undertaken with certain substances [illegible]

Of the various materials tried for this purpose during [illegible] be cured by the addition of 1 to 2 per cent. of hydrochloric acid to the mixing water, or 1 to 2 per cent. by weight of common salt added to the dry clay. The salt seemed to be the most practical, and was used in the greater number of tests.

The amount of water required for tempering the clay was reduced by about 10 per cent. by the addition of salt. The water appeared to convey the salt from the body and deposit it at the surface in a slight scum, but this generally disappeared in burning.

The bricks so treated dried perfectly in about four days at a temperature of 70° to 80° F., but would not stand fast drying.

The object of preheating any clay is to overcome drying difficulties, and the temperature required to accomplish this object varies with different kinds of clay. The amount of heat necessary for some clays would destroy the plasticity of another clay and render it useless for moulding.

In some cases while drying can be carried on safely after preheating, the burned wares may show a tendency to crack, but such clays generally work perfectly when dry pressed.

The temperature used in calcining clay must be sufficiently high to deprive the clay of all plasticity and reduce it to a condition resembling sand. Although this operation requires a higher temperature than preheating with the object of destroying only a portion of the plasticity, the operation is a simpler one because critical temperatures are not observed.

Clays to which salt is added frequently show a slight glaze when burned to cone 1, but the quality of the body does not seem to be affected, especially if the clay is somewhat refractory. The use of salt appears to be detrimental to some of the more easily fusible clays.

No difference was detected in the burned wares made from clay treated with hydrochloric acid.

It is hoped that a more complete investigation will follow the preliminary work already done, but the manufacturer having drying trouble with his clay will probably overcome it by adopting after trial the method which is best suited to his particular case.

◆

The Canadian [illegible] Company have increased their capital by the [illegible] of preferred stock. The company will increase its Toronto plant by the erection of a new factory, and make other extensions.

STANDARD SPECIFICATION FOR REFRACTORY MATERIAL.

At the recent meeting of the Institute of Gas Engineers of Great Britain, the Refractory Materials Committee presented their annual report, which includes a standard specification for silica bricks, blocks, tiles, etc., which has been drawn up by the committee in collaboration with representatives of the Retort and Firebrick Section of the Society of British Gas Industries, together with several other leading makers of this class of material.

The specification has been prepared upon the basis of the results of tests undertaken by Dr. J. W. Mellor, D.Sc. (Principal of the Staffordshire County Pottery Laboratory), who acted as technical adviser to the committee. In presenting the specification the committee state that, owing to the almost entire absence of authentic tests and results on a working scale of silica and siliceous material, the specification must not be regarded as final, and that revision will be made from time to time as experience is obtained. The following is a copy of the specification referred to:—

Section 3.—Silica Bricks, Blocks, Tiles, etc.

The material covered by this specification is divided into two classes:—

(1) That containing 92 per cent. and upwards of silica, and hereinafter called "silica" material.

(2) That containing from 80 to 92 per cent. of silica, and hereinafter called "siliceous."

Refractoriness.

1. Test pieces of the material shall show no sign of fusion when heated to the following temperatures:—

"Silica" material—not less than Seger cone 32 (about 1,710 deg. C.).

"Siliceous" material—not less than Seger cone 29 (about 1,650 deg. C.).

The test shall be carried out in an oxidizing atmosphere, the temperature of the furnace being increased at the rate of about 50 deg. C. per five minutes.

Chemical Analysis.

2. A complete chemical analysis of the material is to be provided when required by the engineer (or purchaser) for his personal information only.

Surfaces and Texture.

3. The material should be evenly burned throughout and the texture regular, with no holes or flaws. All surfaces shall be reasonably true and free from flaws or winding.

Contraction and Expansion.

4. A test piece, when heated in a gas muffle or electric furnace to a temperature of Seger cone 12 for two hours shall not show, on cooling, more than 0.75 per cent. linear contraction or expansion. The temperature of the furnace shall be maintained constant throughout the testing period; and the test piece shall be at least 4½ in. long by 4½ in. wide—the ends being ground flat, and the contraction or expansion measured by means of Vernier callipers reading to 0.1 mm.—a suitable mark being made on the test piece, so that the callipers may be placed in the same position before and after firing. The test samples shall not be taken out of the middle of a brick, block, or tile, but shall be representative of the whole.

Variations from Measurements.

5. In the case of ordinary bricks, 9 in. by 4½ in. by 3 in. or 2½ in. thick, there shall not be more than ± 1½ per cent. variation in length, nor more than ± 2½ per cent. variation in width or thickness; and in all cases the bricks shall work out their own bond. Special bricks, blocks, or tiles shall not have more than ± 2 per cent. variation from any of the specified dimensions.

Cement Clay.

6. This shall be machine ground, and at the discretion of the manufacturer may contain a suitable percentage of fine grog. But in all cases the cement clay shall be quite suitable for the purposes of binding together the bricks, blocks or tiles for which it is supplied, and shall be capable of withstanding the same test for refractoriness.

Inspectioon and Testing.

7. The engineer (or purchaser), or his agreed representative, shall have access to the works of the maker at any reasonable time, and shall be at liberty to inspect the manufacture at any stage, and to reject any material which does not conform to the terms of this specification. Pieces representative of the bulk may be selected for the purpose of testing either before or after delivery; but in every case a representative of the maker shall, if he choose, be present when such selection is made, and shall be supplied with a similar piece of the material to that taken for the purpose of testing.

Any complaint as to quality of material to be made by the purchaser before the expiration of ten days after delivery.

If the engineer (or purchaser) and the maker are not prepared to accept each other's tests, they shall agree to submit the samples for testing to an independent authority, to be mutually agreed upon; and the engineer (or purchaser) reserves to himself the right, if the material does not conform to the tests laid down in the specification, to reject any or all the material in the consignment from which the test pieces were taken.

The cost of these independent tests, and of any bricks, blocks, or tiles, damaged before delivery for obtaining test pieces, shall be equally divided between the purchaser and the maker, if the test proves satisfactory; and if unsatisfactory, such cost, and that for all other subsequent tests required on this account from the same consignment, shall be borne by the makers.

The cost of any tests of or any material damaged for the purpose of obtaining test pieces after delivery shall be borne by the purchaser in the event of the test being satisfactory, and, if unsatisfactory, by the manufacturer, in a similar manner to that specified for the tests prior to delivery.

APPENDIX AND NOTES.

Refractoriness.

Clause 1.—For general remarks and suggestions for testing, also table for softening temperatures of Seger cones, vide appendices of Sections 1 and 2. The cones should in all cases be placed relative to the sample, so that both are subjected to the same temperature.

Contraction or Expansion.

Clause 2.—For general remarks, vide appendices of Sections 1 and 2. As soon as cone 12 has squatted, it ceases to furnish any further indication of the temperature of the muffle; so that the subsequent temperatures should be ascertained, at about 15-minute intervals, by means of a pyrometer. It is essential, however, that the temperature should be maintained constant; and if it is necessary to remove plugs, etc., for the purpose of obtaining the temperature, great care must be taken to avoid cooling the furnace by such means. As in the test for refractoriness, the cone should be placed in such a position relative to the sample under test, that both may be subjected to the same temperature.

Inspection and Testing.

Clause 7.—It has been pointed out by the representatives of the manufacturers that, owing to the high cost of carriage, they may be involved in serious loss if material is extensively condemned after delivery. They agree that the purchaser must have entire freedom to test, and reject, if necessary, any material delivered to him; but it is suggested that until all the manufacturers have suitable arrangements and appliances for constantly testing their goods, it may be possible to render them some assistance by allowing a fairly large sample of their material to be sent in for testing and general approval before extensive deliveries are made. This is in no way, however, to be construed as removing the right of the purchaser to test material in any subsequent consignment.

GASOLINE RAILWAY MOTOR CARS.

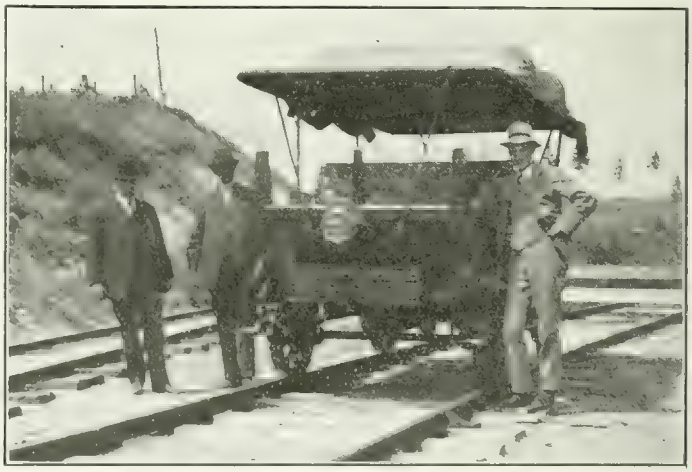
A new type of gasoline railway motor car has recently been introduced into this country by the Drewry Car Company, Limited, of London, England. This firm manufactures railway motor cars of various types, which they have supplied to over ninety railways in all parts of the world. One of their directors is now in Canada on a visit, and has brought with him a 20 horse-power car to carry six passengers. This car is one of the Drewry Company's most popular models, and is fitted with a four-cylinder water-cooled engine and a three-speed gear and reverse, giving all the speeds in both directions. Two sets of control are provided, one at each end of the car, and the seats are reversible. This enables the driver to sit in the front, and the passengers to face the direction of travel in whichever way the car may be running. This is one of the special features of the car, and entirely obviates the use of a turntable. The body is comfortably upholstered, and is fitted with a Cape cart hood and side curtains, and a folding wind-screen at each end. The car is well sprung, and is fitted with heavy steel wheels and axles, which make for steady running at all speeds.

By the courtesy of the Canadian Pacific Railway a demonstration was recently given on this car, which we illustrate, from Montreal to Mont Laurier and back, a total distance of 316 miles. This is one of the most difficult sections of the road, having a considerable length of 2½ per cent. grade and a large number of short curves. The grades were all taken on top gear at over twenty miles per hour, and on the level the car gave a speed of fifty miles per hour, while at the same time it is capable of running at a [illegible] per hour, which greatly facilitating track inspection. At the high speeds the running is wonderfully steady, and the railway engineers who were [illegible]

[illegible]

will be found interesting. He reported in part as follows:—

"In many different parts of the world I have heard railway engineers complain of the difficulty in finding a thoroughly satisfactory type of automobile for inspection purposes, and even the most experienced among them have hitherto failed to secure what they want in this respect. Upon the Paraguay Central Railway I have come across what seems to be as perfect and as satisfactory an automobile as has yet been introduced. This is a reversible, six-seated Drewry car, type "K." The car referred to is 16 horse-power, and it has been running now for some six months at an average of 90 to 100 miles a day. Upon numerous occasions it has attained and maintained a speed of 90 kiloms., say, 56 miles an hour. Both the owner, the chairman of the Paraguay Central Railway, and the chauffeur speak enthusiastically of the car and the work which it does. I have travelled many miles over roughly-laid temporary track in this Drewry car, and I must add my testimony to that above quoted, since it would be difficult to find a smoother-running or a more admirably-built automobile than this."



Drewry Railway Motor Car.

The above referred to a similar car to the one herein described. Various models are marketed, ranging from a light car of 4 horse-power to seat two up to cars of 40 and 50 horse-power to carry forty passengers.

Their business in Canada is being handled by Messrs. Peacock Brothers of 68 Beaver Hall Hill, Montreal, and No. 406 Dominion Trust Building, Vancouver, who will be pleased to give anyone interested further particulars.

HOOPS FOR WATER TANKS.

Round iron hoops for wooden water tanks are advocated as preferable to flat hoops, in the report of a committee of the American Railway Bridge and Building Association. Wrought iron is considered as the best material for this purpose, and is more easily obtained in this form than in flats. One argument in favor of the round hoop is that fully 90 per cent. of its surface is exposed to view, hence deterioration is more easily discovered and painting is more effective. Objections to the use of the round hoop are raised on account of its small bearing surface against the staves and the ledge offered by the upper surface for the accumulation of dirt and moisture. The report states that experience has shown that if properly placed the small bearing surface does not induce crushing of the fibre, and suggests the caulking of the round hoops with oakum and filling the top space with roof cement to obviate the second objection.

LAYING SUBAQUEOUS WATER MAINS AT ROME AND MERIDIAN.*

By M. L. Worrell, General Manager, Meridian Waterworks.

While Superintendent of Public Works at Rome, Ga., the writer had three crossings to construct, one through Silver Creek and two through the Etowah River. The creek was to be crossed close to a highway bridge, and it was deemed preferable to lay the pipe on the bottom of the creek rather than to suspend it from the bridge, or to lay it on the floor, on account of the sudden rises and heavy floods in the stream. The creek was 60 ft. wide between banks at the street level, 40 ft. wide at low water, and, at ordinary low water stage, was 12 ft. deep.

Ten-inch cast-iron pipe with the John F. Ward flexible joint was used. It weighed about 87 lb. per foot or 1,034 lb. per section of 12 ft., and cost 2 cents per pound delivered in Rome. The limit of deflection of this joint is said to be 15 deg., though experience at Rome indicated that it was not safe to use the limit, 12 deg. being safer.

The line of five 12-ft. lengths was made up on a platform spanning the creek at the street level and then lowered by tackle into the stream, the two ends being kept clear of the water for later joining to the water mains on each side of the creek. The submerged part was gradually lowered, thus allowing deflection, until it rested on the bottom. The pattern of the Ward bell and spigot being different from the design of ordinary cast iron pipe, the two were connected by short pieces designed by the consulting engineer, Mr. J. N. Hazlehurst, who was in responsible charge of both engineering and construction.

After the Ward pipe was attached to the street main a test for leakage showed a loss of 28,000 gal. per day of 24 hours. This being excessive, a diver was sent into the water, who discovered that the limit of safe deflection had been exceeded, causing three lead joints to leak very badly. The creek line was detached at each end and raised. All joints were recalked, the bottom of the creek partially filled with small boulders to reduce the deflection of the joints to about 12 deg. and the pipe again lowered and tested. The next test showed a leakage of about 380 gal. per day. Later this joint was again calked and the leakage reduced to about 150 gal. per day. The pipe was covered with boulders and no trouble has since been experienced with it.

The cost of this work approximated $300, everything included, or $5.00 per lineal foot.

The first river crossing was at a point where the banks rose about 40 ft. above low water. A wire cable was stretched from bank to bank, to which trolleys for carrying the supply boat and pontoon raft were attached. The pontoon for laying the pipe in the river was constructed as shown in the diagram. The flotation was provided by 25 empty oil barrels lashed together with ½in. manila rope, the barrels being laid in three rows with a "slot" in the middle row at the stern of the raft. The wood-work was so left as to make it easy to transfer the "slot" from the rear to the front.

Two trolleys with the necessary tackle were attached to the wire cable and secured to the raft, and a supply boat was attached to the cable almost immediately beneath it, this boat carrying extra lengths of pipe, pigs of lead, yarn, melting pot, etc. The pontoon carried nothing but a tripod of 2-in. wrought iron pipe supporting a triplex block for handling the pipe. The outfit was moved across the river by a hand rope.

The first joint was secured to a dead-man on the bank by a heavy chain. The outfit was pushed off, the bell of the pipe being forward, the second joint fitted in and calked, the outfit moved forward again with the next pipe, and this was repeated until the other bank had been reached. The "slot" was then moved to the front end of the pontoon by removing a part of the deck and the short row of five barrels to the stern, thus leaving the last joint of pipe ready for attachment to the forward shore of the river and to the ordinary 10-in. cast iron pipe.

The short joints of pipe for joining the Ward with the ordinary cast-iron pipe were made to lay 3 ft. One had a standard bell on one end and a flexible joint bell on the other and one had a standard bell and a flexible joint spigot.

After the laying was completed two joints on each end of the river pipe were fastened by heavy hog chains to deadmen permanently constructed in the banks.

Before pipe laying was begun the river bottom was sounded. It consists of solid rock, slaty limestone, with three ledges running longitudinally, each ledge having practically the same elevation. These ledges were notched with dynamite and the pipe while being laid was fitted in the notches. These notches secured the pipe from deflection downstream.

The length of this river crossing was 216 ft. and the time required for preparation and actual laying was about 6 days. The work was done under a construction superintendent, who also performed the duties of foreman, a straw boss or gang foreman and five laborers and one water boy, the pipe laying cost being about 35 cents per foot. This particular job cost about $700 all told.

The second river crossing was made with 12-in. pipe. The river was somewhat wider and deeper; no notches in rock had to be cut and no channel to be prepared. The cost was approximately $900. It required less time than the first on account of the experience gained then. The work was done when the river was at the lowest stage known for years. The people were saved upward of $3,000, a waterworks contractor, who had done similar work in Rome, though pursuing a different method, offering to do the work, no material included, for $3,500, the cost of material being approximately $1,200, including equipment.

On each side of the streams through which the pipes were laid valves were placed for cutting off the crossings in case of emergency, and it was by by-passing these valves that it was possible to make the tests heretofore mentioned. One valve at each crossing was enclosed in a manhole, into which was tapped the main on each side of the valve, the inlet tap being ¾ in. and the outlet tap 1 in. Lead connections were attached to the taps and the other ends connected to a sensitive 1-in. meter, thus by-passing the valve which, with the other across the stream, was shut off. The water was turned on at the ¾-in. inlet tap slowly and as slowly let out at the outlet 1-in. tap. As soon as the meter and outlet connection had filled the meter ceased to operate, apparently showing that there were no leaks in first river crossing. The meter was removed and examined, replaced and the line tested with the same result. Both river crossings were tested quarterly with the same results during the writer's service in Rome.

The writer has recently completed another crossing through a stream at Meridian, Miss., by a method entirely different from that at Rome. The two reservoirs at Meridian are some two miles from the city, and it was in laying a 20-in. cast-iron pipe to bring more water to the city that the stream was crossed. The elevation of the bottom of the reservoirs is only 5.4 ft. above the bottom of the settling basin in the city, the elevation of the top of the dam, at high water in the reservoirs, being only 16 ft. above the top of settling basin. Therefore it was absolutely necessary in order to secure the greatest flow to select a route as near to a straight line as possible and to avoid anything like a summit or high point on it. With this in view it was deemed advisable to bridge Sowashee Creek, which had to be crossed, on the way to the city. Upon opening bids for the work the prices named were almost prohibitive, and, besides, great danger was apprehended during flood seasons when the stream carries large quantities of driftwood. The writer was therefore directed by the Meridian Water Commission to devise a safe plan for crossing under the stream.

---

*Paper read before American Waterworks Association.

The route selected has only one turn, an angle of 56 deg. made by laying the pipe at a radius of 270 ft. At the creek there was a downward deflection of approximately 20 ft., the total length of the depressed section being 500 ft. Sowashee Creek carries quite a large amount of sand and has a tendency to fill and widen rather than to narrow and scour. At ordinary winter height it is 30 ft. wide and 9 ft. deep at the crossing.

The writer conceived the idea of using a beam trussed like a freight-car sill, upon which to lay the pipe in saddles, the beam to be 36 ft. in length and 3 ft. wide. The work was started by placing across the creek two house-moving truss beams, secured from a local contractor. The commission's beam was rolled across on top of them, and on it was assembled the pipe, consisting of four joints of ordinary 20-in. Class A cast-iron pipe, one blow-off tee, with a spigot end 6-in. blow-off valve attached. Everything was put together with regulation joints of yarn and lead, and the pipe was secured to the truss beam by U bolts bent to a 22-in. radius and cast-iron washers. The entire bridge was then lowered 4.5 ft. beneath the surface.

Before doing this, however, notches were cut in the banks of the creek of the required depth to allow the beam with its load to rest upon the solid earth on each side. In order to prevent the pipe from filling with sand a large barrel head was fastened in each end. The lowering of the load, an approximate weight of six tons, was successfully accomplished by the use of two gin-poles and two capstans. After clearing away the rigging and beams the water of the creek was dammed at each end of the pipe with sand bags and the two ends joined to the main pipe line.

In order to attain security six creosoted piles in three bents have since been driven, each bent being capped with an oak timber, well seasoned, and the original construction suspended from these bents with U bolts. The piles were driven in the bottom of the creek as far as they could be sunk, some 12 ft., the upper ends sawed off flush with the topped the pipe, the creek having in the meantime fallen several feet, and the capping attached by means of 100-d spikes, generally used in bridge construction. The method used allows the water to pass both above and beneath the pipe. It appears to be strong and is absolutely rigid in every direction. The banks have been secured by driving, in crescent shape, two rows of Wakefield piling into the earth as far as they could be driven, some 10 ft. or more.

WORK ON THE GRAND TRUNK PACIFIC.

The Board of Railway Commissioners has made an order allowing the Grand Trunk Pacific to operate the new Tofield-Calgary branch as far as Trochu, [illegible] miles south of Tofield. [illegible] Tofield has already reached Calgary, and steel [illegible] miles [illegible] beyond Trochu.

[illegible] progress in track laying is being made on the several branch lines of the Grand Trunk Pacific, over 11 miles of the [illegible] having been laid in two days last week.

RAILWAY EARNINGS.

The following are the railroad earnings for the week ended July 21:—

	1911.	1912.	Increase or Decrease.
C. P. R.	$2,120,000	$2,593,000	+ $473,000
G. T. R.	960,016	1,047,951	+ 87,933
C. N. R.	337,000	426,100	+ 89,100
T. & N. O. R.	37,066	30,441	— 6,625
Halifax Electric	5,262	5,628	+ 366

The following are the railroad earnings for the week ended July 31:—

	1911.	1912.	Increase or Decrease.
C. P. R.	$2,170,000	$2,701,000	+ $531,000
G. T. R.	1,339,472	1,544,003	+ 204,531
C. N. R.	427,700	575,000	+ 147,300
T. & N. O. R.	47,833	41,374	— 6,459
Halifax Electric	7,591	7,440	— 151

The official figures on the fiscal year of Canadian Pacific Railway ended June 30 show gross earnings of $123,319,541, and net of $43,298,243.

These compare as follows with last year:

	1912.	1911.	Inc.
Earnings	$123,319,541	$104,167,808	$19,151,576
Expenses	80,021,298	67,467,977	12,553,321
Net profits	43,298,243	36,699,830	6,598,412

The heaviest monthly gross receipts were for April, May and June, when they exceeded $11,300,000, the only other month approaching these figures being October, 1911, when they ran as high as $11,200,000.

The smallest monthly gross was $7,328,781 in January.

In four months of the fiscal year the net earnings exceeded $4,000,000. These were August, October and December, 1911, and April this year.

The gains in gross over the preceding year ranged from $733,872 in September to $2,629,325 in April, and gains in net went from $5,848 in September to $1,239,150 in February.

The company's figures for June and the fiscal year are as follows:—

	June 1912.	July 1st to June 30, 1912.
Gross earnings	$11,311,397.20	$123,319,541.23
Working expenses	7,464,794.51	80,021,298.40
Net profits	3,846,602.69	43,298,242.83

In June, 1911, the net profits were $3,024,671.05; and from June 1st to June 30th, 1911, there was a net profit of $36,699,830.57. The gain in net profits over the same period last year is therefore, for June, $821,931.64; and from July 1st to June 30th, $6,598,412.26.

The Canadian Northern traffic earnings and expenses for the month of June, with comparisons, are as follows:—

	June, 1912.	June, 1911.	Inc.
Gross earnings	$1,769,500	$1,465,000	$303,000
Expenses	1,347,800	1,147,400	200,400
Net earnings	421,700	318,200	103,500
Mileage in operation	4,207	3,608	599

For the year ended June, 1912, earnings and expenses compare as follows with the previous year:

	June, 1912.	June, 1911.	Inc.
Gross earnings	$19,538,600	$15,199,500	$4,339,100
Expenses	14,422,500	11,033,700	3,388,800
Net earnings	5,116,100	4,165,800	950,300
Mileage average	3,888	3,383	505

TENSILE TESTS OF SPLICES OF REINFORCING BARS.

In constructing the walls of the Washington Street tunnel in Chicago the method of drifting by successive levels necessitated the introduction of vertical reinforcing rods of short lengths, cut according to the height of the drift. The walls were built underground and in sections six or eight feet high.

As it was not deemed prudent to rely entirely on the bonding strength of the concrete to transmit stress from one rod to another, tests were made under the direction of the Board of Supervising Engineers on 1-in. twisted steel rods spliced with one or more simple V‘ clamps. These were placed in tension and the load applied at the rate of 1,000 lbs. per minute. As the keys left in the concrete face of each drift allowed a minimum of 8 ins. overlap, this length of splice was used in all tests. A description of the tests is given in the third annual report of the Board of Supervising Engineers, from which we abstract this information

Methods of Testing.—The tests were made with one, two and three clamps as follows:—

(1) Single clamp 8 ins. overlap.

(2) Two clamps fastened on opposite sides.

(3) Three clamps, two fastened on one side and one from the opposite side.

The result showed that in general the two-clamp type was the best to use in construction work. This type, when the clamp was tightened enough—slightly enough to bend the plate—showed a resistance of 6,400 lbs. with ⅛-in. slip. When put under further load there was no movement until the load reached 13,690 lbs., when a sudden slip occurred of 3/16 in. in the strap of one of the clamps and ⅛ in. slip in the rods. The rocks then began to pull apart at this or a lower stress.

The single clamp allowed the bars to twist practically as soon as any stress was applied, and showed a slip of ⅛ in. at 4,000 lbs. stress, increasing to ¼ in. slip at 5,600 lbs.

With three clamps a slip of ⅛ in. occurred in the bars with a stress of 6,760 lbs. The strap started at 10,730 lbs., 11,690 lbs. and 18,330 lbs., respectively, with a total slip at this time of ¼ in. At 25,580 lbs. there was a sudden slip of the bars and one clamp became entirely loose so that no further load could be applied.

In general, the tendency of this type of lap splice is to offer a fairly uniform resistance to tensile stress up to a point where the clamps become dislocated and lose their grip, when complete failure occurs. The effect of tension on the unconcreted joint also appears to hasten the dislocation of the clamps, and consequently decreases the apparent strength of the plain joint.

The working stress used in all concrete designs provided for 16,000 lbs. per square inch tension in the steel. In these tests the resistance was about 7,000 lbs. up to the first slip. This resistance, however, would be much greater when the rods were embedded in concrete, so it was decided to use a splice of the type with two clamps and rely on the bonding stress of the concrete to supply the deficiency between the resistance of the splice and the stress in the steel.

In estimating this additional strength two forces were relied on: First, a surface adhesion taken conservatively at 100 lbs. per sq. in., which directly augments the net tensile strength of the splice; second, a bonding effect, which prevents the bars from twisting, and consequently defers the displacement of the clamps. By this method the full tensile strength of the bar (16,000 lbs.) could be realized.

In various drift levels the key was about 12 ins. in depth, which always provided at least 8 ins. overlap as previously stated. This made it fairly easy to apply the clamps in position.

A second series of tests as indicated on Fig. 2 were made as follows:—

(1) With a two U-clamp splice with ½-in. plate and no concrete.

(2) Two U-clamp splices embedded in a concrete block and tested when the concrete block was seven days old. (Two tests.)

(3) Two U-clamp splices as above, except with concrete 28 days old.

The first test on the plain joint was in the nature of a check on the previous tests, and a maximum of 27,000 lbs. was reached with the first slip at 8,810 lbs. and a total slip of 2¼ ins.

The mixture of the concrete was 1:2:4 with Portland cement, sand and ½ to ¾ in. crushed limestone. The blocks were each 12-in. cubes, thus embedding the 8-in. lap splice 2 ins. at each end, and in this respect the test could not hope to reveal the full bonding strength of a continuous concrete monolith.

The points of measurement of slippage between bars was necessarily outside the cube, so that the combined effect of unrestricted torsion and stretch in these outer sections of the bars undoubtedly decreased the ultimate strength of the joint as put under test, so that the results here recorded may be regarded in every respect as conservative.

The first seven-day cube took a slowly increasing load up to 23,080 lbs., when a movement of ⅛ in. occurred and the concrete cracked on four sides. No further load could be applied until the total slip increased to ¼ in., from which the load was carried up to a maximum of 31,220 lbs. with continual slipping and a total displacement of 1.29 ins. The second seven-day cube failed practically the same as the first, except that the first slip occurred at 19,400 lbs., and a maximum of 34,120 lbs. was carried with a gradual slipping of 1.33 ins.

The test on 28-day concrete showed a slight movement at 13,550 lbs., holding to 21,000 lbs., and then a gradual stretch up to a maximum of 30,480 lbs. with 3/32 in. total slip. In Fig. 2 a vertical movement represents stress without slip, and conversely, inclination represents a continuous pulling apart with increasing load.

Conclusions.—(1) In all cases the strength of the splicing seems to be dependent upon the strength of the concrete, and there is comparatively little margin between the first evidence of distress and complete failure.

(2) The 28-day concrete specimen took about 50 per cent. more stress at complete failure than the average of the two seven-day specimens.

(3) When such splices are used, the concrete would fail before the splice.

(4) This method of splicing reinforcing bars is safe for a working stress of approximately 16,000 lbs. per square inch in the steel.

Figure 2 shows the curious fact that the three-clamp splice without concrete has less strength than the two clamps at lower loads, but as higher loads are applied the third clamp becomes effective. This anomaly is undoubtedly due to the difficulty of securing an equal bearing between bars and clamps until sufficient load has been applied to start abrasive action.

◆

PERSONAL.

MR. JAMES A. BELL, engineer of the township of Dunwich, Ont., has resigned his position and MR. A. S. COLE, O.L.S., has been appointed as his successor.

MR. ALLEN HAZEN, of New York, will oversee the construction of a duplicate filtration plant for the city of Toronto.

MR. J. R. TODD, A.M. Can. Soc. C.E., has taken charge of a new branch office of the John Galt Engineering Company recently opened at 615 Pender Street, Vancouver, B.C.

MR. WILLIAM McGEORGE MASON has been appointed by the council as chief engineer of the city of Prince Rupert, British Columbia.

COMING MEETINGS.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Sixth Annual Convention Kelowna, Okanagan Valley, B.C., August 13, 14, 15 and 16, 1912. Secretary, Normon S. Rankin, P.O. Box 1317, Calgary, Alta.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept. 9th, 1912, during the Exhibition. Secretary, J. B. McNary, 90 Caroline St., North Hamilton, Ont.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912 Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE · Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—[illegible] W. D. [illegible]; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible] P.O. Box [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

[illegible] MUNICIPAL ASSOCIATION.—President, Mayor [illegible] Hamilton [illegible] St. Thomas, Ontario.

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible] Hinsley, [illegible]

[illegible] ASSOCIATION.—[illegible]

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., [illegible]

THE UNION OF THE [illegible] MUNICIPALITIES.—President, [illegible]

UNION OF [illegible] MUNICIPALITIES.—President, [illegible] N.S.

[illegible] MUNICIPALITIES.—President, Mayor [illegible]

UNION OF [illegible] MUNICIPALITIES.—President, Mayor [illegible] B.C.

[illegible]

[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. B. McNary Secretary, 90 Caroline St., North Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. M[illegible]; Secretary, H. [illegible] Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Hon. W. [illegible], Minister of Lands, B.C. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. [illegible], P.O. Box [illegible], Winnipeg, Man. Second Monday except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on for reference only, unless otherwise noted, at the office of he Canadian Engineer, 62 Church Street, Toronto:—

ids close — Noted in issue of
31—Trenching and Backfilling, Edmonton, Alta (S.) 8-8

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Beaverton, Ont., breakwater, sheet piling and dredging	Aug. 26.	Aug. 1.	78
Cape Croker, Ont., schoolhouse.	Aug. 26.	Aug. 1.	67
Cobourg Harbor, Ont., breakwater	Aug. 14.	July 25.	68
Dorval, P.Q., water works, etc.	Aug. 15	Aug. 1.	67
Dunnville, Ont., road machinery	Aug. 14.	Aug. 8.	78
Edmonton, Alta., lighting, Parliament Building	Aug. 31.	Aug. 8.	67
Edmonton, Alta., trenching	Aug. 31.	Aug. 8.	78
Edmonton, Alta., gas plant	Aug. 23.	July 18.	67
Fort William, Ont., water pipe	Aug. 28.	Aug. 8.	78
uelph, Ont., bridges	Aug. 14.	Aug. 8.	78
ckson's Point, Ont., bridge	Aug. 17.	Aug. 8.	80
empenfeldt Bay, Ont., wharf and approach	Aug. 21.	Aug. 1.	67
ockport, Man., superintendent's residence	Aug. 20.	Aug. 8.	68
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
Norway House, Man., school and hospital	Aug. 19.	July 11.	63
Ottawa, Ont., supply of coal	Aug. 28.	July 25.	67
Ottawa, Ont., wire fence	Aug. 20.	Aug. 1.	67
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., alterations to Laboratory No. 1, Experimental Farm	Aug. 24.	Aug. 8.	68
Pas Reserve, Sask., school building	Aug. 19.	July 11.	68
Parry Sound, Ont., wharf and approach	Aug. 26.	Aug. 8.	68
Point Barracks, Esquimalt, B.C., painting work	Aug. 20.	Aug. 8.	68
Port Arthur, Ont., breakwater	Aug. 28.	Aug. 8.	80
Point du Bois, Man., transformer	Aug. 14.	Aug. 8.	68
Port Colborne, Ont., repair of headblock	Aug. 21.	Aug. 1.	67
Regina, Sask., electrical plant	Aug. 14.	July 25.	68
Rosthern, Sask., stable and barn	Aug. 19.	Aug. 8.	68
Sutton, Ont., bridge	Aug. 17.	Aug. 8.	80
Toronto, Ont., drip guards	Aug. 13.	July 25.	68
Township of York, Ont., concrete sidewalks	Aug. 17.	Aug. 8.	80
Vancouver, B.C., club house	Aug. 21.	Aug. 8.	68
Winnipeg, Man., 36-inch pipe	Aug. 28.	July 25.	68
Winnipeg, Man., cedar for paving	Aug. 14.	Aug. 8.	68

TENDERS.

Bassano, Alta.—Tenders addressed to George Bond, Secretary, Bassano, will be received till August 22nd, 1912, for the supply and delivery of 2,400 lineal feet of six-inch to twelve-inch steel pipe, or alternatively, eight hundred tons cast-iron pipe, fifty gate valves, sixteen hydrants. Specifications, etc., at the office of the Engineers, the John Galt Engineering Company, at 317 Portage Avenue, Winnipeg, and Vancouver. (See advertisement in The Canadian Engineer.)

Brantford, Ont.—The Lake Erie and Northern Railway Company will soon call for tenders and commence construction work this fall. Lloyd Harris, of Brantford, Ont., and F. H. Deacon, of Toronto, are interested in the project.

Chatham, Ont.—Tenders addressed to Z. Paul, Commissioner, Croton Post Office, will be received up to August 19th, 1912, for the erection of a concrete pier and steel bridge, known as the Prangley Pap Bridge. Plans and specifications can be seen at the residence of Mr. Z. Paul, Lot 4, Con. 11, Camden Gore.

Edmonton, Alta.—Tenders are invited for the erection of an 8-room addition to the Rutherford School, Edmonton South, to be delivered up to noon of August 22, 1912, at the office of the Edmonton Public School Board, Mortlake Block, Edmonton, Alta. George E. Turner, building commissioner, where plans and specifications may be obtained.

Guelph, Ont.—Tenders will be received from all trades up to Tuesday, August 13th, for making certain alterations and additions for the Royal Bank of Canada at Guelph. Particulars at the offices of Messrs. Colwill, Tanner & Co., architects, Traders Bank Building, Guelph, Ont.

Hamilton, Ont.—Tenders addressed to R. L. Lathan, chief engineer, Toronto, Hamilton and Buffalo Railway, will be received up to noon August 17th next for depositing earth or other suitable filling on certain lands of the above company. Plans may be seen at the office of the engineer or from the agent at Brantford, Ont.

Imperial, Sask.—Sealed tenders will be received by J. G. Hobman, secretary-treasurer, village of Imperial, Sask., up to Tuesday, Aug. 20th, 1912, for the construction of a waterworks system. Plans, specifications and information may be obtained from J. G. Hobman, secretary-treasurer, Imperial, Sask., or at the office of Smith and Ross, engineers, room 4, Peart Block, Regina.

London, Ont.—Tenders will be received at the office of the City Clerk until August 22nd, 1912, for the construction of 5,812 square yards of bituminous-top macadam pavement on a five-inch concrete base, with 3,985 lineal feet of six-inch curb and 15-inch gutter, on Ridout Street, from Horton Street to Elmwood Avenue. Specifications and plans at the office of Geo. W. Wright, City Engineer. (See advertisement in The Canadian Engineer.)

Moose Jaw, Sask.—The city will receive tenders for the drilling of a 3,000-foot gas well in the city of Moose Jaw, and also alternative tenders for the completion of a well which is at the present time drilled to a depth of approximately 1,100 feet, and which it is desired to complete to a depth of 3,000 feet. Further information may be had on application to the City Commissioners.

Moncton, N.B.—Tenders for the new schoolhouse at Georgetown were opened as follows: T. D. LeBlanc, $2,240; Paul Lea Co., $2,190; A. H. Stevens, $2,075. The contract was awarded to A. H. Stevens, he being the lowest tenderer.

Ottawa, Ont.—Tenders will be received at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until August 26th, 1912, for the delivery of creosoted timber for Northern and Eastern New Brunswick. Specification, etc., at this Department and at the offices of Geoffrey Stead, Esq., District Engineer, Chatham, N.B.; E. T. P. Shewen, Esq., District Engineer, St. John, N.B.; C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S., and G. A. Bernasconi, Esq., District Engineer, North Sydney, N.S.

Ottawa, Ont.—Tenders for the construction of a breakwater in Victoria Harbor, B.C., will be received until September 5th, 1912, at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at this Department and at the offices of W. Henderson, Resident Architect, Victoria, B.C.; C. C. Worsfold, Esq., District Engineer, New Westminster, B.C.; J. G. Sing, Esq., District Engineer, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Montreal, Que.; A. Decary, District Engineer, Quebec, Que., and on application to the Postmaster at Vancouver, B.C. (See advertisement in Canadian Engineer.)

Ottawa, Ont.—Tenders for the construction of a laboratory building, quarantine station, Halifax, N.S., will be received until August 26, 1912. Plans and specifications, etc., can be obtained at the office of Mr. W. Bishop, inspector of public buildings, Halifax, N.S., 53 Spring Garden Road, and at the office of R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders addressed to W. W. Cory, Deputy Minister of the Department of the Interior, Ottawa, Ont., will be received up to noon of 20th August, 1912, for the construction of a wire fence around Moose Mountain Buffalo Reserve. P. G. Keyes, Secretary, Department of the Interior, Ottawa. (See advertisement in Canadian Engineer.)

Ottawa, Ont.—Tenders for the erection of a laboratory building, Quarantine Station, St. John, N.B., will be received until August 26th, 1912, at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at this Department and on application to Mr. D. H. Waterbury, Superintendent of Public Buildings, Public Works Department, St. John, N.B.

Ottawa, Ont.—Tenders will be received up to noon of September 2nd, 1912, for the construction of a twin-screw steel steamer for Customs service on the Atlantic coast, to be delivered at the port of Quebec, tenders to be addressed to John McDougald, Commissioner of Customs, Department of Customs, Ottawa. Plans and specifications of the steamer can be seen at the Department of Customs, Ottawa, and at the offices of the Collectors of Customs, Toronto, Collingwood, Montreal, Quebec, St. John, N.B., and Halifax, N.S.

Ottawa, Ont.—Tenders for the construction of deep-water piers in the harbor of Quebec, P.Q., will be received until August 21st, 1912, by R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at the offices of the Secretary; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Merchants Bank Building, St. James Street, Montreal, Que., and A. R. Decary, Esq., District Engineer, Post Office Building, Quebec, Que.

Ottawa, Ont.—Tenders for the construction of a public building at Lethbridge, Alta., will be received at the office [illegible]

Ottawa, Ont. [illegible]

Peterboro, Ont. [illegible]

Tillsonburg, Ont. [illegible]

Toronto, Ont. [illegible]

Toronto, Ont.—Tenders will be received by J. O. Reaume, Minister of Public Works, Ontario, Parliament Buildings, Toronto, up to noon of 30th September, 1912, for the purchase of the Education Department and Normal School Property in the city of Toronto. Conditions of sale, etc., may be obtained at Mr. Reaume's office.

Toronto, Ont.—Tenders addressed to G. W. Lee, General Agent T. and N.O. Railway Commission, North Bay, will be received up to noon of August 28th, 1912, for the purchase of lots in the new sub-division of the townsite of Cochrane, in the District of Nipissing. Conditions of sale, etc., may be had on application either to G. W. Lee or to A. J. McGee, Secretary-treasurer T. and N.O. Railway Commission, 25 Toronto Street, Toronto.

Winnipeg, Man.—The contract for the basement of the new Elmwood Presbyterian church was let to Warwick Brothers. The cost will be $13,000. The estimated cost of the entire building will be about $45,000.

Winnipeg, Man.—At a meeting of the school board the contract for the construction of the new twenty-one roomed school, to be located in Ward Three, was awarded to the firm of S. Brynjolfsson & Co. The tender of the firm was for $122,886. Work will be started immediately.

Winnipeg, Man.—Tenders addressed to M. Peterson, Secretary, Board of Control Office, Winnipeg, will be received up to noon of August 28th, 1912, for the manufacture and delivery, f.o.b. Winnipeg, of one hundred ornamental lighting standards. Specifications, etc., at the office of the Light and Power Department, 54 King Street.

Winnipeg, Man.—Tenders will be received up to noon of August 14th for the electric wiring of the power-house, main and branch tunnels, Agricultural College, St. Vital. Plans and specifications may be seen at the office of the Provincial Architect, 261 Fort Street, Winnipeg. Colin H. Campbell, Minister of Public Works, Winnipeg.

Yorkton, Sask.—Sealed tenders marked "Tenders for laying of outflow sewer," will be received by T. F. Acheson, secretary-treasurer of Yorkton, up to 6 p.m., August 20th next, for the laying of approximately five thousand six hundred (5,600) lineal feet of forty-two inch (42 inch) concrete sewer pipe. Plans and specifications may be obtained from the above. A marked cheque for $500 must be enclosed with all tenders submitted.

◆

CONTRACTS AWARDED.

Province of British Columbia.—Messrs. Culleton Bros., of Spokane, have been awarded an additional five miles of track beyond their ten mile contract north of McBride Junction by the Canadian Pacific Railway.

Mr. J. W. Hoard of Victoria, has been awarded a contract to construct five miles of track south west from Trent River by the Canadian Pacific Railway.

Calgary, Alta. — The Canadian Pacific Railway have awarded a contract for the construction of fifty houses to be used by employees of the company at the Ogden locomotive and car shops. Messrs. Westinghouse, Church, Kerr Company, of New York, will construct this work.

Medicine, Hat, Alta.—The Alberta School Supply Company of Edmonton, have been awarded a contract for the supplying of the interior finish to the two new schools nearing completion in this city. The contract is for 600 desks, chairs, maps, etc.

Montreal, Que. Messrs. Towhy Brothers, railway con [illegible] are required.

Montreal, P.Q. [illegible]

Dolarway
Pavement

"It is permanent because it is concrete."

The Last Word
In Street Pavements

The Dolarway Pavement is popular with City Officials, Highway Engineers and Property Owners because:

It is low in first cost.
Its maintenance cost is lower than that for any other permanent form of Pavement.
No paving plant is required to either construct or maintain it.
It is noiseless, dustless and resilient.
Its traction qualities for both the Horse and the Automobile are of the best.

For full particulars address

DOLARWAY PAVING COMPANY

95 Liberty Street, New York City
510 Title & Trust Bldg., Chicago, Ill.

Applying Dolarway Bitumen on Concrete Base, Central Park, N.Y. City.

Moose Jaw, Sask.—High pressure pumps and equipment: Contractors, Messrs. Chapman and Walker, Ltd., 69 Victoria Street, Toronto, $7,900.

Moose Jaw, Sask.—The Saskatchewan Bridge and Iron Works have received an order for much of the steel work in connection with the new power plant now being erected.

Moose Jaw, Sask.—The contract for the remaining 30,000 feet in connection with the Caron water supply, has been awarded to Messrs. William Newman and Co., Ltd., of Winnipeg.

County of Oxford, Ont.—The Hamilton Bridge Company have received a contract to supply and erect a superstructure of a new bridge being built between this county and Waterloo. The cost of the entire bridge will be about $8,000.

Saskatoon, Sask.—Messrs. Frid Lewis & Co., Winnipeg have received a contract to erect a departmental store for F. R. MacMillan & Co. A sprinkling system and a permanent vacuum cleaner are included in the plans.

South Vancouver, B.C.—Messrs. McPhalen Bros., 828 Seventh Avenue East, have been awarded a contract by the Board of School Trustees to erect four school buildings as follows:—Secord school, Victoria road, $36,200; Gordon school, Ferris road, $35,700; Sexsmith school, Sixty-first Avenue and Ontario Street, $35,300; Norquay school, Ferguson road, $35,200.

Victoria, B.C.—The Vancouver Machinery Depot have been awarded a contract to supply and erect the mechanical equipment of the civic coal bunkers at the city yards. The cost of this work is $7,271.

Victoria, B.C.—The contract for the municipal hall at Ladner has been let to Mr. C. G. Bowden, Burnaby Lake, the price being in the neighborhood of $13,000.

Westmount, P.Q.—The tender of R. T. Smith has been accepted by the council for the work of paving Hillside Avenue with asphaltic concrete at a cost of $13,370.

Winnipeg, Man.—The National Meter Co., 318 Dearborn St., Chicago, have the contract for supplying 3,000 5/8-inch water meters to cost $61,878.75. H. N. Ruttan, 223 James Street, is engineer.

◆

RAILWAYS—STEAM AND ELECTRIC.

Saskatoon, Sask.—The municipal council have awarded a contract to the St. Louis Car Company for twelve new single truck street cars at a price of $5,009.25 each, f.o.b. Saskatoon. Messrs. Stone and Webster are engineers to the council in all matters relating to street railway.

◆

LIGHT, HEAT AND POWER.

Claresholm, Alta.—The engine in the power house was damaged by lightning, and the town will be in darkness for [illegible]

Dunsmuir, B.C.—Six thousand electrical horse-power will be available from a plant now being installed at the Canadian Collieries, Limited. According to Mr. W. L. Coulson, Victoria, this addition will allow the plant to [illegible]

Nelson, B.C.—[illegible]

Regina, Sask.—[illegible] proposal.

Vegreville, Alta.—[illegible]

◆

COPY OF CANADIAN ENGINEER WANTED.

[illegible]

GARBAGE, SEWAGE AND WATER.

Fort William, Ont.—Providing that a bond sale is successfully negotiated the council of this city will construct a trunk sewer at a cost of $125,000. The high cost of this work is due to the fact that excavation will have to be carried down 35 feet in many sections. John Wilson, city engineer.

Montreal, P.Q.—Superintendent Lesage has recommended that a new pump be purchased and installed in readiness for next summer.

Moose Jaw, Sask.—The Municipal Commissioners are about to consider tenders on the construction of a high pressure water system. There is included in the plan of this work a large dam on the river below the Manitoba Street bridge. Five firms have tendered on this work.

Vegreville, Alta.—The ratepayers have voted the sum of $82,000 on the installation of a waterworks plant.

Victoria, B.C.—It is probable that temporary financial assistance will be required to complete the enlarged sewage plans of this municipality. Mr. C. H. Rust is engaged on the preparation of an estimate of the cost of this work.

Windsor, Ont.—If the Provincial Health Act is rigidly enforced there will be a large expenditure on a sewage disposal plant in this city. At present the river is employed to carry away the refuse. F. E. Brian, city engineer.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Berlin, Ont.—A report is in circulation in this city to the effect that a milk Pasteurizing plant will probably be established. The names of the interested parties are withheld for the present.

Brantford, Ont.—A branch factory of the Keeton Motors, Limited, will be established in this city. Messrs. Harley and Sweet are interested in the project.

Edmonton, Alta.—The management of the Commercial Hotel have made arrangements for a new building to replace the present wooden structure. It is also their intention to further enlarge the premises by 1913.

Kamloops, B.C.—W. J. Ellis has prepared plans and details for the erection of a new foundry to be built on a site near Ward's garage. Work on the new plant will be commenced at once.

Lethbridge, Alta.—Owing to the recent sale of the Salvation Army Barracks on Fifth Street, that body are preparing to erect a new structure. The new building is to cost about $25,000.

Montreal, P.Q.—The building to be erected by the Mount Royal Garage will be 70 x 200 feet, six stories and basement, steam heating, and will contain a well-equipped repair and machine shop.

Moose Jaw, Sask.—The City Commissioners have been given power to purchase steel for the new power house without the formality of tenders.

Moose Jaw, Sask.—The municipal council have sold a site to the management of the Canadian Swift Company. It is the intention of the latter to erect a distributing plant.

Ottawa, Ont.—A new building, costing in the neighborhood of $50,000, for the Geodetic Survey of Canada, will be erected at the rear of the Dominion observatory at the Experimental Farm in the near future. The plans and specifications are now being prepared by Mr. David Ewart, chief architect of public works.

Outremont, P.Q.—The Bell Telephone Company are preparing to erect an exchange building at this point.

Saskatoon, Sask.—The management of the Quaker Oats Company have decided to erect a separate mill for the manufacture of their oats and not include this branch of the business with the manufacture of flour. This decision will mean an expenditure of several thousand dollars over the original estimates. Mr. John Stewart, second vice-president of the company, has been in Saskatoon in connection with the preliminaries of this work.

St. Thomas, Ont.—The St. Thomas Dehydrator Company has been formed with Mr. John Lyle as president. The plant of the St. Thomas Canning Company has been purchased and machinery will be installed at once for the dehydrating and evaporating of fruits and vegetables of all kinds.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
RESERVOIR TANKS

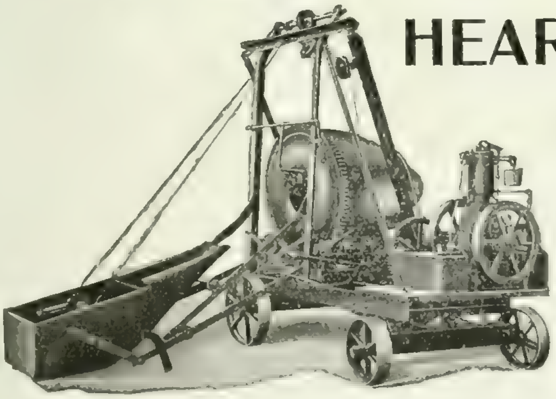
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

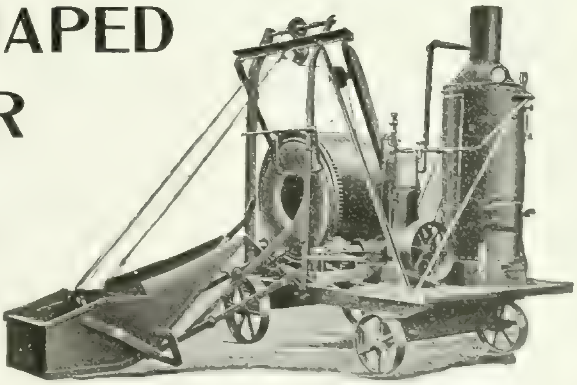
PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER

HEART-SHAPED MIXER



Write for 1912 Catalogues.



The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH.
BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.,
316 Lagauchetiere St., W.,
Montreal, Que.

Vancouver, B.C.—The Minister of Militia and Defence has announced his intention of erecting an armory on Deadman's Island.

Victoria, B.C.—The Federal Government are considering plans for the establishment of a suitable harbor to accommodate ships that will come to this port on the opening of the Panama Canal. It is reported that tenders will be called in a few days for a portion of this work.

Victoria, B.C.—The management of the Hudson Bay Company intend to erect a large store in this city.

Whitby, Ont.—The municipal council have received the approval of Mr. Andrew Carnegie on the plan for a new library to be erected in this town. Tenders are to called at an early date for this work.

◆

BRIDGES, ROADS AND PAVEMENTS.

Ayr, Ont.—The council of this village intend to build a pier and abutment to replace the damage caused by the floods last spring. Engineer Bowman, Galt, Ont., is preparing the plans, and also superintending an extension to the Blair bridge.

Deseronto, Ont.—A report states that Government officials are seriously considering the establishment of a bridge between Deseronto and the Prince Edward county shore.

Edmonton, Alta.—City Engineer Latornell has prepared estimates for a proposed drive. His figures are as follows:—

East End River Drive	$ 5,5[illegible]
West End River Drive	25,320 00
Six-foot sidewalk along East End Drive	6,000 00
[illegible]	[illegible]

Ottawa, Ont.—The municipal council has given notice of several works to be constructed under the heading of local improvements. These include a 9" tile sewer and several 12" tile sewers. This work is to cost about $8,000. N. Ker, is [illegible]

Peterboro', Ont.—Estimates and preliminary plans have been prepared by Mr. Hay on a proposed bridge at Dalhousie Street. This will be 793 feet in length, and cost $87,875, made up as follows:—

Excavation, unwatering and pile driving	$ 4,800 00
Machinery, pumping and power	2,100 00
Reinforced concrete, abutments and piers	18,840 00
Steel superstructure, three spans of 125 feet	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Sidewalks (on steel superstructure only)	675 00
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
	$87,875 00

Plattsville, Ont.—[illegible] Woodstock, Ont.

Province of Saskatchewan.—[illegible]

Toronto, Ont.—[illegible]

Victoria, B.C.—[illegible]

Victoria, B.C.—Mr. C. H. Rust, city engineer, is pleased with the results of oil sprinkling on the roads, but is hampered from further work along this line owing to a shortage in suitable oils out West.

County of York, Ont.—$13,500 is the estimated cost of a roadway to be constructed through the village of Mimico by the York County Highway Commissioners. E. A. James, 57 Adelaide St. East, Toronto, is engineer to the Commission.

◆

CURRENT NEWS.

Arcola, Sask.—Indications of a valuable coal deposit were found at this point during well drilling operations at the foot of Moose Mountain near this town.

Dunsmuir, B.C.—The Canadian Collieries, Limited, are opening up a new shaft near Cumberland, and expect to strike a seam of coal at 900 feet according to the present borings.

Eastern Ontario.—A company taking the name of the St. Lawrence River Concrete Company has been formed with a view of supplying all the cement and concrete to replace the damage caused by the recent fire at the Thousand Islands. They will do their manufacturing at this point.

Edmonton, Alta.—The Commissioners have received the following tenders for the supply of gas mains steel pipe and specials:—

Gorman, Clancey & Grindley	$90,000 00
Munderloh & Co., Montreal	86,000 00
John Coates & Son	Detailed prices

Edmonton, Alta.—The Commissioners have received an offer from E. Manders for the construction of the special city boulevard at a cost of $13,000.

Montreal, P.Q.—A three-story steel frame building in course of erection at 913 Mount Royal Avenue collapsed and fell into the street.

Fort William, Ont.—Active work on the construction of the New Fort William Elevator Company, grain elevator, is now under way by the contractors, Barnett & McQueen of this city.

Moncton, N.B.—A boiler in use at Well No. 26 at the gas fields on the Petitcodiac River exploded and caused considerable damage to the plant. Mr. Boggs, the manager, will have the remains of the boiler shipped to Moncton to see if repairs are possible.

Province of Nova Scotia.—Coal contracts recently let by the Department of Railways and Canals will go a long way to increase the coal business in Eastern Canada. This supply is for the operation of the Intercolonial Railway. The Dominion Coal Company at Springhill have a contract for over 80,000 tons, the Maritime Coal Company will furnish the People's Road with 75,000 tons, the Minudie Mine 40,000 tons, and a number of other small collieries have also been given substantial contracts.

Ottawa, Ont.—A report states that the Federal Government will create a new portfolio during the coming season. This will be a Portfolio of Mines, and will deal with these matters exclusively.

Ottawa, Ont.—Mr. H. W. White, a prominent landscape artist of Great Britain, will visit this city on the invitation of the Prime Minister and express an opinion on the layout of the proposed government buildings to be erected on the Wellington site.

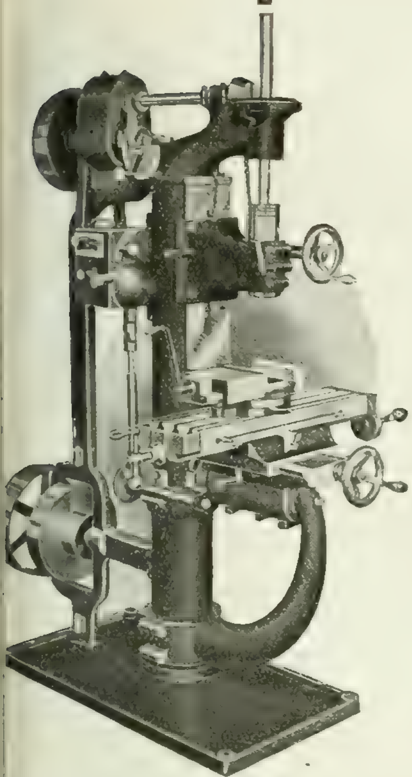
Quebec, P.Q.—Messrs. Sir William Arrol & Company, Limited, of Glasgow and Montreal, have been awarded the contract for the large, new 50-tons wharf crane with which the Harbor Commissioners are equipping this port. Next to the Montreal Harbor Commissioners' 75-tons floating crane, which was also constructed in the works of this company, this machine will be the largest of its kind in Canada, and will fulfil a long felt need at Quebec.

Province of Saskatchewan.—About nine hundred miles of long distance telephone line is rapidly nearing completion.

Stratford, Ont.—Owing to a rise in the price of gravel supplied by private pit owners the municipal council investigated and located a new source of supply in a park owned by the city. The gravel in this part is of a high grade and almost unlimited quantity.

Vancouver, B.C.—A report states that Mr. Charles W. [illegible] of the Maple Leaf Milling Company, has recently examined several suitable sites in this city with a view of estab-

You Need a Machine Like This on a Dozen Different Jobs



It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows :—Spindle of crucible steel, ground bearings ; working surface of table, 29 × 8½ inches ; feed, longitudinal and transverse ; floor space, 60 × 68 inches ; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

lishing a branch mill to be in operation concurrently with the opening of the Panama Canal.

St. Thomas, Ont.—The ratepayers will be asked to express their opinion on the following industrial propositions:—

To loan $15,000 to the Erie Iron Works, Limited.

A loan of $35,000 to the St. Thomas Biscuit Company.

To grant a free site, the cost not to exceed $2,500, for the Galt on Metolic Steel Grave Vault Company.

To loan $12,000 to E. E. Donovan, of London, who will start a men's shoe factory.

County of Waterloo, Ont.—A project has been started which calls for an exhibition to be known as "Produced in Waterloo." Mr. F. C. Hart, Galt, is interested in the work.

◆

TORONTO'S NEW CIVIC ABATTOIR.

The question of a civic abattoir has been considered for some time by the municipal council, and of late the matter has taken definite form. A site has been chosen on the north side of Wellington Street, in Stanley Park, opposite the city cattle market.

Mr. William R. Perrin, Jr., of Chicago, Ill., will prepare an estimate of the cost of this project as the preliminary plans call for considerable mechanical facilities in addition to a cooling plant. A rough sketch has also been submitted to the council by the same gentleman.

◆

TAX ON SIGN BOARDS.

The French Chamber are possibly the first legislative body to tax the sign and bill boards along the roadways. This is done as means of their abatement, as in France many of them are hideous and undesirable.

◆

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible] by the Board of Railway Commissioners, to date. Each week on this page may be found summaries of orders [illegible] facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

[illegible] from mileage [illegible]

[illegible] over Wyandotte Street, Windsor, Ont.

[illegible] C.P.R. to construct spur for [illegible] Bros., on its Thompson S.D., near Kamloops, B.C.

[illegible] C.P.R. [illegible] Avenue E, [illegible] Lots [illegible] and [illegible], [illegible] rescinding Order No. [illegible]

[illegible] County of [illegible]

[illegible] C.P.R. to construct [illegible] Strathcona-Calgary Extension.

[illegible] C.N.M. Tunnel and Terminal Co. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

17113 July 23—Authorizing C.N.M. Tunnel & Terminal Co. to cross C.P.R. by carrying C.P.R. tracks overhead, Montreal, and to cross C.P.R. near Outremont Yard, Montreal.

17114 July 23 Authorizing C.P.R. to construct spur for McGillivray Coal and Coke Co., Coleman, Alberta.

17115 July 25 Authorizing C.P.R. to construct spur for Buell & Co., Cochrane, Alberta.

17116 July 25 Authorizing C.P.R. to construct two spurs for Alberta Ice Co., at Keith, Alta.

17117 July 23 Authorizing C.P.R. to cross public road between Section 31-51-24 and Sec. [illegible]-52-24 west 4 M., Strathcona-Calgary Extension.

17118 July 23 Authorizing C.N.O. Ry. to cross public road between Lots [illegible] and 31, Con. 1, Twp. of Nepean.

17119—July 22—Directing that stop-over privileges granted to British Canadian Canners, Ltd., by railways operating from the Peninsula Westward, in Ontario, be granted them at the two points east of Toronto; namely, Bowmanville and Cobourg, Ontario.

17120—July 19—Approving and sanctioning G.T.P. B.L. station grounds on Tofield-Calgary Branch between Tps. 42-21 and 41-21 west 4 M.

17121 July 2[illegible]—Authorizing C.N.O. Ry. to cross public road between Lots 84 and 85, Parish of Ste. Dorothee, County of Laval, P.Q.

17122—July [illegible] Refusing application of the C.P.R. for authority to cross with Asquith to Conquest Branch the G.T.P. Ry. main line in Sec. 20-26-6 west 3 M., Sask.

17123 July [illegible] Refusing application of town of Forward, Sask., for order directing C.P.R. to furnish station, telegraph service, etc., at that point.

17124 July 2[illegible] Approving of G.T.P. B.L. station and station site at Dinant, Alberta, Tofield-Calgary Branch.

17125—July 29—Refusing application of C. M. Keily, Edmonton, Alta., in relation to the diversion of Fort Saskatchewan Trail, and crossing of G.T.P. Ry. over said Fort Saskatchewan Trail.

17126 July 29 Refusing application of the G.T.P. Ry. for leave to appeal to the Supreme Court from Order of Board No. 16700, authorizing crossing of the G.T.P. Ry. at Spruce Street, Edmonton, Alberta.

17127 July 29 Dismissing petition of residents of Resplendent, B.C., alleging that supplies carried on G.T.P. Ry. in that district for use of contractors have been sold in competition to private dealers.

17128—July 29—Authorizing C.P.R. to remove spur connecting Lot 23, part of Block 1, Lot 1, Parish of St. John, Winnipeg, Man.

17129—July 29—Ordering that on or before the 1st of September, 1912, the C.N.R. construct a farm crossing on Adelard Meunier's farm on southeast [illegible] Sec. [illegible] west 4 M., Alberta.

17130 July 29 Directing that on or before September 1st, 1912, the G.T.P. Ry. survey and convey to the city of Edmonton a lane 20 feet wide in lieu of lane which said company blocked by construction of its railway.

17131—July 29—Directing C.N.R. to fence that portion of its right-of-way from Saskatoon to northern limits of R. M., No. 344, to be completed on or before November 1st, 1912.

17132—July 29—Directing that Hamilton Radial Electric Ry. make a gravel crossing over its railway at a suitable point for the accommodation of each house on the portion of tracks south of canal (at Burlington Beach, Ontario), wherever such a crossing does not already exist, within 30 days from the date of this Order.

17133-[illegible] July [illegible] Approving agreements between the Bell Telephone Co. and the East Middlesex Tel. Co., Ltd., the Byron Tel. Co., Ltd., the Twp. of North Colchester and the Twp. of Brooke, for the interchange of messages or service.

[illegible] July [illegible] Approving of location of Edmonton, Dunvegan & B.C. Ry., mileage 29.783 to 68.30, and authorizing it to cross highways.

[illegible] July [illegible] Approving agreement between Bell Telephone Co. and the Twp. of Rochester, Ont., for interchange of traffic.

17139—July 26—Approving of the proposed change in location of C.P.R. station building at St. Hermas, on Lot Cadastral, No. 244, County of Two Mountains, P.Q.

[illegible] July [illegible] Authorizing C.N.M. Tunnel & Terminal Co., to cross [illegible] Road, Parish of St. Laurent, P.Q.

17141—July 26—Approving of the revision of grade of the G.T.P. Ry. at Tete Jaune Cache, between mileage 170 and 180, Wolfe Creek, West, B.C.

17142—July 26—Authorizing G.T.R. to construct spur for A. Knibb & [illegible], Ontario.

[illegible] July [illegible] Authorizing G.T.P. B.L. to operate trains over crossing [illegible] Prince Albert Branch of C.N.R., at R[illegible]

[illegible] July [illegible] Authorizing G.T.P. B.L. to cross and divert highways [illegible] M., Sask., Prince Albert Branch.

[illegible] July [illegible] Approving agreement between Bell Telephone Co., and [illegible] of West Tilbury, Ontario, and [illegible] for interchange of traffic.

[illegible] July [illegible] Authorizing C.N.O.R. to cross Township road at station [illegible] and to divert highway between mileage [illegible]

[illegible] July [illegible] Authorizing Edmonton, Dunvegan & B.C. Ry. to cross C.N.R. [illegible] west 4 M., [illegible] south of Morinville, Alberta, [illegible] plant.

[illegible] July [illegible] Authorizing C.N.O.R. to cross [illegible] River and tracks of C.P.R. [illegible], Ontario.

[illegible] July [illegible] Authorizing C.N.O. Ry. to construct spur for the Central [illegible] Station, Ontario.

[illegible] July [illegible] Authorizing C.P.R. to construct bridge over Thames River [illegible]

[illegible] July [illegible] Authorizing C.N.R. to construct spur through Block [illegible] Hudson's Bay Reserve, Edmonton, to cross Lots [illegible] and [illegible], and [illegible] Avenue.

[illegible] July [illegible] Authorizing C.N.O. Ry. to cross public road between Lots [illegible], Con. [illegible], Township of [illegible], Ontario.

Volume 23. Toronto, August 22, 1912

Contents of this issue on page 355

The Canadian Engineer

An Engineering Weekly

THE POWER PLANT OF THE SPANISH RIVER PULP AND PAPER MILLS, LIMITED.

In the issue of *The Canadian Engineer* of June 6th, 1912, there appeared a general description of the plant of the Spanish River Pulp and Paper Mills, Limited. This plant is located at Espanola, on the Soo branch of the Canadian Pacific Railway, forty miles west of Sudbury and one hundred and thirty-eight miles east of Sault Ste. Marie. We herewith present some further data descriptive of the hydraulic and steam power equipment of the plant.

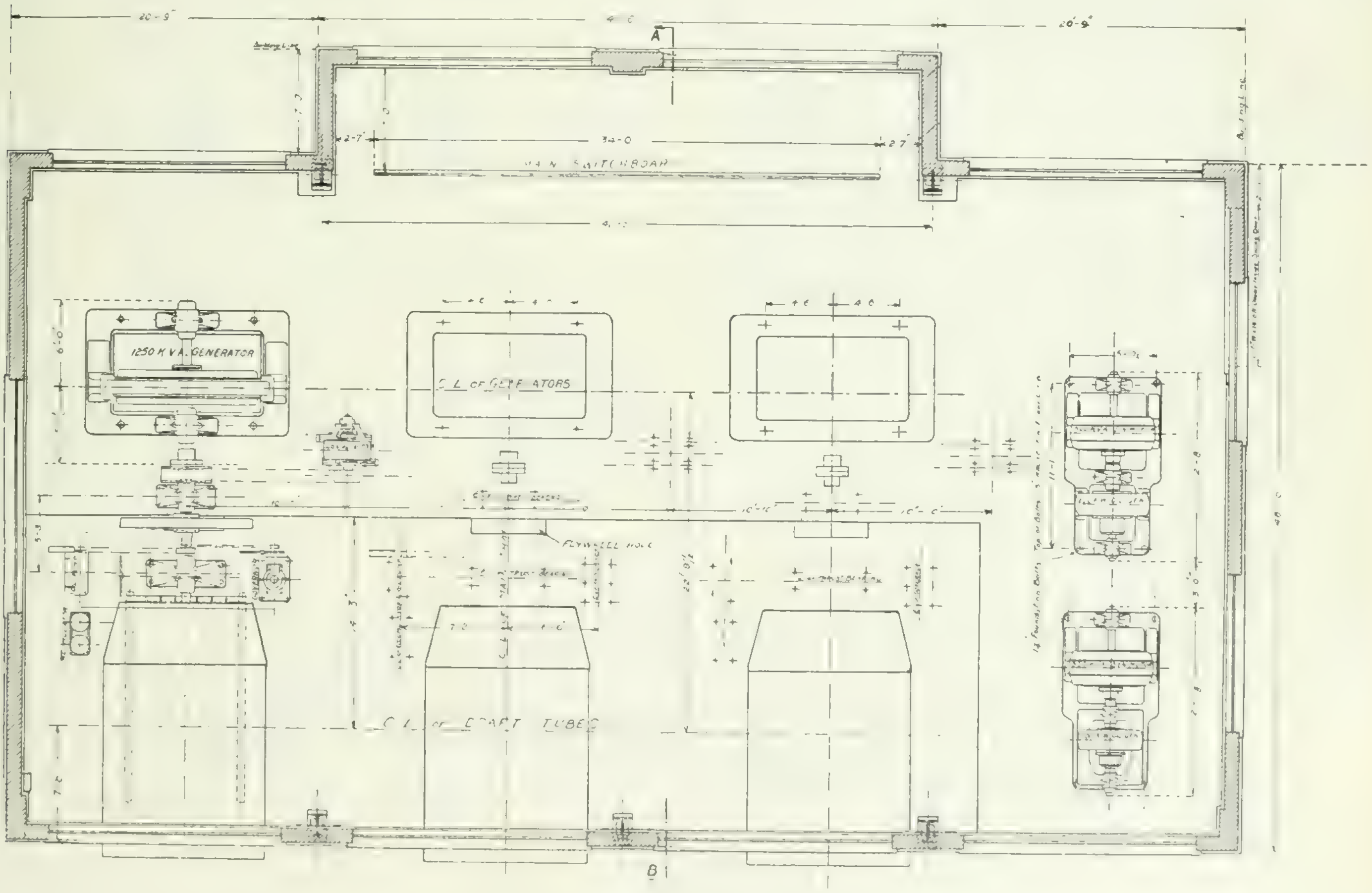


Fig. 1.

The Spanish River runs through the heart of the timber limits owned by this company, which comprise some 6,000 square miles. At Espanola the river runs between two promontories, creating a favorable location for the dam, which is built of concrete, flanked by natural rock formation on either side, and providing a 60-foot head of water. The storage thus provided serves not only to regulate the water supply, but also creates the necessary storage capacity for some 40,000 cords of wood, which it is necessary to prepare during the winter months for supply throughout the year.

Five large penstocks convey water from this dam to the turbines, which supply power for grinding the wood to pulp. A sixth penstock supplies water for three other smaller turbines direct-connected to generators, which supply current for operating the numerous motors used in the various parts of the plant. The five grinder turbines have 2,200 horse-power capacity each. The single penstock, which feeds the turbines driving the generators, is 14 feet in diameter, and on reaching the power-house divides into three sections, one supplying each unit. These three turbine units each consist of two 30-in. diameter Hercules water-wheels, 1,650 horse-power capacity, 360 r.p.m. when operating under the 60-foot head.

The penstock is 275 ft. long, the first 25 ft. being made from 5/16-in. plate, and the rest of 3/8-in. The intake is

12 ft. 2 in. wide and 14 ft. 0 in. high, with arched top. There is a 16-in. vent pipe to prevent collapsing of penstock when emptying, and an expansion joint is placed about half-way down to take care of expansion and contraction due to changes of temperature. Two 6 in x 6 in. angle iron rings are rivetted on the pipe at each end; between these angles a 3 in. x ½ in. anchor stay, ends of which are embodied with the angles in large concrete anchor piers. The upper part of the penstock is carried on cast-iron brackets, which are rivetted to the pipe, and set on concrete piers. The lower section is carried on structural steel, the saddles being carried on a trestle.

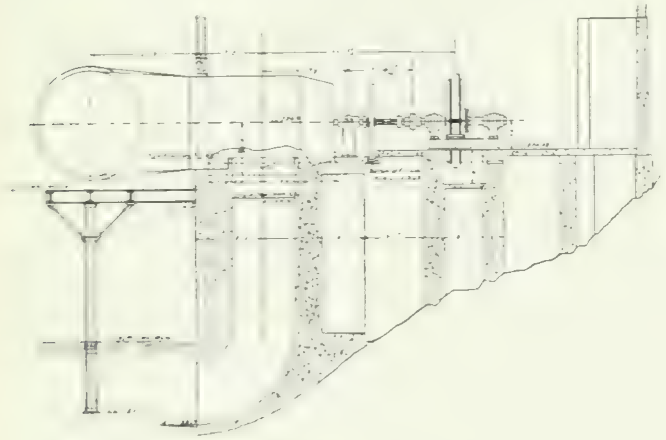


Fig. 2.

Fig. 2 gives a cross-section through the power-house, and shows the arrangement of generator, turbine, penstock and draft-tube. Fig. 1 is a plan of the power-house, showing the switchboard, the exciter layout, and the general arrangement of the turbines and generator.

The three generators are of 1,250 kv.a. capacity, revolving field, two-bearing, water-wheel type. Two exciters are installed of 40 kw. each, belt-driven. The electric generators and all electrical equipment were supplied by the Canadian Westinghouse Company. This equipment further includes about 2,500 horse-power in induction motors, about 700 horse-power in synchronous motors, a 17-panel switchboard, black marine finish, for the power-house, and a five-panel board for the substation.

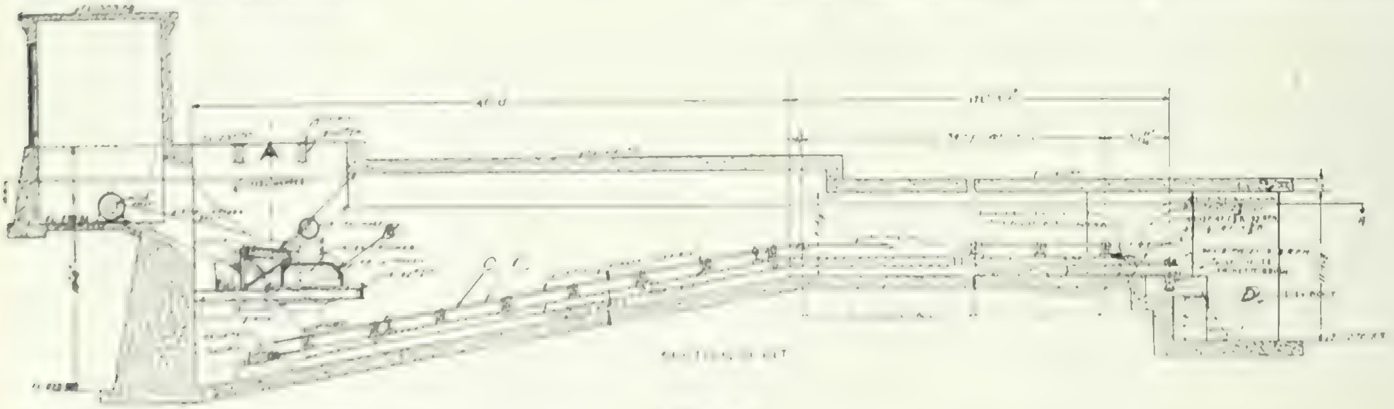


Fig. 3.

The steam plant equipment has also been carefully designed with a view to the most economical handling of the fuel and the labor. The arrangements for handling the fuel were governed largely by the necessity of storing sufficient fuel to meet the requirements of the mill during the winter months. A storage area of ground adjacent to the railway tracks has been taken, and a spur track laid in a manner that will permit piling the coal to a depth of [illegible] as the grade is level. As much area of ground can thus be covered as will ensure a sufficient supply over any desired period of time. For taking coal out of storage and placing it in the furnaces, mechanical handling has been adopted throughout. The coal is first dug from

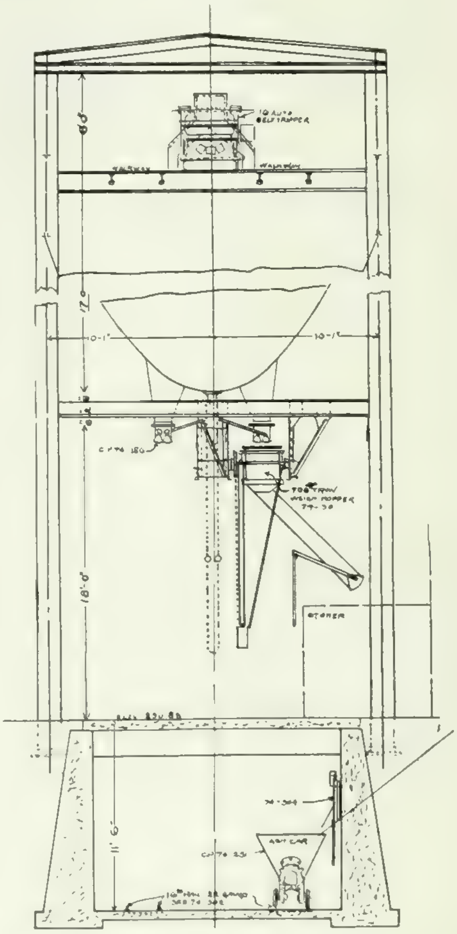


Fig. 4.

the storage pile by means of an orange peel bucket operated from a steam locomotive crane and loaded into a bottom-dumping car. The locomotive crane is then used to shunt this car to a track hopper, into which the car is discharged. Under the track hopper is arranged a crusher and feeding-gate, which feeds the coal to a belt conveyor. This conveyor carries the coal from the track hopper to a point at the end of the boiler house, where it is elevated by means of a bucket elevator to a belt conveyor, which distributes it in a steel coal bunker over the boilers. Here there is capacity for storing approximately one week's supply of coal for the boilers.

The coal bunker is placed at an elevation suitable for drawing coal by gravity to the Murphy stokers attached to the boilers. In its passage from the bunkers to furnaces the coal is weighed and daily records kept of the consumption.

For the handling of ashes a tunnel has been constructed under the boiler-house, into which ashes can be drawn by gravity from ash hoppers under each grate. Industrial cars are used to collect the ashes from each of these ash hoppers and transport them to the end of the tunnel, at which point they are dumped into a skip hoist. The skip hoist consists of a sheet steel bucket, which is raised on an inclined track, dumping its load into a large storage bin for ashes and returning to its position in the tunnel automatically. The storage bin for ashes is supported on a steel tower at a suitable height to permit drawing off into railway cars when a sufficient quantity has accumulated.

The coal is dumped from railway cars into a receiving hopper (Fig. 3) (a), and is fed into the crushers by an automatic feeder, where it is crushed to stoker size (b), and then flows on to a belt conveyer (c), and then conveyed with the same belt conveyer through a tunnel to an elevator (d). From there it is elevated to the top of the steel tower and led on to a belt conveyer, which leads over the coal storage bunkers in the boiler-room. It is distributed into this bunker by an automatic travelling tripper (Fig. 4), The coal is then drawn from the bunkers into one traveling weighing hopper, and is accurately weighed. From there the coal falls into the stokers.

The entire apparatus is automatic from beginning to end, and avoids the use of manual labor for the handling of the coal.

The ashes are dropped from the hoppers underneath the boilers into side-dump ash-cars. These cars are pushed by hand, and are very easily operated, having roller bearings, and are taken out through a skip, at which place the ashes are dumped into the skip hoist into a bunker. This bunker is carried in a steel tower, and from there drawn into the railway cars. In this instance also the entire apparatus is practically automatic, and only requires the attention of one man to touch the button in order to operate the apparatus.

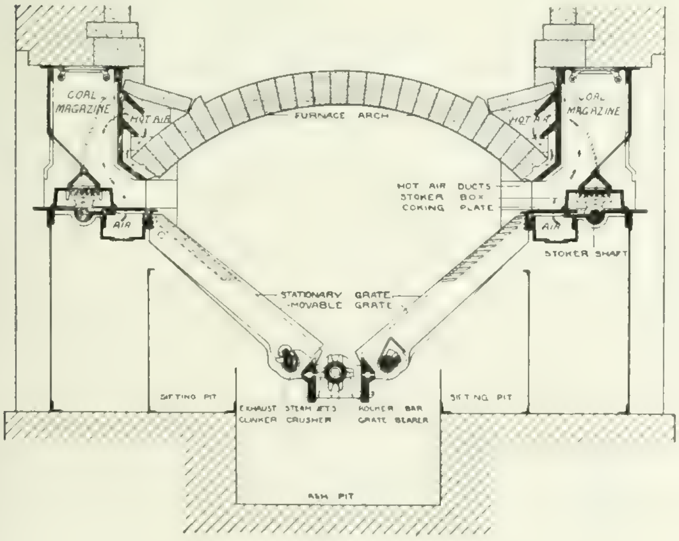


Fig. 5.

Two 600 horse-power steam engines of the Corliss type supply power for running the paper machines, and the exhaust steam from these engines is used for the drying of the paper.

Fig. 5 shows a transfer section through the Murphy stoker. Fig. 6 is a longitudinal section of the same.

Joseph H. Wallace & Company, Temple Court Building, New York, designed the plant. The water-wheels were manufactured by the Holyoke Machine Company, of Worcester, Mass.; the generators and switchboard by the Canadian Westinghouse Company, Hamilton, Ont.; the boilers by the Robb Engineering Company, of Amherst, N.S.; the steam engines by the Goldie-McCullough Company, of Galt, Ont.; the economiser by the B. F. Sturtevant Company, of Hyde Park, Mass.; the steam piping by M. W. Kellogg Company, of New York. The entire coal and ash-handling equipment was installed by the Exeter Machine Works, of Pittston, Pa., while the Murphy Iron Works, Detroit, Mich., furnished the Murphy automatic, smokeless furnace. The penstocks were built by the Jenks Machine Company, of St. Catharines, and the hydraulic governors are of the Lombard type.

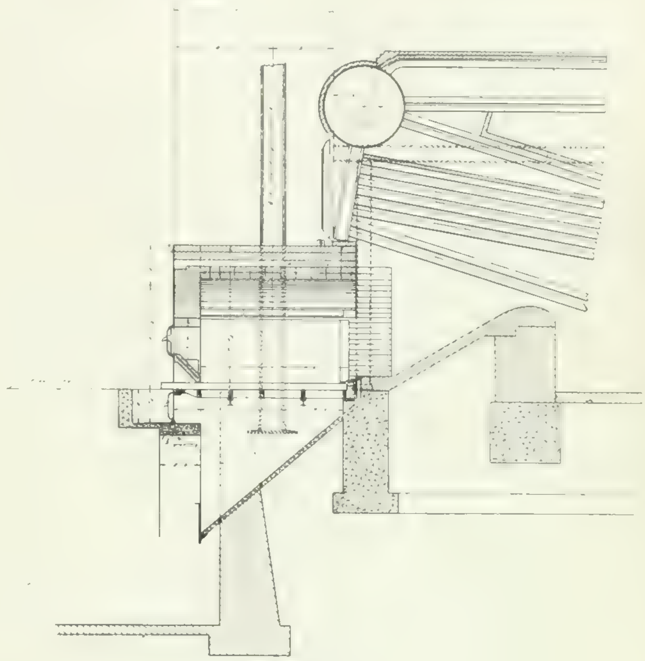


Fig. 6.

FIRE TESTS WITH GLASS.

From the conclusions of the recent fire test with glass of the British Fire Prevention Committee, the following excerpts are taken:

Too little account is often taken of the effect of an external fire on a fire-resisting building, and the protection of the vertical enclosure seems to be more often than not forgotten or neglected.

We have in fire-resisting glazing, if properly applied, a very valuable ally, and the report of the tests shows that such a material will afford a most useful amount of protection from the exposure risk.

It would seem that the maximum protection is afforded by fixing the glazing into metal frames or into masonry direct.

It seems regrettable that often the value of such a useful article as the type of glazing may be seriously discounted by inefficient fixing. It thus behoves the officers of the local authorities concerned to be on their guard in this respect.

A WATER SURVEY OF OTTAWA.

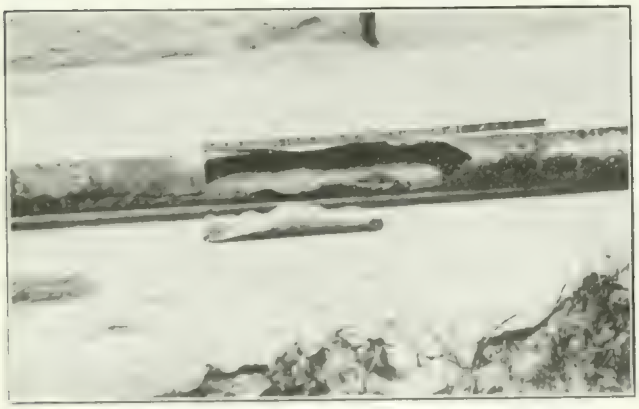
Some months ago we noted in *The Canadian Engineer* that the Pitometer Company, 220 Broadway, New York, were starting work on a pitometer survey of the water mains of Ottawa. Some results have been secured by the company, and through the courtesy of Mr. E. R. Howland, the resident engineer in charge of the work for the Pitometer Company, we present them herewith.

Work was started on May 22nd at the pumping station, and all the pumps were tested for slip. The following tabulation shows the results secured. The results show that, with few exceptions, the pumps were in remarkably good condition.

All the pumps are horizontal, crank and flywheel, and have outside packed plungers.

Results of Tests on Pumps.

Pumps, No.	Type.	Discharge per revolution in gallons per 24 hours. Theoretical.	As measured by pitometer.	Per cent. of slip.
	Triple	127.0	127.0	[illegible]
2	Triple	127.1	126.8	0.0
3	Triple	127.72	118.5	7.2
4	Triple	342.42	[illegible]	11.5
5	Duplex	10[illegible].25	97.6	5.[illegible]
6	Duplex	1[illegible].25	102.5	0.7
7	Duplex	[illegible]	105	1.0
8	Duplex	[illegible]	101.4	4.4



View of Three-Inch Broken Main to Foundry.

[illegible] survey of the distribution system was started in the first [illegible]

[illegible]

Three-inch service to disused foundry badly [illegible]

[illegible] main blanked on both sides of the water.... 350,000

A number of leaks have also been found on abandoned and fire services, bringing the total leakage, discovered to date, and repaired, up to about four million gallons per day. Many of the mains in Ottawa are laid in rock cut; the waste water, therefore, easily finds its way into the sewers without giving any surface indication. It is stated that some of the leakage discovered was undoubtedly caused by the exceptional depth reached by the frost last winter.

The illustration shows the break in the three-inch service to the foundry, mentioned in the above description of leaks.

◆

EFFICIENCY IN EDUCATION.*

By Dr. George A. Hoadley.

We are living at a time in which the question of securing the highest efficiency in every form of business enterprise has become a dominant one. No man would undertake a business unless he could assure himself at the very outset that every department of it could be conducted both economically and efficiently.

For a man to take such precautions is not only an evidence of good common sense, but the stand is one that must be taken as a matter of self-protection.

There have been times in the progress of almost any kind of business when it was possible to keep it alive, and even prosperous, in spite of the careless and wasteful methods employed; but at the present time, when our excellent systems of communication have brought all parts of our country together and when manufactured products can be quickly delivered to the places where they are needed, however remote any manufacturer is almost as keen a competitor of another a thousand miles away is though they both lived in the same city.

Space and time have been annihilated, from the business standpoint, and the man who does not meet the standards of economy and efficiency set up by his competitors will be crowded off the course by their inertia of motion or left stranded far in the rear by his own inertia of rest.

Since there is such a demand for high efficiency in the business world, it may be well for us to enquire whether there can be efficiency in education, and, if so, how it may be secured.

At the very beginning we are met with fundamental differences in the conditions. In the factory one has to do with inert matter; in the school, with individuals whose actions are governed by their own wills. In the factory we deal with a piece of automatic machinery which does the thing for which it was made, or, if it does not and refuses to work at all, it is largely our own fault in allowing it to get out of repair and become useless. In the school we deal with separate personalities, no two of which are alike, and no two of which are sure to do the same thing under exactly the same conditions; while, if the results obtained are not what we want, we are limited to the giving of advice, which is accepted or not, according to the mood or fancy of the one who receives it.

It would seem, then, by this comparison of the material with which we have to deal, that the problem becomes a much more difficult one when we bring it into the field of education.

When a man designs a piece of automatic machinery he must, in order to be at all successful, have very definitely in mind the purpose for which the machine is being designed: what it is that the machine is to do. To take any other course would stamp the attempt with failure from the start.

---

* Address delivered at the meeting of the Alumni Association of the Franklin Institute, March 23rd, 1912.

To secure efficiency in education, should there not be the same clear-cut, definite knowledge of the result to be obtained? There is in both cases a groundwork of that which is fundamental. In the case of the designer it is his knowledge of the physical qualities of the materials to be used. He must know what the limit of elasticity is of the material that he proposes to use in every part. He must know whether it will be able to stand the strains that will be put upon it in the work that it has to do. He must know whether there is a choice in this material, and he must make choice of the very best, or the next man who takes up the problem and who can profit by what he has done will so far surpass him in his design that the work will be a failure through the very competition that it invited, by not being the best machine that could be made. Not only must the designer have this fundamental information, but this fundamental strength, this fundamental elasticity, this fundamental adaptability must have been put into the material by the maker, or the machine will be a failure through his lack of this fundamental knowledge.

The same thing obtains in efficient education. There are, first of all, the fundamentals to be obtained and to be made such a part of the every-day life of a child that they seem to him things that have always been known.

At the very foundation of these fundamentals I would place the ability to think straight. Perhaps you think that I am beginning at the wrong end, and that the ability to think straight is the aim and end of education and cannot be had at its beginning. Well, there may be some reasons for your opinion, but I really believe that in order to secure efficiency in education it must be founded upon the ability to think straight, to have the moral sense of what is right and what is wrong; and, moreover, I believe that this ability is common to most men and women.

To the man who does not think straight, or who will not, an education brings at most the ability to succeed in things in which it would be better if he should fail. There is another phase of thinking straight, and that is to have one's thoughts clear and well defined. This, too, seems to me to be one of the fundamentals in education.

If we are to have any hope whatever of being of service to those about us, or of being influential among them, we must be able to present our opinions to them in a clear and forceful manner, and this we cannot do unless we are able to think them out clearly to ourselves. It is a pleasure to listen to a man who has a definite purpose in his mind, and also has the ability to express that purpose in fitting words, and so I would include, as another fundamentally important thing, an ability to use one's native tongue forcefully.

Too frequently, none of the things that I have mentioned are considered as a necessary part of an education at all. In addition to the ability to understand and use the English language, there is one other department of knowledge that lies at the very foundation of daily life, and that is mathematics. Now, do not think of the kind of mathematics that delights the mathematician, for what I mean is the fundamentals—that is, the elementary mathematics, such as arithmetic, algebra, and geometry. If we consider for a moment that the great discoveries of Nature were most of them made with just these branches of mathematics applied to the questions in hand, possibly adding trigonometry for the use of the astronomer, we shall see that the essentials are elementary.

No one can live in our times, surrounded as we are by the most striking applications of science, without feeling that a study of the natural sciences is required in order to consider that we may be entitled to the name of educated people. Here, again, the fundamentals are of the greatest importance. Take, for example, electricity, which has so general an application in lighting, heating, and furnishing us a means of transportation. As a matter of fact, the essentials are few. It is in the applications that there is so great a divergence. Let a man be thoroughly grounded in the elementary principles of magnetism and electricity: it is a simple matter of diligent application of these principles that solves the most intricate problems to be met.

When we calculate the efficiency of an electric generator, for example, we find that it is the ratio of the power output to the power output plus the **losses.** How are these losses made up? Why, there is the loss in the shunt field, and this we expect and are willing to allow, because if there were no shunt field there would be no lines of magnetic force for the armature wires to cut, and there would be no voltage generated for delivery at the brushes. Then there is the armature loss, and this we expect, for there must be wires to cut the lines of force, and they all have some resistance; hence there is a heat loss in the armature that increases as the current increases. Then there are the stray losses—those heart-breaking losses that the designer tries to cut down, and generally fails: losses that have no compensation; that have no redeeming feature; that are only detrimental to the machine, and that cut down its efficiency ten per cent. How are these losses made up? Why, there is the friction between the shaft and bearings, between the brushes and commutator, between the rotating armature and the air. There is the time-lag or hysteresis loss, and there is the eddy current loss, which is due to currents set up by the cutting of the magnetic lines by the armature core or the pole pieces, and which only serve to heat up the machine and increase its resistance. Now, how does this apply to education? What I would say is that if we wish to increase efficiency in education we must cut down the losses. Perhaps there are some of them that are really so connected with the system or method that they cannot be avoided. But there are certain others—the stray losses—that are wholly harmful, and these should be eliminated. The friction losses between teacher and taught should disappear. The system should be so changed that friction between both teacher and taught and the system should not be possible. And greatest of all, the eddy currents, those vampires that destroy uselessly, caused by inattention, lack of interest, lack of enthusiasm should be themselves destroyed.

To ensure efficiency in education there must be a greater saving in another great loss, and that is in the loss of time. This requires that one shall know without question what it is that he wants to inform himself on, and not flounder along helplessly for months or years with no definite goal in view. You who have the opportunity of taking the courses that the Franklin Institute offers have had the advantage of knowing definitely what it was you wanted to study. You have had the opportunity placed before you of applying yourself directly to the problem in hand, and if you have taken advantage of these opportunities you have the consciousness that the education so secured has brought with it something that has been of real and lasting value. I believe we should never look upon our education as a thing of the past. I greatly admire the point of view of the centenarian who had completed his hundredth year in this year 1912 who went to a shoemaker to have a pair of shoes repaired, and who was very insistent that they should be made strong enough to last a long time. The shoemaker said to him: "Why, you are a hundred years old, and still you seem to be as anxious that these shoes shall last as though you were to live another hundred years." "Well," said the old man, "perhaps I shall. I am a great deal stronger than I was when I started out in 1812." That is the kind of optimism that I like.

3000 KW. VERTICAL ROTARY CONVERTERS.

Two 3000 kilowatt, vertical, synchronous booster, commutating-pole, rotary converters have just been built and tested by the Westinghouse Electric and Manufacturing Company in its East Pittsburg works. These two machines, which are of unusual interest because they are the largest vertical rotary converters ever constructed and because they are the only vertical converters ever built involving the synchronous booster and commutating-pole features, are for the New York Edison Company for installation respectively in its Clinton and its Crosby Street sub-stations.

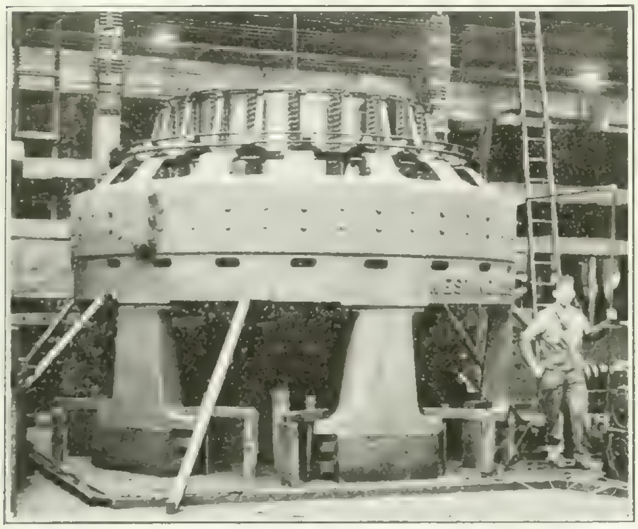


Fig. 1. 3000 kw., Vertical, Synchronous Booster, Commutating-Pole, Rotary Converter on Test.

The converters deliver a normal direct current voltage of 270, and are for 25 cycle, 6-phase operation. The direct current voltage variation obtained by virtue of the booster feature is 15% buck and 15% boost from the normal voltage, giving a total direct current voltage variation of 30%. These machines were made of the vertical type to conform in general construction to the other converters in the sub-stations, all of which are vertical machines.

Fig. 2, a sectional drawing, shows the detail construction of the machines. The converter armature and frame are mounted above the booster armature and frame. The commutator is at the top of the machine and the collector rings at the bottom. The armature consists of a rotary converter of the usual [illegible] mounted on the same shaft with the smaller booster armature, which is connected in series with the converter armature so that when the booster field excitation is varied, the alternating current voltage impressed on the converter armature will be decreased or increased accordingly.

The main or converter poles are shunt wound. The commutating poles which lie between the main poles have been [illegible]

to the armature coils, and through these spaces the cooling air is forced by the rotation of the machines. A commutating pole converter which is to be started from the alternating current end must be provided with a brush lifting device, but inasmuch as these machines are to be started from the direct current end, a brush lifting arrangement is not necessary.

Some of the mechanical constructional features are unique and different from any heretofore used for vertical electrical machines. The pedestal on which the armature rotates, and which is plainly shown in Fig. 2, is a one piece, hollow steel casting having a large area of base. With this construction a much more rigid structure results than with the usual one wherein a steel pedestal with flange on its lower end is bolted to a cast iron base. The pedestal is tapered so that the upper bearing is smaller in diameter than the lower one. This facilitates assembly. The bearings proper are babbitted and cast in a sleeve which can be readily taken out of the converter spider for re-babbitting.

A roller thrust bearing is arranged at the top of the pedestal to take the weight of the revolving element. The bearing rests on a plate which has a spherical seat carried on the pedestal so that perfect alignment is assured. The roller bearing can be taken out by removing the top plate of the machine. To assume the weight of the rotating part at times when it is necessary to remove the top plate, six 1¾ inch bolts are provided that turn through the lower portion of the pedestal flange. When it is necessary to take off the top plate, these bolts are screwed up until they raise the rotating element a trifle and assume its weight.

Lubrication is effected with a gravity oiling system. The oil is drawn from the reservoirs and forced up through the oil pipe in the centre of the pedestal. At the top of the pedestal, the oil discharges through a nozzle into a cylindrical chamber within the roller bearing. The pressure on the oil forces it from this chamber out between the bearing rollers into an annular pan surrounding the roller bearing. Oil cannot leave the chamber except through the bearing, and the height of the outlet nozzle and the oil pan rim are such that the bearing rollers always travel in a bath of oil. When the oil overflows from the pan around the roller bearing it passes into an annular chamber just above the upper pedestal bearing. From this chamber its only exit is through oil grooves in the pedestal. While it is passing through these grooves the rotating babbitt bearing surfaces take up oil. From the upper pedestal bearing the oil flows down through the chamber around the shaft to oil grooves for the lower bearing similar to those above described. From the lower

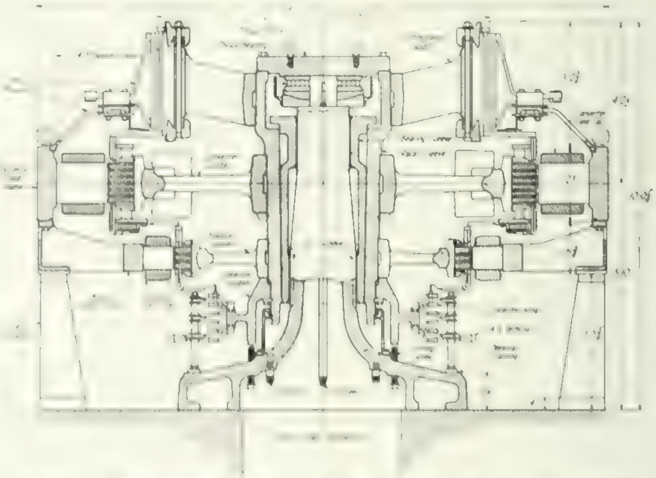


Fig. 2. Sectional View of 3000 kw. Vertical Converter.

oil grooves, the oil discharges into an annular reservoir to the lower part of the pedestal from which it drains into a storage reservoir to be circulated again through the lubricating system. An effective oil thrower arrangement is provided at the upper part of the oil space and around the lower part of the pedestal which effectively prevents oil creepage up the shaft.

◆

EFFECT OF INSTALLING METERS AT DECATUR.*

By Harry Ruthrauff.†

As to the effect of installing water meters at Decatur, Illinois.—First let me say I do not wish to claim the title of an expert; but simply wish to state the facts as I have found them during my twenty-two years experience in the water department at Decatur.

I believe it important for every community to obtain and conserve, without unnecessary waste, a water supply ample and suitable for all purposes. The question with me from the beginning of my experience was,—"How to Stop Unnecessary Waste?"

I was first employed as a laborer in this department; later as foreman and finally in the year 1894 was appointed water inspector. I therefore knew of the great waste of water upon entering the duties of my office.

The first five years I served as water inspector I worked faithfully in an effort to stop the waste, which was enormous, due to carelessness on the part of consumers and defective plumbing. I used every honorable means along this line, always looking after this work personally. In 1896 I employed four assistants with the avowed intention of stopping all leaks, and thereby preventing waste in the city. I again went over the city in 1898 with four assistants, looking after this waste, giving the matter personal attention.

I brought into our police courts citizens by the score and prosecuted them for wilful waste. After about five years labor along this line, I began to get discouraged. I found that a great many of our citizens believed we had an inexhaustible supply of water, therefore could not see any good reason why I should be so extremely anxious about this matter. Consequently, I began to look for some other plan. I believed, if this waste were allowed to continue, taking into consideration our rapid increase in population, we would in a short time find our supply short, or be at an unnecessary expense for additional machinery, mains and enlargement of our reservoir and filter plant to handle water merely to be wasted.

In 1901 I recommended to the council the adoption of the water meter on all services. The recommendation was filed, but no action taken. Again in 1902 I urgently recommended the same plan and was then ordered to have all the livery stables, hotels and laundries install meters. I was then able, by comparison, to prove the water meter would be beneficial both to the city and the consumer, and each year thereafter I strongly recommended the placing of all meters on all services, and finally in the spring of 1908, the council ordered all services metered by July 1st, 1908. The results are as follows:

April 31st, 1904, the end of our fiscal year, we had 2,112 services recorded; five consumers for each service gave us 10,560 consumers; 987 of these services were metered. I wish to say here that there was no record kept of the water pumped prior to the year 1903. However, with 10,560 consumers, 4,935 of them metered, there was pumped for this year 1,023,463,180 gallons, which gave us a per capita consumption of 266 galions.

Revenue for this year was		$32,812.99
The operating expenses at plant for this year were	$17,100.84	
The operating expenses, outside of plant, such as laying mains, repairs, etc., were	5,899.16	
The total expense		23,000.00
Leaving a balance of		$ 9,812.99

The plant was operated at this time with two shifts with coal costing $1.50 per ton.

For the fiscal year ending April 31st, 1911, we had 4,939 services in use, 4,933 being metered. I will say the 6 services unmetered are large consumers. This gives us, on a basis of 5 consumers to the service, 24,695 consumers. There was pumped during this year 1,124,212,338 gallons, which is 100,749,158 gallons in excess of that for the year ending April 31st, 1904. With an addition of 14,135 consumers, we now have a per capita consumption of less than 125 gallons. It is my belief that if the six consumers previously mentioned were metered, our per capita consumption would be less than 100 gallons. This may yet seem excessive to some, but we have some very large consumers for a city of our size, having 6 consumers using annually about 300,000 000 gallons.

The operating expenses at the plant for the year ending April 31st, 1911, were	$30,657.23
The operating expenses outside of plant, laying mains and miscellaneous were	26,960.01
Making the total expense	$57,617.24
The revenues for this period were	52,577.00
Leaving a deficiency of	$ 5,040.24

We now have three shifts at the pumping station, with coal costing us $2.15 per ton. The lowering of the water rates a few years ago and increased cost of operation are the causes of the deficiency, which has been overcome by a slight raise in water rates effective July last.

We have accomplished by the enforced use of meters at least a 30 per cent. reduction in the average householder's bill. Under the old flat rate system a 7 room modern house would cost him $17.00 per year and under our present system, his yearly bill should not exceed $12.00.

We have also cut the per capita consumption from 265 gallons to 125 gallons,—thereby saving, at the present time, an unnecessary pumpage of 1,270,928,175 gallons each year. Therefore, the benefit derived from a complete metering of any city is very clear to me.

◆

General passenger agent W. P. Hinton, of the Grand Trunk Pacific Railway, says that such good progress is being made with the construction work that the line will be completed from Winnipeg to Prince Rupert by the end of 1914. There is at present a gap of 300 miles between the western end of the line in Yellowhead Pass and the eastern end of the completed line from Prince Arthur. Mr. Hinton says the Grand Trunk Pacific will do its share in the movement of this season's grain crops. He estimates that the Western farmers should have $75,000,000 more to spend from this year's crop than they had from the yield last year.

---

*Paper delivered before Illinois Water Supply Association, March 5, 1912.

†Commissioner of Public Property, Decatur.

MAINTENANCE OF ROADS AND PAVEMENTS.*

By James Owen.†

The writer of this article would have preferred that the title of this paper should have been the economies of roads and pavements, as he sees that at this stage of road development the financial question is paramount. But as finally the maintenance problem is the one with which to deal, the discussion of that feature will of necessity include the money end, so it is hoped that undue stress upon what is sometimes too apt to be ignored in engineering in the means of construction as well as the methods will be pardoned.

In discussing the pavement problem in such an extensive country as this, with its varying climate, topography, materials to be used and habits of the people, it would seem impossible for any one individual to cover the whole ground, as, of necessity, each man's environment and experience are limited. Yet, the aggregate of such experience will be of value to all. So, if in these remarks statements at variance with the ideas and experience of other members of this convention are made it is hoped that prompt repudiations of the statements will be evolved, as by such means will accurate data be accumulated.

To properly consider the subject in its entirety it may be wise to indulge in a classification of the people, the pavements and the pay. The traveling people may be divided into urban, suburban and rural and it may be confidently stated that the requirements of the pavements differ in character practically in accordance with this division, except that there may be a certain overlapping due to special conditions. This covers two heads. The ability to pay varies spasmodically with climate, topography and the energy of the community.

Now enters into consideration the character of vehicles which there are to-day two, self-propelled and horse-driven. Both of these may be divided into fast and slow moving, the heavy wagon, the light buggy, the motor truck and the automobile, these introducing still other items, the iron tire of the wagon, the solid rubber of the buggy, the corrugated tire of the motor truck and the pneumatic tire of the automobile. All these factors vary in weight and speed and their effect on the surface of the pavement is of vital importance.

[illegible], is the effect of different pavements on the tires of vehicles. So far, the owners of such vehicles have been so busy trying to get something smooth to ride upon that they have been content to pay [illegible] ungrudgingly, yet in the future it will be an important economic factor.

[illegible] to-day is the most important in road construction, viz., the suppression of dust. Also, there enters in, to a lesser degree, the suppression of [illegible]

[illegible]

and with proper care in the selection and manufacture of material and a conscientious disposal of it in place, and in most cases a smooth dustless pavement will be secured. But here enters the question of maintenance and also the traveling factor. At the same time there arises a controversy between drivers of horse and motor vehicles on the question of smooth pavements, the horsemen claiming that the smooth pavements, like wood block or asphalt, are impassable and useless at certain periods for heavy hauling and should not be tolerated. That at seasons their slipperiness is detrimental is not doubted. However, this point is one for purely local consideration and cannot be generalized upon.

Cobbled and old-fashioned granite block are certainly permanent but not desirable. The close jointed grouted granite block and the Medina sandstone would seem to be ideal. They are smooth, and once down relieve the maintenance department from attention for a generation. Wood block as now laid is desirable, smooth, and, at times, slippery, but its permanency is unknown.

The brick pavements of to-day are desirable and appropriate, especially in districts where there are no stores. Here it is proper to make the statement that many paving brick manufacturers are setting an example to the community in concentrating their efforts on making and delivering the best possible brick, relying more on the character of the material than on their profits for future prosperity. The writer suggests this example to other industries. Brick pavements as now constructed also relieve the maintenance department, if proper care is used in discriminating on certain character of travel. Where there are extraordinarily heavy loads and dense vehicular travel, it is not wise to use brick.

We now come to the mastic propositions in which the maintenance department sooner or later takes an interest. The asphalt and tar preparations give a smooth, dustless and serviceable road, and are desirable for residential sections and in many cities are universal. Their maintenance is carried on in different municipalities in different ways, some owning their own repairing plant, others contracting the repairs, and still others neglecting them altogether. It is safe to say, however, that after five years' use of these pavements the item of repairs begins to be a factor, although the writer has one asphalt pavement which has been in use for nearly ten years without repairs or apparent necessity for them.

Interjected into many cities is the use of cheaper pavements for purely residential streets of both high and humble character. Sanitary precautions in some cases cause their existence before the demand is made by the residents who often are not able or willing to pay. In other instances they are laid at the desire of the property owners, and in these the maintenance problem soon appears, and the practice there can be considered the same as in suburban communities.

In street development in suburban communities or small towns there are new factors to be considered. Except in main thoroughfares the travel is light. The unwillingness to pay large assessments and also the suppressing of dust has opened the field to endless inventions with varying materials to provide cheap, smooth and dustless pavements. All kinds of pavements have been promoted and enormous sums of money have been expended in experiments, and it is to be hoped that in the near future a practice may be adopted available to all within their means. This same idea extends, to a degree, to rural highways, and it would seem desirable to discuss the problem as common to both classes of communities.

---

*[illegible] American Road Builders' [illegible]

†[illegible]

To properly appreciate conditions it would be well now to consider what these pavements, so-called, have to endure. With horse-drawn vehicles and steel tires, the roads were constructed to be available for such use and the standard generally adopted where material was convenient was the macadam or telford pavement, using the local rock if possible, but in many cases bringing it from 200 to 250 miles by water or rail. Where rock was not available, other natural materials were used, such as gravel, shale, chert, sand and clay, and in the arid sections, clay and oil. The success of these pavements when properly constructed and maintained gave an enormous impulse to automibile travel, in some cases causing it to supersede horse travel. The rapid increase of automobile travel, however, speedily began to impair the surface of the highways and pavements, and also created volumes of dust. This condition started new ideas and new investigations, of which we are now in the throes.

Careful comparison of the effect of iron tires and shoes and rubber tires on road surfaces shows a marked difference in their action. Under the old order of things, if a coating of broken stone or gravel were placed on a highway it was confidently expected that the surface would soon be consolidated. It was probably wearing out the patience of the traveler, but showing that a consolidatory effect was obtained. The writer has made experiments with automobiles, at low and high speeds, both on macadam and gravel surfaces and finds that their action is disturbing, the higher speed the greater the disturbance created. There are, therefore, two opposing factors in the maintenance of present highways and the resultant is determined by the preponderance of certain kinds of travel. Where the wagon travel is universal the old conditions exist and the old practice may prevail, and where the automobile is universal, an entirely different system of maintenance has to be followed. But where there are equal volumes of the two kinds of traffic the greatest difficulty exists. The question of the future must now be considered. Will automobile travel entirely supersede wagon travel or will the travel still be mixed? It is well accepted that there is a great growth of automobile use and a great diminution of horse-drawn vehicles and the decision of such a factor is purely local.

Another very important factor is the suppression of dust, and here the writer wishes to enunciate the fact that the automobiles themselves are not the creators of the dust, as is generally considered. The steel tire with its grinding action creates the dust and the automobile, with the wind, disturbs and scatters it. As a proof of this a coating of screenings laid in late spring on a road carrying only automobile travel will still be in the same condition in the fall, merely disturbed, but not consolidated. And there will be no dust.

Taking these facts as axiomatic, the maintenance of all pavement surfaces liable to wear must be considered as a purely local problem governed entirely by the local travel. The dust question has this peculiarity: It may be more troublesome on a less traveled highway. This question, while of somewhat recent origin—that is to say, while there was always plenty of dust, the public for some occult reason did not complain of it—is really the governing source of all new efforts at road making, and is just as much of an economic problem in rural communities as it is in urban. The impairment of the value of crops, especially fruit, is an accepted fact and the demands for suppression are insistent and imperative. In the effort at dust palliation a large amount of gray matter has been expended and a great many expedients have been devised. Setting aside the experience of the French engineers at Algeria where the first experiments in dust suppression were made with the oil of Massat, the California practice was really the first that did not use water. But we all understand that water was the first material used for dust suppression, whether by rain or the watering cart. In southern California there is little or no rain and the heavy mineral oil was used, first by surfacing the adobe soil with clay and then sprinkling the oil. This gave good results and an application twice a year proved satisfactory.

This idea spread and the practice of using crude oil for surfacing came into vogue. The smell in the houses and the ruination of carpets and clothes stopped its use and then oil, without the smell, was manufactured, and with some of the stickiness eliminated. These oils, generally with asphaltic bases, gave general satisfaction and are now in general use. The idea, however, was prevalent that a dustless, smooth, permanent surface could be devised that would be cheap and effective, and such surfaces have been provided, but the question of cost then becomes the vital point.

The original experiments made by Mr. Blanchard of Rhode Island in resurfacing roads with asphalt or tar mixtures and the reasonable low cost with good results after a limited period of use encourage the whole country, as well as the writer to be up-to-date and do likewise. It must be understood that those experiments were made by a competent engineer with selected help. When, as is often the case, communities do not employ a competent engineer nor have selected help, however, very different conditions prevail.

The writer started on the unknown path and resurfaced miles of road with heavy asphalt oils by the penetration method, and also drew specifications for new roads to be built by the same methods. The results, however, were so unsatisfactory that the practice both in old and new work was quickly abandoned. Subsequently contracts were made for work by the mixing method both by cold and hot application and results from them have been satisfactory. The final practice arrived at by the writer is to build his roads by the old water bound method and then apply a light surfacing oil at the proper season to allay the dust. This is found to give the smoothest pavement for the least money on an average country road in New Jersey where there is a large automobile travel.

The experiences in the penetration method were peculiar and there was also a curious case from the fact that the engineer was compelled to rely upon the chemist for his data, accepting such data even though based on meager procedure. The question of manipulation by the labor available became more of a factor than the chemical data. Men of experience in the old practice were at sea in the new methods, and in one case, even though an expert was called in and special men were employed, the result was unsatisfactory, from an engineering standpoint. It is true a certain percentage showed good results, but forty per cent. efficiency is not ideal.

In one instance a section of newly built road a mile in length was finished in the fall and presented a good, smooth surface. In the spring, however, the surface broke to pieces over the entire length and had to be renewed. In other cases the rolling of the surface mixture into waves practically put an embargo on travel and the surface had to be entirely removed. In another case a rut six inches deep and a half a mile long appeared with no apparent cause. With such experience the writer may be excused from indulging in any more surfacing escapades.

With the mixing process better results have been obtained. In one case, with a hot mixture, the surface, after being rolled and having cooled, was a series of waves

Curiously enough, after eighteen months of travel these waves disappeared and a smooth surface now exists with no appearance of wear.

The cold mixture gives excellent results, producing a surface that is smooth and equal to asphalt.

A few experiences in surface oiling may be interesting. In maintaining a system of 150 miles of road with city and suburban travel a complete system of repairs is obligatory and breaking the continuity of such a system leads to complications. As the demand in the writer's section for the suppression of dust was in the spring it was considered desirable to find an oil that would last the season. It did last the season in most local cities, but such an oil ruins the surface of a pavement, creating a pitting which is very objectionable. This heavy oil of course prevents the ground particles of the road from being blown away but when it rains an emulsion is formed which is of great local objection. Therefore it was found advisable to use a lighter oil with more frequent applications, and with such practice no impairment of the surface is presented. With the practice of repeated applications of dust preventives the use of materials not containing oil may be advisable, depending of course on the system in vogue and the cost of the material itself. Some of these the writer has tried but so far not with the success anticipated. In residential localities these preparations are of advantage as no oily particles of dust are carried into the houses or on the clothes of wayfarers.

There is one other point that the writer wishes to emphasize, and that is that with the growth of automobile travel the character of the mineral aggregate in any mixture is of secondary importance. Under the old conditions, hard trap rock was ideal and was used wherever available, even when long hauls were necessary. Such an insistence is not now necessary as it is found that with the grinding eliminated and the use of surface oils, good gravel gives as excellent results as the trap rock. Granite can be used with impunity, and such natural materials as chert and shale can also be used. The sand and clay roads of North Carolina can, with oiling, be made into perfect roads, as is shown in California. A full appreciation of such a fact will reduce the cost of thousands of miles of roads in the future.

The writer now wishes to allude to the financial problem in road construction, and it might be well to note the varying channels from which money comes. Taking my own State as an example, these are as follows:

City street paving.—A part, say about 80 per cent., on property, balance on the city at large. Maintenance a city charge.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

As to ability, that is a condition hard to gainsay. As to willingness, that can be overcome by education. To properly educate a community to higher ideals and standards, those ideals and standards must first be crystallized on a permanent basis and then set before them.

In too many cities of the United States there are rough and unsightly pavements tolerated by educated people and traveled over with repugnance, yet there they are. In country districts where good roads have been made they have been allowed practically to disappear through neglect. In other communities the desire for the ideal and also the willingness to pay are both present yet the supply of talent and material is deficient.

So, in this question of road surface maintenance the practice in cities is fairly conceded to be beyond controversy. Only the money is required.

In suburban and rural highways this problem confronts us: ·In days before the automobile, with wagon travel alone and with a system of roads in cities, towns and country, the average cost of macadam repairs was three cents per square yard per annum. This, by increased travel, increased cost, and automobile, has now raised the cost to six cents, and the oil at one cent brings it up to seven cents per square yard per annum for having and keeping a smooth oil surface.

Rejecting the penetration method as erratic and uncertain and applying the mixing process the cost runs from 80 cents to $1.10 per square yard. Consequently the mixture has to last ten or twelve years to be equal in actual cost to the oiled macadam. Another item enters in. The renewal by mixing, or 150 miles of road 16 ft. wide at, say, 90 cents, would cost $8,300 per mile or a total of about $1,245,000. As this would have to come out of the annual appropriation, whatever money was expended in the mixing should be made a separate item, otherwise the maintenance account of the balance of the roads would show a shortage and deterioration would ensue. This has been the experience of many communities and great dissatisfaction has been the outcome.

In conclusion the writer hopes that in the near future the mistakes and experiences of different men in different sections may bring the practice of road repairs into some definite shape, both as to construction and financing. The community, including the road wearers and taxpayers, want good roads at the lowest cost and are willing in most cases to furnish the money if good results can be obtained. It is the province of this association to supply the demand.

◆

MANUFACTURES IN CANADA.

The census of manufactures of Canada taken last year for the calendar year 1910 as now compiled by the Census and Statistics Office, gives the following comparative statistics, compared with those of the census of 1901 for the calendar year 1900, viz.:

—	1910	1900	Increase	Increase p.c.
Establishments	19,20[illegible]	14,650	4,55[illegible]	31.07
Capital	$1,245,018,881	$446,916,487	$798,102,394	178.58
Employees	511,844	339,173	172,671	50.91
Salaries and wages	$240,[illegible]	$113,249,350	$127,[illegible]	112.[illegible]
Materials	$[illegible]	$266,[illegible]	$[illegible]	125.1[illegible]
Products	$1,164,695,0[illegible]	$481,053,375	$683,641,657	142.11

The capital employed in manufactures increased during the decade by 178.58 per cent. and the value of products by 142.11 per cent. The number of establishments employing five hands and over last year was [illegible], being an increase of [illegible] in the decade.

EMERGENCY WELDING OF BROKEN PARTS OF DREDGES.*

By S. E. Lawrence.

The continuous operation of dredging plants, day and night, and the extreme usage that some of the machinery is subjected to are conducive to many break-downs, which are very expensive both in repair cost and more especially in delays and crew costs while parts are being repaired.

Such accidents are provided against as far as they can be ordinarily foreseen by keeping on hand such duplicate parts as may be expected to give way under usual conditions, and each plant in this district is equipped with a small machine and blacksmith shop to handle emergency repairs. Such precautions do not, however, provide for the larger breaks and the extraordinary accidents, and it is in this particular field that the Thermit welding process has been of service in several instances.

The first time this method was employed by this office was in the repair of the low-pressure connecting rod of the 550-h.p. triple-expansion engine directly connected to the dredging pump on the 20-in. U.S. pipe-line dredge "Col. A. M. Miller."

This fracture was an example of the sudden development of an invisible flaw made in the original forging of the part. This engine had been in constant operation for several years and no precaution had been thought necessary to keep an extra rod on hand.

As it would delay the dredge for an indefinite time to secure a new part from the factory, and also several days at least to machine one in a local shop, it was determined to try and reweld the broken fork. Only fair results were obtained, and it was not thought advisable to use the rod. Then it was that the Thermit process was resorted to. About 1 in. of metal was removed and the parts fastened to a bedplate in as perfect alignment as possible. The weld came out of the sand in good condition and, after removing gate and riser, the part was placed in the engine without further machining and was so used with best of results.

The second instance in which this method of repair was made use of was in the repair of one of the propeller shafts of the seagoing hopper dredge "Galveston." This was hardly a weld in the common acceptance of the term, as there was no uniting of several parts, but it served as an illustration of the varied uses that this method can be put to.

While at work at the mouth of Galveston Harbor a wire cable became entangled about one of the shafts in such a way as to wear a groove in it about 1¼ in. deep and 4 in. wide. This weakening of the 10-in. shaft necessitated its removal, a spare part being substituted. The local shops did not afford a lathe of sufficient size to handle the removed shaft, and other methods of repair other than the conventional ones had to be resorted to.

Two processes suggested themselves, the oxy-acetylene process of autogenous welding and the Goldschmidt Thermit process, and representatives of both methods were asked to submit proposals for the filling of the groove cut by the entangled cable.

Upon receipt of the proposals, the oxy-acetylene bid proved the lower and a contract was awarded for the filling in of the cut with new metal by their method.

To facilitate matters the shaft was raised on concrete piers, the top of the piers forming a socket in which to turn the shaft more easily. This turning was accomplished by means of a tackle and rail.

The apparatus was put in place and the shaft preheated with charcoal and covered with asbestos to retain the heat as much as possible. The work was done under extreme physical conditions, the great heat requiring frequent relays and changing of men, it being almost impossible for a man to stand close enough to the cut to operate the burner for very long at a time. When the circle was at last complete and inspected, the ring of the metal melted into the cut was found to be separated from the metal of the shaft in places, the bond was insufficient to strengthen the weakened place, and the material so placed was easily removed. The failure was due mainly to the large radiation and conducting of the heat from the particular part where a bond of metal was desired, and to the severe physical strain. Smaller parts have been successfully handled here.

The Thermit exponents were then given a chance to fill in the worn place. The groove was carefully filled with wax and an adjustable flask placed around the worn part and the mold. Air was supplied from a derrick car, the derrick also being utilized to suspend the crucible containing the charge. The preheating was accomplished by gasoline blow torches and the wax was carefully removed and the mold cleaned by compressed air.

The reaction was perfect, and the result was a complete welding of the new metal into the groove. Precautions had been taken to provide a large riser and gate to cover the shrinkage and to insure solid metal in the worn part, as the top metal may be in some cases more or less porous. When the mold was removed, very satisfactory results were found. The removal of the extremely tough surplus metal was the most difficult part of the work. The gate and riser were finally removed, and outside of a few marks the weld was unnoticeable. Some concern was felt about the chances of warping the shaft when such an intense heat was suddenly applied in a comparatively short length, but such fears were dispelled when no appreciable change in the alignment was evident.

No machine finishing was necessary in this case, as the portion of the shaft affected did not come upon any bearing surface. Herein consisted the efficiency of this particular method, as there was no machine of sufficient size to handle this length of shafting available in this immediate locality, which would have barred the ordinary schemes of repair.

The third incident of interest in this district was the repair of a crankshaft of the main engine of the U.S. Engineers pipe-line suction dredge "Captain C. W. Howell."

The crankshaft of this 12x22x14-in. compound engine, directly connected to a 12-in. dredging pump, was 5½ in. in diameter. A crack was discovered in the low-pressure crankpin, and a careful investigation showed that instead of the characteristic fracture the crack ran into the web and back again around the pin. This precluded all the ordinary schemes of replacing the broken pin by shrinking in a new one, as the web did not have sufficient remaining metal to make such a repair safe.

The dredge was operated until arrangements could be made for a Thermit weld, and on the repair day the plant was shut down and the shaft removed to a shop. It was found to be entirely broken off. Part of the pin was machined off, leaving about an inch of space between the web and pin when the parts were aligned and fastened to a bedplate.

The mold was repaired in the usual way, and the ends to be united heated to as high a temperature as was safe. There was no hitch in the pouring of the crucible and, after cooling over night, the mold was removed in sections to prevent uneven contraction.

---

* From "Professional Memoirs, Corps of Engineers, U.S .Army and Engineer Dept. at Large," July-Aug., 1912. Vol. 4. No. 16.

When the gates were removed and the complete shaft placed in a lathe the nice allowance for shrinkage, etc., was evidenced by the fact that scarcely any refinishing was necessary on the thrust collars of the shaft. The pin was turned up and the surplus metal removed and web reshaped to original dimensions without changing the balance of the shaft.

A total of four days was lost by the plant because of this repair, most of the delay being due to the distance of the dredge from the shop. This shaft continued in constant use without any evidence of the repair whatever, and was in use when this dredge was lost a year after on the Texas coast.

An idea of the saving effected in this instance may be obtained from the fact that a new shaft ordered rushed at once from the factory at a cost of $465 was not ready for shipment 90 days after receipt of order, as compared with a charge of $150 and a delay of four days for the Thermit weld.

The necessity of skilled handling and placing of parts to be welded cannot be too forcibly emphasized, as the chances for ruining a part are greater from mishandling than from failure of the weld, and much unnecessary finishing work is prevented by careful attention to the mold conforming exactly to the desired shape of the part to be repaired.

The hard-driven machinery of dredging plants, with their interdependent individual machines, offers an excellent field for economic employment of this method, and it will very likely play an important part in cutting down long delays brought about by extraordinary accidents.

◆

THE MELTING POINTS OF FIRE BRICKS.*

By C. W. Kanolt, Assistant Physicist.

We are accustomed to thinking of a melting point as a temperature at which a substance changes from a rigid to a fluid condition; but a melting point can be precisely and rationally defined only as the temperature at which a crystalline [illegible] phase and an [illegible] or isotropic phase of the same composition can exist in contact in equilibrium. While this definition is satisfactory for pure substances, so complex a mixture as an ordinary fire brick usually has no single definite melting point according to that definition, since several crystalline phases may be present, all differing in composition from the isotropic phase produced by fusion. We can only note where the temperature at which the transition from a rigid to a fluid state seems most distinct, and take that as the melting point [illegible]. In the case of fire bricks the [illegible] commences at several [illegible], for [illegible] sufficiently [illegible]. I have taken as the melting point the lowest temperature at which a small piece of the brick could be distinctly seen to flow.

The determinations were conducted in an Arsem graphite resistance vacuum furnace. The samples were usually [illegible] in a [illegible] tube made of [illegible] and [illegible] in the [illegible] to protect them from the small amount of [illegible] gas of the furnace, [illegible]. The samples were observed through a glass window in the top of the furnace.

The temperatures were determined by means of a Morse optical pyrometer of the Holburn-Kurlbaum type, which was sighted vertically downward through the glass window. The carbon-filament pyrometer lamp was calibrated by two methods. In the first calibration it was sighted into a platinum resistance furnace in which black-body conditions were obtained, and the temperature of which was measured by platinum platinum-rhodium thermocouples. These thermocouples had been calibrated against the freezing points of pure metals. In the second calibration the lamp was calibrated against the freezing points of metals directly, without the intermediation of thermocouples. The metals used were copper, silver, and the copper-silver eutectic, which freeze at 1083 deg., 961 deg., and 779 deg., respectively. The metals were melted in the vacuum furnace in graphite crucibles, the pyrometer being sighted into a thin-walled graphite tube inserted in the metal. The pyrometer readings corresponding to the freezing points were determined by means of cooling curves. With silver and copper, heating curves were also obtained.

As the melting points to be measured were above the working limit of the pyrometer lamp, an absorption glass was interposed between the pyrometer and the furnace.

The true temperatures were then found from the apparent temperatures measured through the glass, by means of the equation

$$\frac{1}{T_2} - \frac{1}{T_1} = A,$$

where T_1 is the absolute temperature of the furnace, T_2 is the apparent temperature observed through the glass, and A is a constant. The value of A was determined by calibrations at various temperatures. A small correction was also applied for the absorption and reflection of the glass window of the furnace.

The samples, which were from one to two centimetres in diameter, were heated at the rate of about ten degrees per minute when near the melting point. It was found that in the case of certain bricks made of heterogeneous material of relatively low melting points were slightly higher after six hours' heating to 1550 deg., apparently as the result of the gradual running together of dissimilar particles to form a mixture having a higher melting point than the most fusible of the original materials.

The results are summarized in the following table:

Material	Number of Samples.	Melting point, Centigrade.
Fire clay brick	41	1555° to 1725° mean 1640°
Bauxite brick	8	1565° to 1785°
Silica brick	3	1700° to 1705°
Chromite brick	1	2050°
Magnesia brick	1	2165°
Kaolin	2	1735° to 1740°
Bauxite	1	1820°
Bauxite clay	1	1595°
Chromite	1	2180°
Pure alumina		2010°
Pure silica		1750°

The value 1750° given for silica is not the true melting point, but represents approximately the temperature at which the silica flows distinctly. It was found that silicon carbide does not melt below [illegible]; it becomes unstable at much lower temperatures.

---

*Abstract of Technologic Paper of the Bureau of Standards, published in the Journal of the Franklin Institute.

THE PRESERVATION OF REINFORCED CONCRETE IN SEA WATER.*

By Lieut. Edward Burr, Engineer Corps, U.S.A.

There still remains much doubt in the minds of engineers as to the reliability and permanence of reinforced concrete immersed in sea water or exposed to its effects. This doubt arises primarily from uncertainty regarding the effect of sea water upon the Portland cement or other binder employed in the mortar of the concrete, since, if the concrete is properly proportioned and put into place, and if it continues sound and intact, little remains to be done for the preservation of the steel. The problem, therefore, in its essential features, resolves itself into the employment of a cement or mortar unaffected by sea water, and its utilization in such a manner as will prevent access of sea water to the interior of the concrete and to the steel, with such additional precautions as experience may show to be efficacious. This short statement of the case is simple in terms, but its solution rests upon the determination of the most suitable cement and mortar to produce permanent results when used in concrete placed in sea water, which question has for years been before engineers for solutions and now has increased importance through the advent of reinforced concrete. In one respect, however, the problem is less difficult than would otherwise be the case, since it is only in rare instances that reinforced concrete cannot be seasoned before being exposed to sea water, and methods for its preservation can be employed under these circumstances that are not available for subaqueous work, with its attendant difficulties and possible defects.

The above concise analysis represents your general reporter's view of the problem involved in the determination of the best means for insuring the preservation of reinforced concrete in sea water. If it is correct in its general terms, the relatively long experience already had with plain concrete in sea water is available as a basis for drawing conclusions as to the reliability of reinforced concrete in maritime works, and we are not dependent alone on our short experience with reinforced concrete for the formulation of opinions and conclusions thereon.

The hydraulic mortars of lime and pozzuolana used by the Romans have through the centuries proved their worth for the conditions under which they were used in the Mediterranean. Portland cement is, through its universal availability, the material upon which modern engineers generally rely for hydraulic construction. While comparatively a modern product and subject to much suspicion in its earlier applications, it has been developed and perfected until it is now accepted by the profession as reliable for all purposes when selected and used with good judgment, and to this fact must be credited many of the most noted accomplishments in maritime works. In its application to such works, some failures have resulted, particularly in the earlier structures, but the failures chargeable to the material, in contradistinction to those due to other causes, have become notably less. Many successes with it have been had for decades, and of this fact no other evidence is needed than that supplied by its continued wide application to maritime works. The question, therefore, is not whether Portland cement mortar and concrete are reliable in such works, but is merely the determination of the conditions necessary to its most successful utilization. The conditions necessary to success appear to have been attained most generally when the concrete has, for various reasons, been seasoned in air to a greater or less extent before being placed in the work, and this is almost invariably the practice in reinforced concrete structures. Such success as has been secured with good examples of plain concrete, seasoned before placing in sea water, may therefore be expected with reinforced concrete, provided the precautions leading to that success are followed, together with such others as are peculiarly necessary to reinforced concrete construction, by reason of its design. The deteriorating effect of sea water on mortar and concrete is due to two general causes, physical and chemical. Physical effects result especially from the action of frost in the severe climates of northern latitudes and are largely localized to the areas between low and high-tide planes, where alternate freezing and thawing occur with each tidal oscillation. Effects of this class are to be found on the northern Atlantic coast of the United States, and require for their avoidance the application of methods that are not practicable in the general case, when the concrete is placed in the green or plastic state.

Chemical effects resulting from the action of sea salts on Portland cement are well known in their general aspects, and the general reporter will not enter in detail on this part of the subject, deeming it to be outside the scope of this report. It may be stated, however, that while engineers and chemists are, as a rule, agreed as to the general principles involved, there still exists some differences of opinion in regard to the desirability of having in the cement or mortar an excess of free lime, alumina or iron oxide.

It may be well at this point to refer to the opinions held by some engineers that mortars are inevitably destroyed in time by immersion in sea water. Such views were advanced at the St. Petersburg Congress in 1908 by some reporters and general reporters upon the questions of the application of reinforced concrete to hydraulic and maritime works, but were not sustained by the congress, which found sufficient grounds for believing that first results were encouraging if certain precautions were observed. Your general reporter concurs in that action and is of the opinion that further experience confirms it. He bases his opinion more broadly, however, upon the longer experience with plain concrete in sea water, and numerous specific instances may be cited where concrete has continued sound and unaffected after immersion from twenty to forty years or longer, in latitudes extending from the tropics to the severe climate of the north Atlantic. With these facts before us we can only confirm the opinions expressed sixty years ago that laboratory experiments are not conclusive in this matter, and only by immersion in the sea in the locality where it is to be used can the reliability of a cement for maritime works be absolutely determined. Long experience has shown that with sound cement and properly proportioned mortar and concrete, excellent results may be had if the materials are mixed and placed in position with all the care and precautions demanded by good workmanship in maritime works. Concrete, when used intelligently, has proved itself to be the best of mandmaidens to the modern engineer, but in the hands of engineers or workmen unskilled in its application, manufacture and placing, it has, by its failure, often exhibited their inefficiency. The failure of concrete in some maritime works cannot be held to prove it to be unsuited for such works, but, in view of its many successful applications, merely shows that some of the conditions necessary to success have not been met. It is believed, therefore, as a result of past experience, that good Portland cement concrete may be accepted as a reliable material for maritime works under suitable conditions, and may be expected to be reasonably permanent.

Both the physical and chemical effects of sea water on mortar and concrete result from their porosity, and if per-

---

[*] Abstract of report to International Congress on Navigation.

colation can be prevented, these effects can be avoided or retarded through the denial of access by sea water to the constituents subject to its action, if such there be in the concrete. A dense compact mortar is therefore essential to success, and is obtainable throughout the entire mass of reinforced concrete. While engineers are agreed upon this point, there are differences of opinion as to details in regard to materials, proportions of mixtures and other factors.

A sound, finely-ground cement, with limited percentages of sulphates and magnesia, is the first requisite. A minimum of free lime is generally agreed to, but opinions differ on this point and in regard to iron oxide and alumina. A rich mixture is necessary. It should not be leaner than 1:2:4, and some engineers recommend 1:2:3 or 1:1:1⅔. Opinions differ between fine and coarse sand, but, to the writer, this matter resolves itself merely into the question of a sand so graded as to have the minimum of voids, bearing in mind that a very fine sand makes, as a rule, a weak mortar. The gravel of broken stone should be small and well graded to secure a minimum of voids. The addition of pozzuolana or trass is strongly advocated by some, who hold that it combines chemically with the free lime of the cement, but this is denied by others, who maintain it to be an inert material, and opinions differ as to whether it strengthens the mortar. Others advocate the addition of anhydrous colloidal clay, or similar materials, finely ground and intimately mixed with the cement at the factory. Numerous proprietary compounds for improving the impermeability of mortar and concrete are in the market and are recommended by some maritime works, but they should be used with great caution until their stability in sea water is established.

The consensus of opinion is favorable to the use of salt water in gauging, but, since there remains some doubt on the subject, it is believed that fresh water is safer and should be used if reasonably available. The general tendency in modern practice is toward the use of a wet mixture for concrete either in mass or reinforced. The writer's practice goes back to the period when dry mixtures, in accordance with the theory of the times, were almost universally recommended, but experience has demonstrated to his satisfaction that the practical conditions of actual work can only be met by wet mixtures if the best results are to be secured with a minimum of defects. He also has a preference for small gravel or pebbles in lieu of broken stone, since sufficient adhesion for all practical purposes is found between the gravel and mortar, and since the gravel, through the shape [illegible] itself well to consolidation in the mold, particularly in small work.

Under the conditions just given, a dense, compact concrete is obtainable, if it is manipulated and placed with care. [illegible] steel bars, through care in selection and manipulation. It [illegible] ability, and concrete structures built and finished as de- [illegible]

[illegible]

mortar is one of the best of preservative coatings for steel or iron, even when exposed to continual of intermittent immersion in water, and instances can be cited in support of this opinion. Some fifteen years ago a composite water main made of thin sheet iron, coated inside and outside with cement mortar, was removed from the streets of the city of Washington, where it had been buried and in service for nearly forty years. The mortar coating was about three-quarters of an inch thick and the sheet iron was absolutely in as good condition as when the pipe was made. It is recognized that such examples hold only so far as concerns exposure to fresh water, but they confirm the opinion as to the protective value of sound mortar, and numerous cases may, no doubt, be found of similar protection when the exposure was to salt water. A case is cited (1) where reinforcing chains in a concrete-in-situ sea wall at Bridlington showed no signs of corrosion after being twenty-five years in place, although at points they were but one inch from the face of the wall, of which the lower half was covered by the sea at each tide. Further arguments and citations of facts appear unnecessary, since if protection can be and has been shown to have been secured in specific instances, it merely remains for engineers to reproduce in their own works the conditions necessary to secure like protection.

In this connection it may be added that short-time experiments in the United States of concrete exposed to sea water indicate the desirability of coating the steel bars with neat cement, well brushed on, before imbedding them in the concrete, and Mr. Luiggi, in his report upon this communication, recommends such a coating to be applied immediately, before the concrete is placed. The general reporter has prescribed this practice in all reinforced concrete work under his charge in recent years. To secure the best adhesion between the steel and the mortar for the development of the full strength of the work and for the protection of the steel from corrosion, the bars should be thoroughly cleansed of all oil, grease, rust and mill scale before the cement coating is applied.

While doubt remains in the minds of some engineers as to reliability of cement mortar immersed in sea water, and while other engineers maintain that it will be destroyed in a relatively short time, there is no difference of opinion in regard to the desirability of permitting concrete to harden or season in air or in sand for as long a time as the circumstances of the work will permit, before exposing it to the sea. Like views are held in regard to protecting concrete in place from the action of sea water, when the necessities of the case expose it to such action before it has fully hardened. Concrete that has thoroughly hardened in air before exposure to the action of sea water has fully established its greater reliability than concrete placed in sea water in a plastic state, and the subject requires no further comment here.

Earlier in this report a passing reference has been made to the excellent results obtained with concrete in the hands of skilled engineers and workmen. Every engineer is familiar with failures, more or less complete, of concrete when misused in incompetent hands. Even in skilled hands, care and watchfulness from the selection of the cement to the final completion of the work, are necessary to the best results. This is true of works in the open, and is all the more true for maritime works, where added adverse conditions prevail, and where the sea will inexorably prove the quality of the work in time. Therefore, a requisite to success is the unremitting exercise of every precaution needed to secure good workmanship at all stages of the work.

---

(1) Page 17, Reinforced Concrete Construction, by Adams and Matthews, Longmans, Green & Co., 1911.

Mr. Voisin reports that the works described by him have generally behaved well, and the oldest of them (piles and sheet piling on the sands of Olonne) were nearly thirteen years old in 1911. He recommends a rich mixture for submerged work, a brush finish of cement on the outside mortar surface and one or two coatings of coal tar, and a minimum protective coating of from 0.025 to 0.03 metres (1.0 to 1.2 inches) over the steel bars. He refers to the promising use of ceresite in mortars, and sums up by expressing his opinion that the conclusions reached by the 1908 congress have been confirmed and can now be more precisely stated.

Mr. Luiggi advocates the use of certain proportions of pozzuolana or trass to counteract the effect of any free lime in the cement, and refers to the lime-pozzuolana mortars that have continued sound in the maritime works of the Romans. In addition he sets forth four conditions necessary to success that may be summarized as follows: (1) A sound, finely-ground cement containing the minimum of sulphuric anhydride, magnesia and, especially, of free lime; (2) a rich mixture with a liberal excess of cement and mortar above that necessary to fill voids; (3) great care in the manipulation and placing of the concrete and the coating of the reinforcing bars with cement; (4) plenty of time for the concrete to harden in air. If his instructions are followed, Mr. Luiggi is of the opinion that "there will be obtained a practically impermeable concrete, and one, so to speak, unchangeable in sea water, in the interior of which the completely protected iron will last under good conditions for centuries.

"The reinforced concrete used with the precautions stated above will give excellent results when used for works in salt water, and may be adopted, therefore, with full confidence."

Mr. van Kuffeler is of the opinion that the covering over the steel bars should be not less than 0.02 metres (0.8 inch). He cites instances of the better performance of air-hardened concrete in comparison with concrete placed in sea water in a plastic state, and recommends a richer mixture under the latter conditions. Little objection is seen to the use of sea water in gauging, but a watertight concrete is considered a necessity. He advocates the use of trass or pozzuolana with the cement to increase the density and strength of the concrete, and refers to the tests of German special committee. Mr. van Kuffeler's conclusions, briefly stated, are: (1) Use only slow-setting Portland cements of the best quality; (2) mix thoroughly and place carefully the concrete in watertight forms; (3) the addition of trass or pozzuolana is desirable; (4) use a watertight concrete having 1 of cement and 1½ of trass to 3 of sand, or 1 of cement to 1½ of sand; (5) harden in the air if possible, and otherwise use a richer mixture.

Your general reporter is of the opinion that in good, sound concrete, plain or reinforced, the engineer has a most valuable device adaptable to meet any conditions in maritime works; that if designed with good judgment and applied with discretion, it will permit of the execution of works that might otherwise be financially or physically impracticable, and will ordinarily permit of economy in permanent works; that it is reasonably permanent in sea water if applied with all the precautions that experience to the present time has suggested, and that further experience may provide additional means for increasing its reliability; but that no precaution should be omitted in its application. He would not, however, be considered as advocating the use of concrete under any and all conditions, and recognizes that in some situations other materials, alone or combined with concrete, give better or more economical or more permanent results.

It is evident from the reports before the congress, and more especially from the current literature upon this subject, that experience with reinforced concrete in sea water has not to the present time covered a period sufficiently long to permit of laying down conclusions in detail as to the best methods to be followed for its preservation. With longer experience, such conclusions might be so formulated as to meet the approval of the Congress and some of them might be put forward at this time. It would seem, however, to be wise merely to refer to the experience heretofore gained in the matter of such details, as contained in the reports before the congress or as found elsewhere, and to defer action by the congress on such matters until conclusions thereon may be supported by such further experience as will enable the congress to adopt them with greater assurance as to their efficiency.

Only the following general conclusions are therefore submitted for the action of the congress:

1. Further experience tends to confirm the conclusion of the congress of 1908 that the earlier results of the application of reinforced concrete to hydraulic and maritime works are encouraging, and to indicate that reinforced concrete may be expected to be reasonably permanent in sea water if the precautions necessary to secure that end are intelligently and unremittingly exercised in accordance with the best experience in such works.

2. In view of the comparative novelty of this type of construction, its increasingly wide application, and the rapidly growing experience in its use, this subject should again be made a question for consideration at the next congress.

THE LIFE OF COTTON ROPES.

In a paper by Mr. Edwin Kenyon, delivered recently before the Canadian Society of Civil Engineers, on "The Transmission of Power by Ropes," it was stated that as to the life of cotton driving ropes, much of course depends upon their size and the conditions under which they have to work. All things being equal durability may be gauged by sectional area, and the most economical diameters range from 1½ inches to 1¾ inches more of the latter being used than any other size for textile work.

A remarkable case of longevity may here be quoted where twenty-four cotton ropes 1¾ inches in diameter are employed to transmit 820 horsepower at a velocity of 4,396 feet, direct from the engine fly wheel 28 feet in diameter to the various rooms of a Lancashire cotton mill. These were fixed in September, 1878, and all the ropes driving the card room have been running from then till now, a period of over thirty-three years. Another set has been working an average of twenty hours per day and appear to be little the worse for their twenty-three years' service.

The lives of other cotton driving ropes similarly circumstanced have extended over periods little short of this, while others again fixed from eleven to fifteen years ago though working without cessation, week-ends excepted, are still doing good service. A good example is to be found at a large paper works near Glasgow where cotton ropes have been working night and day for nearly fifteen years. Such cases of longevity lead to the conclusion that fatigue of material is due to constant activity does not readily manifest itself in well made cotton driving ropes.

Their quick recovery from driving strain is suggested as the cause, seeing that they pull down on the working side but bulge out to their normal diameter immediately they pass to the trailing or slack side of the pulleys.

ROADS ADAPTED TO LOCAL CONDITIONS.

At the last convention of the American Road Builders' Association, held at Rochester, Mr. Nelson P. Lewis gave a paper on "The Adaptability of Roads and Pavements to Local Conditions." Mr. W. A. McLean, the Ontario Provincial Engineer of Highways, in discussing the paper, said that a study of road conditions in various countries of the world will show a remarkable similarity in their several stages of road improvement, and in the problems which have confronted each. Throughout all, certain general principles are apparent, although local circumstances may require or permit a considerable variation in detail. These variations are, in general, more superficial than otherwise, and the underlying principles are in most cases of universal application. Thus on this continent we say, "Too many cooks spoil the broth," but in China they say, "Too many cooks spoil the dog." The general truth that too many cooks are an evil is taught in either case, and "broth" or "dog" are merely the local details. General truths are the same the world over, and it is important that, on the one side, we do not deny the usefulness of the general principle because of varying local applications; and on the other hand, that we do not render a failure the general truth by neglecting to adapt details to local conditions.

Let me emphasize a matter alluded to by the previous speaker—the selection of paving material for particular streets and roads, according to the preferences or prejudices of some of the abutting owners, "judiciously accelerated" by the enterprise of a salesman representing some particular kind of pavement. Most emphatically, "Too many engineers will spoil the pavement." It is a basic truth in all good business management, that responsibility should be centralized in order that full credit or blame may be placed where due. How can this be possible when paving materials are selected by the people or by councillors in opposition to or without the recommendation of their engineer? This is an evil in Canada as well as in the United States, and one which, solely in the public interest, should be strenuously combated. It is right that the preferences of the people should be made known; it is right that the taxpayers should express their views, and that these preferences and views should be given impartial and wise consideration by the engineer. [illegible] as an expert [illegible] as regards paving, the selection of the most suitable material for a given street or locality, should be one of his most important functions. Responsibility should be fixed upon him in this regard, and if he is inefficient and his selections are plainly unwise, another engineer should be sought. But the public, in its own interest, should be the last to relieve the engineer of [illegible] of the most suitable paving material for each street under his jurisdiction.

[illegible] lish practice, that, in letting contracts, purchasing material, [illegible] be made only in open council or in open committee, and any [illegible]

[illegible]

Climatic differences of temperature, moisture and wind in all combinations, materially influence the amount and method of drainage to be adopted. For example, if the subsoil and situation of a road are such that the natural soil is saturated and filled by the autumn rains and the melting of snow during the winter, and if this is acted upon and expanded by frost during the winter to a depth of three or four feet, as in Canada and the northern States, it is manifest that a very weak condition of the subsoil must exist when the spring thaws and freshets come. The foundation of the road may in this way become a quagmire for two or three weeks in the spring, during which time traffic will break through or partially disrupt any stone surface that could reasonably be applied. Under such climatic conditions, the need for careful underdrainage of the subsoil is manifestly much greater than in such a climate as that of England, where the frost penetrates only three or four inches into the ground. A mild climate having long periods of heavy rain may develop very similar conditions, though without the added difficulty of expansion by frost, or an impervious stratum of ice below the surface.

In the use of bituminous binders we have much to learn from other countries, particularly England, France and Germany, but any deductions should be made with full consideration of climatic and other differences. Thus in England tar is widely used for road purposes by spraying, by penetration, by the matrix, and by the mixing processes. But the extremes of temperature and the dry atmosphere of this continent present influences which do not exist in the more uniform and moist climate of Great Britain. Experience with tar in Canada has shown that it will resist successfully the climatic conditions, but the numerous failures have as clearly shown the necessity for a more scientific use with a view to climatic differences, demanding a careful study of methods of manufacture, of distillation, of proportioning the tar, pitch and creosote oil, and of selecting and grading the mineral aggregate. More frequent surface painting and gritting may also be one of the means for overcoming the influence of hotter and dryer climatic conditions.

First cost is often, necessarily, a determining factor, but as pointed out by Mr. Lewis, the ultimate cost at the end of the life of the pavement should, if possible, for true economy, be the most considered. The cost of pavements varies greatly according to locality, and an economical material in one district may be extravagant in another, owing to relative difference in price. In Cleveland, vitrified brick (an excellent paving material for many situations) cost $8 per M, while at Toronto the cost is $18 per M. Roads of local gravel, with short haul, may in cases be had for one-third of the cost of broken stone brought by rail; so that a gravel road, even if it has to be heavily resurfaced every four or five years, is probably, under such circumstances, a more truly economical road than broken stone would be.

The local cost and efficiency of labor is a factor which may favor or cause the rejection of an otherwise suitable paving material, which elsewhere can be economically laid. There is often a considerable range in this regard in short distances, while as between separated countries or regions the variation may be exceedingly marked. Wages are generally higher in the cities than in the country; are lower in Europe than on this continent, and are usually lower in southern than in northern countries, so that methods and materials should be varied accordingly.

Road construction has been criticized from time to time because of large bond issues, and the economic value of large expenditures has been questioned. Very great care must be taken in the local adaptation of road making materials in order that this criticism may not be justified. The use of heavy foundations, bituminous binders and other first-class materials is no doubt justifiable and essential on heavily traveled suburban and main interurban highways—the class of road which is or should become of national, or state, or occasionally of county importance. But this will ordinarily apply to a comparatively small percentage of the total highway system, and a road that is too good, and too costly, for the amount of traffic, is as much an economic blunder as bad roads. But all roads of the country need improvement. It is as necessary that the 90 or 95 per cent. of less traveled township and country roads be made proportionately good by grading, draining and surfacing, as that the 5 or 10 per cent. of trunk roads be built, but care must be taken that costly design suitable only for the latter, be not carried into the division where cheaper construction would be satisfactorily serviceable. Construction adapted to location and traffic, with proper regard to future requirements, is of vital necessity.

◆

SOME TEST CURVES OF TURBINE-DRIVEN CENTRIFUGAL PUMPS.

A complete line of turbine-driven, low-pressure centrifugal pumps have recently been placed on the market by McEwen Bros., of Wellesville, N.Y. These pumps have been developed after over two years' careful investigation from designs made by Mr. C. V. Kerr, chief engineer of the company. They represent an advance in turbine machinery, as the speeds used conform to exceptional turbine economy. The usual type of centrifugal pump cannot run at turbine speeds for low-pressure work, and so the steam consumption is sacrificed.

Fig. No. 1 shows the calibration curves for a well-known small turbine. It will be noted that the curves are lines of constant steam conditions, and also constant steam flow. At, for example, 150 lbs. steam pressure and atmospheric exhaust, with the same total steam flow, the horse-power increases from 21 at 1,500 r.p.m. to 36½ at 3,000 r.p.m.

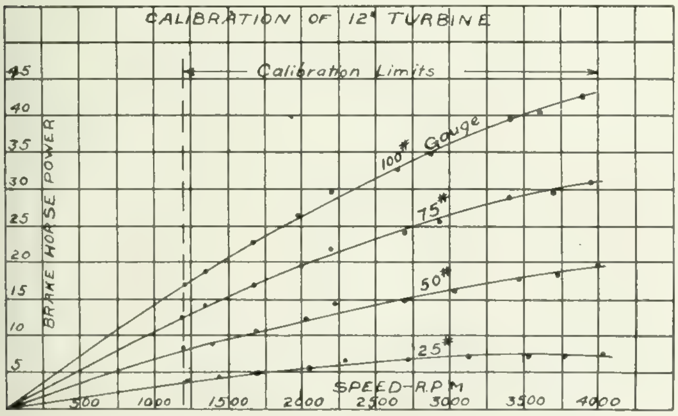


Fig. 1.

The advantage of high speed will at once be evident. A smaller turbine may be used in most cases, and the water rate is greatly improved.

Fig. No. 2 shows test results obtained on a standard 30-in. pump. It will be noticed that the maximum pressure occurs at no discharge. This gives best conditions for starting and general service. At constant pressure the horse-power at no discharge never exceeds 40 per cent. of the normal, and may be less than 30 per cent. The horse-power decreases at discharges greater than normal when the speed is kept constant. As the horse-power increases at higher speeds or pressures, the pump of itself forms a highly efficient governor, and service conditions are maintained over variable operating possibilities. At the same time, under variable speed control the horse-power curves vary about as the quantity delivered at constant pressure. The gain in efficiency and horse-power used under these circumstances enable the turbo pump to further encroach on the field of the plunger type.

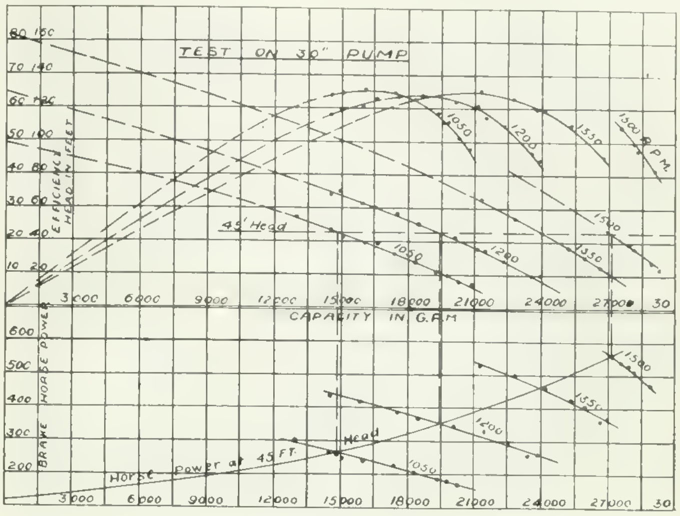


Fig. 2.

◆

STRUCTURAL COMPOSITION AND PHYSICAL PROPERTIES OF STEEL.

The following is abstracted from an interesting article by Albert Sauveur in the May Journal of the Franklin Institute:—

Bearing in mind that hypo-eutectoid steel is composed of free ferrite (pure metallic iron, magnetic and stable below 850 deg. C.) and pearlite (an alloy of carbon and iron, of lamellar structure), and that hyper-eutectoid steel consists of free cementite (iron carbide, formula Fe_3C) and pearlite, and knowing the proportion of carbon in pearlite and cementite, the structural composition of any steel may be calculated, provided the percentage of its carbon content is known.

For hypo-eutectoid steel, $F + P = 100$, and $0.01EP = C$, in which F is the percentage of free ferrite present, P the percentage of pearlite, E the percentage of carbon in the pearlite, and C the percentage of carbon in the steel. For hyper-eutectoid steel, $P + Cm = 100$, and $0.01EP + 0.0667Cm = C$, in which Cm is the percentage of free cementite.

The exact carbon content of pearlite is not known, and it varies somewhat both with composition and treatment; in commercial steel it is probably not far from 0.85%. For simplicity in calculation it is warrantable to assume that pearlite contains 1 part by weight of cementite to 7 parts by weight of ferrite; or

$$12.5\% \text{ cementite} + 87.5\% \text{ ferrite} = 100\% \text{ pearlite},$$

and since cementite contains 6.67% carbon, 12.5% of cementite will contain $(6.67 \times 12.5 \div 100 =)$ 0.834 % carbon. With this assumption and the fact that the carbon in the steel produces exactly 15 times its own weight of cementite, the calculation of the structural composition of any steel becomes extremely simple.

From the foregoing considerations it may be shown that the percentage of pearlite in hypo-eutectoid steel (i.e., steel containing less than 0.834% carbon) is equal to 120 times its carbon content, or $P = 120C$, the remainder of the steel consisting, of course, of free ferrite ($F = 100 — P$). To find the percentage of pearlite in hyper-eutectoid steel, the percentage of carbon in the steel should be substituted for C in the formula $P = (800 — 120C) \div 7$, and the remainder of the steel will be made up of free cementite ($Cm = 100 — P$). For example, a steel containing 0.50% carbon will have a structural composition of ($120 \times 0.50 =$) 60% pearlite and ($100 — 60 =$) 40% ferrite. In a steel containing 1.25% carbon the pearlite will amount to $[800 — (120 \times 1.25)] \div 7$, or 92.9%, and the free cementite $Cm = 100 — 92.9 = 7.1\%$.

Physical Properties of the Structural Constituents of Steel. It is evident that the physical properties of ferrite must resemble closely those of wrought iron and steel having a very low carbon content. It, therefore, is very soft, very ductile and relatively weak; it is magnetic, has a high electric conductivity, and cannot be materially hardened by rapid cooling from a high temperature. Pearlite is hard and possesses maximum hardening power. Little is positively known as to the physical properties of cementite, excepting that it is exceedingly hard and brittle, and that it possesses no hardening power. The properties of these constituents of steel in its normal condition are substantially as follows:—

	Tensile strength, lb. per sq. in.	Elongation in 2 in., %.	Hardness	Hardening power.
Ferrite	50,000*	40*	Soft	None
Pearlite	125,000*	10*	Hard	Maximum
Cementite	5,000 (?)	0	Very hard	None

---

* More or less

Tenacity of Steel vs. Its Structural Composition.—It is reasonable to make the assumption that these constituents impart to the steel their own physical properties in a degree proportional to the amounts in which they are present. The tensile strength (T) of any hypo-eutectoid steel may, therefore, be expressed by the formula

$$T = (50,000F + 125,000P) \div 100,$$

or, simplifying, $T = 500F + 1,250P$; or, in terms of pearlite alone (since $F = 100 — P$), $T = 50,000 + 750P$; or, finally, in terms of carbon (since $P = 120C$), $T = 50,000 + 90,000C$.

According to this simple formula, steels containing 0.10, 0.25, and 0.50% carbon have tensile strengths of 59,000, 72,500, and 95,000 lbs. per sq. in., respectively. These values agree closely with our knowledge of the average tenacity of such steels when in a pearlitic condition. Steels forged and finished at a fairly high temperature are practically in this condition. The formula cannot be used for steel forged until its temperature is quite low, and especially if it be cold worked—the tensile strength is generally increased by such means. Neither can it be used for hardened tools nor for steel castings unless properly annealed. The formula is of value only in the case of commercial steels containing the usual proportions of impurities and in which the percentage of manganese varies roughly with the carbon content (from [illegible]). A greater percentage of manganese would naturally increase the tenacity.

The tensile strength of hyper-eutectoid steel cannot be calculated so closely, because of lack of accurate information as to the physical properties of cementite. Assuming it to have a tensile strength of 5,000 lbs. per sq. in., the tensile strength of a hyper-eutectoid steel $= T = (125,000P + 5,000Cm) \div 100 = 1,250P + 50Cm$, or, in terms of pearlite (since $Cm = 100 — P$), $T = 5,000 + 1,200P$. As $P = (800 — 120C) \div 7$, the foregoing may be further simplified to $T \div 142,000 — 20,600C$. Applying this formula to steels containing respectively 1.25 and 1.50% carbon, the respective tensile strength are found to be 116,250 and 111,100 lbs. per sq. in., which are fair values for the average tenacity of pearlitic steels of those degrees of carburization.

Steel of Maximum Strength.—From the preceding considerations it seems evident that eutetoid steel must possess maximum tensile strength, since the influence of the presence of ever so small an amount of free ferrite in hypo-eutectoid steel or of free cementite in hyper-eutectoid steel must necessarily be a weakening one, because of the relative weakness of free ferrite and free cementite as compared to the strength of pearlite. Most writers state that a slightly hyper-eutectoid steel, containing about 1% carbon, possesses maximum tenacity. It seems probable, however, that the steels to which they refer were in a sorbitic rather than in a pearlitic condition; it may well be that when in a sorbitic condition maximum strength corresponds to a higher degree of carburization—i.e., 1%—because sorbite may, and indeed often does, contain more carbon than it does pearlite.

Ductility of Steel vs. Its Structural Composition.—It should be possible to work out a formula expressing the ductility of any hypo-eutectoid steel in the annealed (pearlitic) condition from the known elongation under tension of ferrite and pearlite (see table). This ductility should be $D = (40F + 10P) \div 100$, or, in terms of pearlite alone (since $F = 100 — P$), $D = 40 — 0.3P$; and, since $P = 120C$, the ductility in terms of carbon would be $D = 40 — 36C$. Pearlitic steels, for instance, containing 0.25 and 0.50% carbon should have elongations of 31 and 22%, respectively.

Reduction of Area vs. Structural Composition of Steel. Similarly, the reduction of area of any slowly-cooled (i.e., pearlitic) hypo-eutectoid steel may be calculated on the assumption that pearlite has a reduction of area of 15% and ferrite a reduction of 60%. Then reduction of area $= R = (60F + 15P) \div 100$, or, in terms of pearlite (since $F = 100 — P$), $R = 60 — 0.45P$, or, in terms of carbon (since $P = 120C$), $R = 60 — 54C$. Pearlite steels containing 0.25 and 0.50% carbon should, therefore, have reductions of area of 46.5 and 33%, respectively.

◆

CHEMICAL WOOD PULP.

Experiments in the manufacture of chemical wood pulp are carried on in the Forest Products Laboratory at Madison, Wisconsin. This is the largest and most complete laboratory of its kind in the world. The building, costing $100,000, was erected by the University of Wisconsin. The equipment, staff and operating expenses are supplied by the United States Forest Service.

The laboratory started work in June of this year. The results of the work have not yet been published, but it is known that a good quality of kraft paper has been manufactured from the saw-mill waste of western yellow pine, that the saw-mill waste of Wisconsin has been found satisfactory for chemical pulp manufacture, that great advances have been made in the manufacture of a good quality of chemical pulp from dead and green tamarack, hemlock and jack pine. The staff at Madison have also examined samples of pulp from practically all the mills in the country, and have worked out satisfactory methods of standardizing, comparing and grading wood pulps.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: **62 Church Street, and Court Street, Toronto, Ont.** Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, AUGUST 22, 1912. No. 8

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Material for Road Aggregate 355
Long Distance Power Transmission 355

Leading Articles:

The Power Plant of The Spanish River Pulp and Paper Mills, Limited 337
A Water Survey of Ottawa 340
Efficiency in Education 340
3,000 Kw. Vertical Rotary Converters 342
Effect of Installing Meters at Decatur 343
Maintenance of Roads and Pavements 344
Emergency Welding of Broken Parts of Dredges .. 347
The Melting Points of Fire Bricks 348
The Preservation of Reinforced Concrete in Sea Water 349
Roads Adapted to Local Conditions 352
Some Test Curves of Turbine-Driven Centrifugal Pumps 353
Structural Composition and Physical Properties of Steel 353
Destruction of Concrete Track Foundation 357
Report on Moose Jaw Municipal Heating Plant .. 358
Chlorination at Cleveland, Ohio 359
Heating and Ventilation of a Factory 360
The Relation of Electrical Engineering to the Profession 362
Large Rolling Lift Bridge 365
Tests of Brick 366
Railway Development in the Kootenay 367
Report of Calgary Municipal Street Railway 368

Personals 369
Coming Meetings 370
Engineering Societies 370
Market Conditions 24-26
Construction News 67
Railway Orders 74

MATERIAL FOR ROAD AGGREGATE

In a paper before the American Road Builders' Association, and printed in this issue of *The Canadian Engineer*, on "The Maintenance of Roads and Pavements," Mr. James Owen places emphasis on one feature of road-making which, we feel, to the present time, has been lost sight of by many road-builders. This fact is that the increase of automobile travel has caused the character of the mineral aggregate in any road mixture to assume a place of secondary importance. Under the old conditions of traffic the ideal material for road metal was hard trap-rock, and this was used, and is being used, wherever available, even at great cost on account of long hauls. Under the present conditions of travel, however, it is found that with the grinding eliminated and the use of surface oils, good gravel gives as excellent results as trap rock. Mr. Owen draws attention to the fact that granite can be used with impunity, and such natural materials as chert and shale can also be used. The sand and clay roads of North Carolina have, with oiling, been made into perfect roads. A full appreciation of this fact will reduce the cost of many miles of road in the future.

◆

LONG DISTANCE POWER TRANSMISSION.

The question of long distance electrical power transmission has assumed vast proportions during the past few years. Voltage and distance of possible transmission has increased tremendously. When the Niagara Falls Power Company began its development in 1891 it was considered a wonderful feat when power was transmitted to Buffalo, a distance of about twenty miles. To-day we find plants operating at a voltage of 140,000 and up to distances of 200 miles. The limiting voltage of power transmission is an interesting point. In discussing a recent paper by Dr. Steinmetz before the American Institute of Electrical Engineers, Mr. F. W. Peek, jr., made some interesting comments on this point. He states that a comparison of the past with the future is of interest in giving a comparison of past difficulties with present difficulties, and limitations of the past with the apparent limitations of the future.

He states that he came across, quite accidentally, an old book of letters by a very prominent engineer—it was not such an old book either, measured in time, but old measured by engineering progress. The writer states in one letter that an operating transformer had actually been built that could stand 15,000 volts, and it was hoped that ultimately a transformer could be built to operate successfully at 20,000 volts. The apparatus at that time was the limiting feature of transmission. Voltages went up by leaps and bounds, and transformers were shortly thereafter operating practically at voltages of from 50,000 to 60,000. At this stage the pin type insulator began to give trouble, so, naturally, the suspension insulator was invented. Voltages then jumped up to 100,000, and another trouble appeared, or what seemed to be a trouble or limiting feature, that is, corona. This led to investigations of corona losses, and it now appears that we still have some margin in the matter of corona limit; for instance, power could be transmitted at 200,000 volts with a conductor about one inch in diameter with 12 to 15 feet spacing. With long lines and high voltages other troubles appear; as an example, suppose we take a line, say, 200 miles long, with a voltage of 140,000. The capacity current may equal the total load current of the whole station. This will mean trouble unless some method is adopted that will take care of this heavy leading current, or the generator units are properly arranged as to size. If part of the load is supplied by part of the generator units and the load is suddenly lost, these units may be over-loaded by the capacity current. Another emergency to be provided against is the rise in voltage at the receiving end (due to capacity current through reactance) when the load is suddenly thrown off. Taking a practical instance, after the comparatively small lighting load is taken on in the evening, the heavy factory loads go off; over-voltage is put on the lamps. Fortunately, the effect of capacity current can generally be well taken care of by shunted synchronous reactance. Now, it is rather interesting, for the moment, to look forward into the future and perhaps ask a question, What will actually be the limiting voltage of power transmission, or limiting distance? Will it really be due to the loss of energy into the air by corona, the line insulator, the apparatus, or will it be an electrical feature after all? Will it not rather be, with some few exceptions, an economic or natural feature? For instance, the power naturally concentrated at a given point, as in a waterfall, will generally be exceeded by the demand before the distance becomes so great that it is necessary to use voltages above the electrical limit.

EDITORIAL COMMENT.

The Western Canada Irrigation Association has just closed its annual convention at Kelowna, B.C. Next year's meeting will be held at Lethbridge, Alta.

* * * *

Ottawa is slow to move on the water supply question, although they have had sufficient warning to warrant immediate action. The mayor is endeavoring to shift responsibility to the shoulders of the city engineer. The public, however, will no doubt remember that it is over a year since the previous typhoid epidemic, and since that time no action has been taken by the city council to improve the water situation.

* * * *

A magazine published in the United States and enjoying a large circulation among persons of a scientific tendency recently sent out a number of letters to scientists of international reputation in order that a vote might be secured and the seven wonders of the modern world tabulated. The result was that wireless telegraphy, telephone, aeroplane, radium, antiseptics and antitoxins, spectrum analysis and the X-ray were given as the seven wonders. A glance over the list at once raises the question of where the high-power microscope stood when the total was ascertained. It is doubtful if any piece of mechanism could be named that has rendered more service to mankind. The high-power microscope is to the sanitary engineer exactly what the compass is to the commander of the transoceanic liner, and without its discovery and development municipalities that are today [illegible] their existence by discharging their refuse into lakes and streams and then attempting to secure a satisfactory drinking water supply from the same source, would be depopulated and devastated without the ability to secure control of the bacillus that was the cause of all the evil. The science of bacteriology was unknown before the invention of the oil immersion microscope objective. This instrument, that has bridged the gap between disease and the source of disease, and has given sanitary engineers and medical experimenters the power to combat bacteria and observe the results of their labors, is worthy of a place on this list.

* * * *

Many instances could be cited regarding the general laxity of business methods employed by religious denominations in their dealings with architects and contractors. One of the most pointed instances has recently come to light in a rapidly growing city in the Province of Alberta. Tenders were called in the usual manner, the date of expiration mentioned, and the parties tendering were given to understand that their respective prices and offers would receive full attention from the governing body of this particular religious body, which has its provincial seat of control in Edmonton, some miles from the proposed place of work. As the time for the awarding of the contract lengthened, several contractors made enquiries, and were informed that the purpose of calling these tenders was to aid the architect only. When this gentleman (with the assistance of the contractors doubtless fully appreciated) made a report on the probable cost of the structure the building committee would reconsider the matter.

* * * *

The mayor of Ottawa has issued an invitation to citizens at present securing water from private sources, other than that publicly sold, to forward samples to the civic medical health laboratory for free bacteriological examination. The invitation contains an extraordinary statement to the effect that "many wells, particularly those drilled in rock, are contaminated." As a matter of fact, wells drilled in rock as a general rule furnish pure water. Recently in the council meeting of a large Western Canadian city a discussion was under way relative to the merits of the spring which certain parties were urging the authorities to purchase. An analysis of the water had been prepared and a number of the council took issue to the high reading of the chlorine factor. Their objections, however, were overcome by one member of the council, who ventured to impart the valuable information that the chlorine in water "was just what made it hard," and, as he explained, doubtless would be easily removed. The above incidents illustrate the amount of scientific knowledge held by the average member of a city council.

THE END OF A FAMOUS SHIP.

The Canadian Pacific Railway liner, Empress of China, was recently sold to a junk dealer in Yokohama, Japan, for the paltry sum of $67,180. It is just exactly one year since the palatial white liner, sister ship to the present Empresses plying from Vancouver to the Orient, went on the Shirahama reef in a dense fog and during a freak tide. About eight months ago she was floated under great difficulties and taken to Yokohama.

After the big liner had been surveyed it was found that it would cost anything from $150,000 to $200,000 to effect such repairs as would enable her to continue in the Trans-Pacific passenger trade. The underwriters have been negotiating for the sale of the vessel for some considerable time, and several Japanese have been in the field bidding for the wrecked liner. The Empress of China was raised by the Mitsui Bishi Dock Company, of Nagasaki, after the rocks which held the ship fast had been blasted away, and with the help of exceptionally high tides. The Canadian Pacific Railway put in claims for a constructive total loss, and a settlement of the insurance claim was made by the underwriters when the liner was offered for sale. The Empress of China will be broken up for scrap by the Japanese purchaser.

DESTRUCTION OF CONCRETE TRACK FOUNDATION.

A method of breaking up old concrete track foundation is described by Mr. C. B. Vorce, construction engineer for the British Columbia Electric Railway Company, Vancouver, B.C., in an article in a recent issue of Engineering and Contracting, and we reproduce the description herewith.

Granville Street in Vancouver, British Columbia, is a principal business street, over which six car lines, or about 150 cars per hour, pass. The tracks on this street between Robson and Drake Streets, a distance of one-half mile, were riding so badly that their reconstruction was imperative. It was not advisable to rebuild during operation and as there is a double track car line only two blocks away, the Board of Public Works granted the B.C. Electric Railway Company permission to abandon traffic during construction, providing it was restored in 24 days.

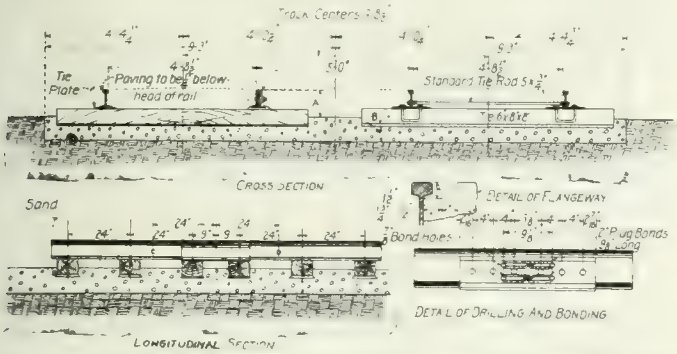


Fig. 1.—Standard Track Construction of British Columbia Electric Railway, Vancouver, B.C.

The street was paved with wood blocks laid on 6 inches of concrete, and each rail of the double track was carried on a concrete girder 2 feet wide and 15 inches deep. Owing to the nature of the foundation these girders were not heavy enough to carry the weight imposed upon them and on account of this the company adopted the type of construction shown by Fig. 1. This construction consists of a 6-inch concrete slab which is laid over the entire track allowance, 18½ feet wide, upon which 91-lb. T rail 7 inches high are laid on 6 x 8-inch by 8-foot ties spaced 2 feet centre to centre. The track is then surfaced to grade on a sand cushion averaging 1 inch deep and the concrete is brought up to the under side of the pavement.

By referring to the standard cross-section (Fig. 1) it will be seen that the botton of the concrete slab is 20 inches below the rail grade.

As stated above, the reconstruction of the tracks called for taking out and replacing the following quantities: 5,100 sq. yds. of wood block paving, 10,200 lin. ft. of rail or 5,100 lin. ft. of single track, 1,800 cu. yds. or 5,100 sq. yds. of concrete, 600 cu. yds. of earth and the laying of 2,400 cu. yds. of concrete, one-half mile of double track, 850 sq. yds. of granite flangeway blocks and 4,250 sq. yds. of wood blocks.

As the concrete has to set 10 days before traffic can be turned back on the street, this necessitated the completion of the work above outlined, except the paving, in 12 days, and not 14 days, as two Sundays intervened. The work was carried on day and night, and a schedule (Fig. 2) was prepared showing the rate of progress which must be made on each of the operations in order that the work should be completed within the time limit. This schedule was so closely followed that all the work, except the paving, was finished one hour before the time called for by the schedule, and during the 10 days the concrete was setting the street was repaved, so that when traffic was restored all the work was completed.

The B.C. Electric Railway Company has a large construction force, who do the greater portion of its work, so it was certain of the speed with which the various operations, with the exception of breaking up of the concrete, could be accomplished.

The company had just built a piece of new track which called for the removal of about 300 sq. yds. of concrete of a similar nature, which had been laid by the same contractors. This piece of concrete was removed by hand and it took 15 men 6 days to do the work. As the schedule called for the removal of about 32 sq. yds. of concrete per hour, it was seen that some mechanical means must be used, and the following scheme was adopted:

The dipper arm was taken off the electrically driven Thew automatic shovel owned by the company and the pile driver leads about 20 feet long were hung from the end of the boom, being held in position by two braces running back to the main frame of the shovel. A hammer weighing 2,600 lbs., with a wedge shaped cutting edge about 8 inches deep running parallel to the track, was specially cast. The cutting edge was placed this way in order to not injure the remaining concrete in the street. This scheme worked excellently and no trouble whatever was found in breaking up the concrete as rapidly as it could be taken away.

The concrete breaker, which could swing through 350 deg., was placed on one track and on the other track the derrick car was placed. This derrick car had a 60-foot boom, which could also swing through 360 deg. and could move itself up and down the track. This car was used to break up the larger pieces of concrete and load them on flat cars placed behind the concrete breaker, also to unload skips in which were placed the smaller pieces of concrete and earth, this material being dumped into wagons standing alongside.

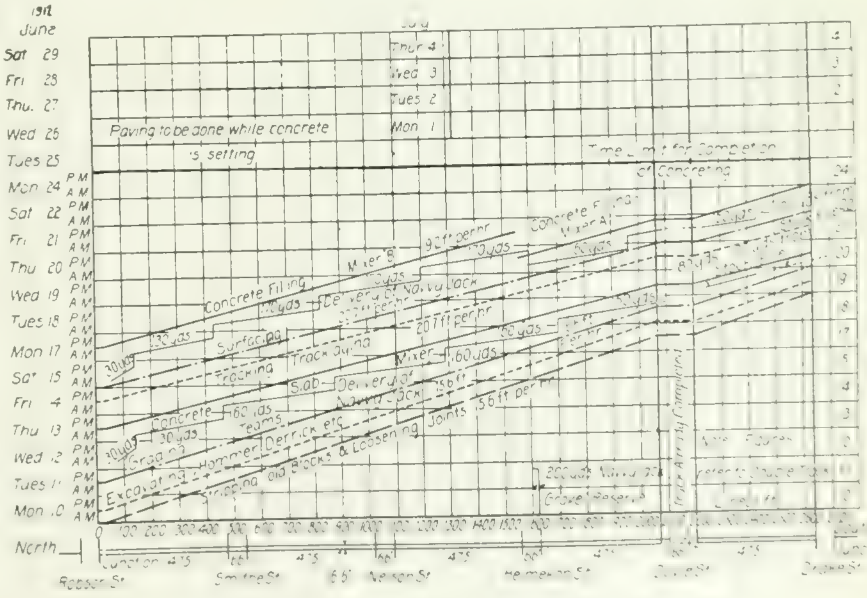


Fig. 2.—Progress Chart of Track Reconstruction Work.

The concrete breaker and derrick car backed up on the old track as soon as the concrete was broken up for a rail length ahead of them.

The price of common labor was $3 per day of 10 hours, and teams received $8 per day shift of 10 hours and $9.50

[illegible] The average haul for teams was [illegible] of a mile and for the track cars about 2 miles. The cost of the work was as follows:

Digging up wood blocks, 8 9/10 cts. per sq. yd.

Tearing up old track, 11 cts. per ft. of single track.

Breaking up concrete, 40 cts. per sq. yd., or $1.13 per cu. yd.

Excavation, loading and dumping, 82½ cts. per cu. yd.

Removing material by teams and work train, 65 cts per cu. yd.

Mr. G. R. G Conway, M. Am. Soc. C.E., is chief engineer of the B.C. Electric Railway Co., and the work was carried on under the supervision of Mr. C. B. Vorce, M. Am. Soc. C.E., engineer of construction, assisted by Mr. H. J. Tippet, engineer maintenance of way, and Mr. A. J. Kennedy, roadmaster.

REPORT ON MOOSE JAW MUNICIPAL HEATING PLANT.

A report was presented to the City Council of Moose Jaw, Sask., recently, on the advisability of installing a municipal heating system, by Mr. J. D. Peters, the municipal electrical superintendent. The report in abstract follows:

"Before deciding upon what line of action to adopt regarding the new power plant to replace the one destroyed by fire on May 25th, there are several things to be taken into consideration, at least the suggestions and advice that are forthcoming regarding this matter make it necessary to consider everything carefully. I will endeavor therefore to point out to you clearly and as briefly as I can my own views regarding the matter. I will say I am not prejudiced in any way, but am anxious that we shall get the best and most economical and up-to-date plant possible. I also think that I am in a better position to discuss this matter than any other person, as I know the conditions under which we have been operating. The first thing I would suggest would be the changing from the two phase system to the three phase. The advantage of the three phase system is:

1st.— That 25 per cent. less copper wire and space is re[illegible]

2nd.—The three phase systems are generally conceded to be the standard, and with the result that only three phase apparatus is carried in stock to any extent by manufacturers. Two phase is regarded as "special." It is often very difficult to obtain two phase apparatus without waiting for it [illegible] think there will be much effort among the manufacturers to improve upon it. To consumers having plants in different [illegible] tors or other apparatus. Beyond this, and the saving in in[illegible]

[illegible]

"Regarding the central steam heating system, if you will refer to my annual report for last year, you will find the following: 'To instal a steam heating plant system and connect with our plant to accommodate sufficient business to warrant placing back pressure on our engines would entail an expenditure of at least $300,000. From such a plant we would derive a revenue of about $1.25 for every kw. produced. Therefore to sell sufficient exhaust steam to make 10 per cent. on capital expenditure, or $30,000, it would be necessary to sell the exhaust produced by manufacturing 2,400,000 kw.h., or twice total output for the year 1911. Then this amount would have to be sold during the heating season of about eight months. Further, on account of our widely varying load, we could not utilize all our exhaust during the hours of heavy load, and would, no doubt, have to make up with live steam during the hours of lightest load. Our very low load factor is against the proposition. When all these things are considered, I believe our annual output would need to be about six times the output for 1911 before we could go into the heating business to advantage, and the load factor of the plant would need to be improved.'

"I have during the last few days been checking up this statement quoted above, and do not think it necessary at the present time to modify it in the least. I would only emphasize the last few words referring to the load factor. There are so many things to be taken into consideration in figuring out the advantages and disadvantages of the steam heating system that it would require months to get a full reliable report upon the matter, and it looks to me as though it were scarcely worth investigating at the present time, considering our present load conditions. I would not recommend any action towards the installation of a heating plant without having a full report from a heating expert and one whom we are sure has no 'axe to grind.'

"The prospects of going into the heating business at some future time should not, however, have any effect upon our present requirements of generating apparatus, as we would require other units to take care of our heavy loads and summer loads, the exhaust from which could be utilized for heating system. As to the location of the plant, if the heating business was started a more central location would be slightly more desirable. However, the cost of such a site would be so great that it would pay better to run the necessary mains from the present site to the business section of the city. I do not think there is a better location for a power plant in the city than the present one.

"I do not regard the heating business as being suitable for municipal ownership, as only a comparatively small portion of the ratepayers could expect to share directly in the benefits of such a system. Indirect benefits might come in the way of reduced rates for electricity, but on the other hand the heating business might turn out a failure, and drag down the electrical department with it. However, these are points for more of an expert than myself to deal with. I have already pointed out to you that we will require, in any [illegible] apparatus that is not adapted for steam heating, and also that the present location of the plant need not be changed.

"I will therefore recommend that immediate steps be taken [illegible] light and power service at the earliest possible date by the installation of a steam turbine and generator large enough to handle our maximum load until such time as we can get a smaller unit installed. If the machines are available I would instal a unit of 1,000 kw. capacity at once, and a [illegible] kw. unit as soon afterwards as possible. These two units will handle our business during the [illegible] but it will be necessary to add to this capacity next year. Then if we have a favorable report upon the matter of steam heating, and decide to go into it, a unit suitable for it can be installed next year. At the present time this department is standing a net daily loss of about $225, so you will see that prompt action is necessary.

"We have been already offered several generating units for quick delivery, both new and second-hand. Among these we have an offer from the Canadian General Electric Company to substitute a three phase outfit for the two phase outfit already ordered from them, and to ship same immediately. This is an exact duplicate of the one already ordered, with the exception of the winding of the generator, and the same guarantees and other terms of the contract will apply. All that is necessary to obtain the outfit at once is to give the company an order to change the winding of the generator from two phase to three phase. The price will be the same, except for some slight adjustments to cover switchboard not now required in the contract, and the exciter set to be given in part payment, but which is now destroyed by fire. There will also be a charge of $350 for work already done on the two phase machine. Condensor equipment can be shipped in six weeks, and until this arrives the turbine could be operated non-condensing. If this proposition was accepted we could have full service restored in about five weeks' time, and would also have a thoroughly up-to-date machine in our plant. In our present plight I believe it is the very best action to take."

CHLORINATION AT CLEVELAND, OHIO.*

By Dr. D. D. Jackson, Sanitary Expert, New York City.

When the chlorinating plant for treating the water supply of Cleveland was placed in operation in September, 1911, disagreeable tastes and odors were noticed from time to time and investigations were undertaken to regulate the application of the chemical and determine its effectiveness as a sterilizing agent. It was found that the unsatisfactory results were due to the use of unnecessarily large amounts of chlorine. The quantities of chlorine have been reduced while the sterilizing effect upon the water has been sufficiently active. The efficiency of the process was demonstrated during the present year, both by analytical results and by the fact that while ice movements in April caused specific infection in the water supply at the intake during three days, yet there was no accompanying rise of typhoid in the city. Since the installation of the new four-mile intake the water supply of Cleveland has been in a satisfactory sanitary condition at all periods of the year, with the exception of the short intervals during which the annual breaking up of the ice has occurred. The sewage-laden ice from the river and harbor has, on several occasions, infected the supply at that time, especially in 1910 when the ice movements were oscillating and protracted.

Under present conditions infection occurs only during and directly after the ice movement and it is at these times only that it is imperative to treat the water with hypochlorite. In order to insure the use of standard amounts of chlorine when sudden increase or decrease in pumping takes place, it is recommended that an automatic device be installed which will regulate the flow of hypochlorite solution directly in proportion to the flow of water, and that experiments be made with a view of substituting the chemical solution by compressed chlorine gas made directly from the electrolysis of common salt. This gas is more effective at low temperatures, is readily eliminated from the water by its more rapid reaction, can be easily regulated and is in all respects like treatment with ozone, but more practical of application and much less expensive. The estimated cost of an installation for Cleveland is $2,000 and the cost of treatment from 40 cents per million gallons downward to about 25 cents as liquid chlorine comes into general use and is made on a large scale.

With the present funds available for waterworks purposes at Cleveland it is proposed to extend the old intake line to a point 16,000 ft. northwesterly from the old west-side crib, thereby having two long lines ready for use so that in case leaks should develop in one the other would be available for use while repairs were in progress on the damaged line. The extension of this intake together with the installation of permanent apparatus to treat the lake water is believed to be a satisfactory method of insuring a pure supply of water and is much less expensive than building filters.

The present chlorinating plant consists of a small mixing tank 4 ft. in diameter and 3 ft. 4 in. deep, equipped with a mechanical stirrer. There are two 11 ft. 8 in. diameter solution tanks, 7 ft. 5 in. deep; a 1 per cent. mixture is used, the feed being controlled by two orifice tanks with float valves. The daily pumpage is about 70,000,000 gal., so that from 11 to 18 lb. of hypochlorite per million gallons is used, corresponding to an amount of chlorine of from 0.5 to 0.7 parts per million. Sudden changes in pumpage, together with the sometimes great variation in the strength of the individual drums of chloride of lime, has at times been a source of difficulty in the application of the treatment. This difficulty was greatest at the time when it was thought that 0.8 parts per million of chlorine was necessary. It is now found that from 0.5 to 0.7 parts is sufficient. Any amount in excess of 0.8 parts produces during cold weather objectionable tastes and odors.

In Jersey City, where the first practical tests of the treatment were made, it was found that 0.35 parts of chlorine per million was sufficient; this amount was used also at Cincinnati. In the Croton supply of New York 0.5 parts was required and in the Bronx supply 0.6 parts.

Compressed chlorine, liquefied under pressure, is now on the market sold in 100 lb. cylinders and can be had at about 8 cents per pound, about double the price of hypochlorite of lime as far as available chlorine is concerned. It has, however, many decided advantages over hypochlorite in that it is a pure and definite product which is absorbed by the water as a gas. It is easier to apply with regularity and its added cost is nullified by the fact that almost no labor is required in its application. No solution tanks are necessary and no lime sludge has to be disposed of. The only installation required for this treatment is a gas pressure-regulator with pressure gauges on either side of the regulator. The gas then passes through a series of hard rubber orifices and is absorbed in the flowing water. The only labor required is about 5 min. work to connect up a new 100-lb. tank once in 6 hours in the case of the Cleveland supply.

In regard to typhoid fever since the new 4-mile intake was installed in 1904 the death rates have been low. The year immediately following the installation of the new intake the typhoid death rate dropped from 48 to 15 per 100,000 and has averaged 16 for the 7 years that this intake has been in use. In spite of the low death rate there have been occasional times when for short periods the water appeared to be the source of slight infection and this infection occurred always in the early part of the year. It was to stamp out this source of risk that the sterilization of the supply was adopted.

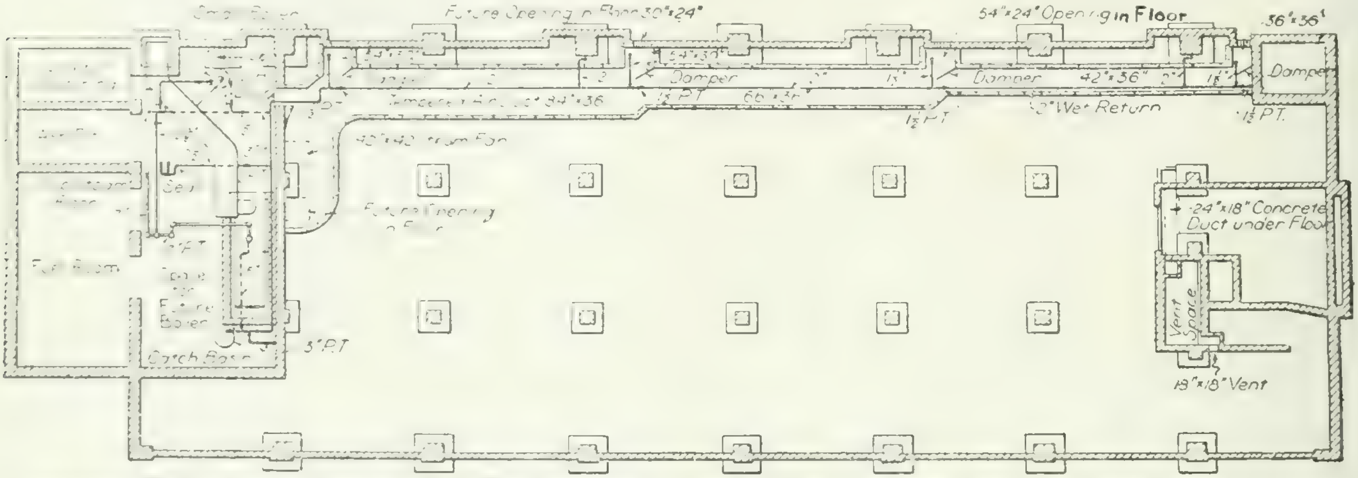
---

* Paper read before American Waterworks Association.

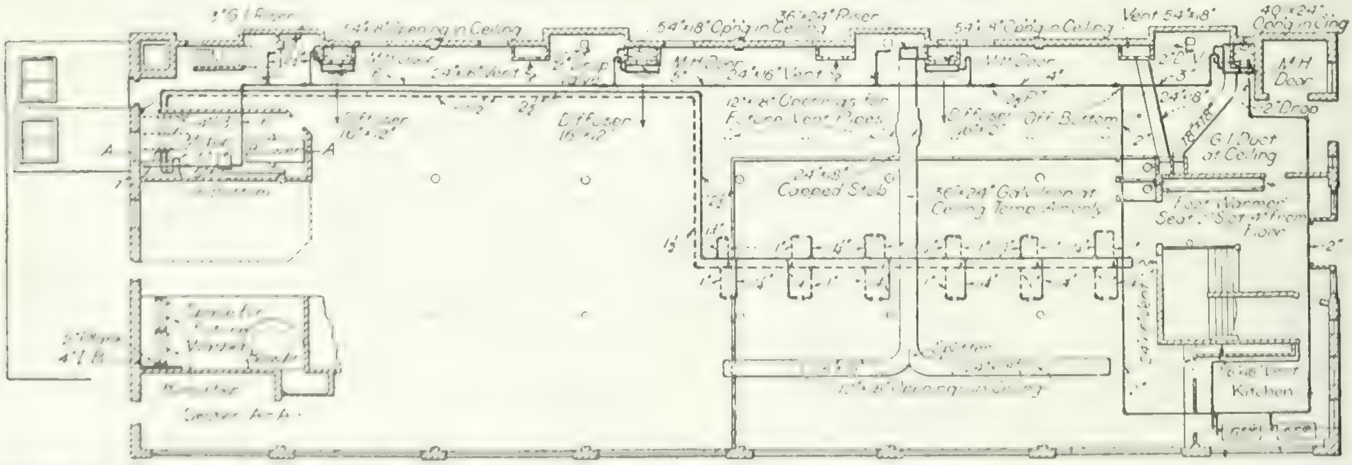
HEATING AND VENTILATION OF A FACTORY.*

By Samuel R. Lewis.

The object of this paper is to describe the heating and ventilating arrangements of the factory of the Defiance Tick Mitten Co., Toledo, O. The first floor is used for storage, packing, etc., while the second floor is occupied by about 250 operatives, nearly all women, who work at power sewing machines, pressing and finishing tables, etc. There are a number of steam-heated forms upon which the finished gloves and mittens are pressed. The desire of the owner was to provide an especially sanitary, light and attractive building, as he had learned by experience that these features had so great an influence on the attendance and efficiency of the labor that it was a good business investment as well as a function of good citizenship to provide them. The operatives are nearly all paid by piecework, [illegible]



Basement Plan, Showing Tempered Air Duct Supplied by Fan on First Floor and Leading to Flues Containing Heating Surface.



Basement Plan, Fan Heater Unit and Arrangement for Doubling the Capacity and the Steam and Air Distribution, Particularly for Second Floor.

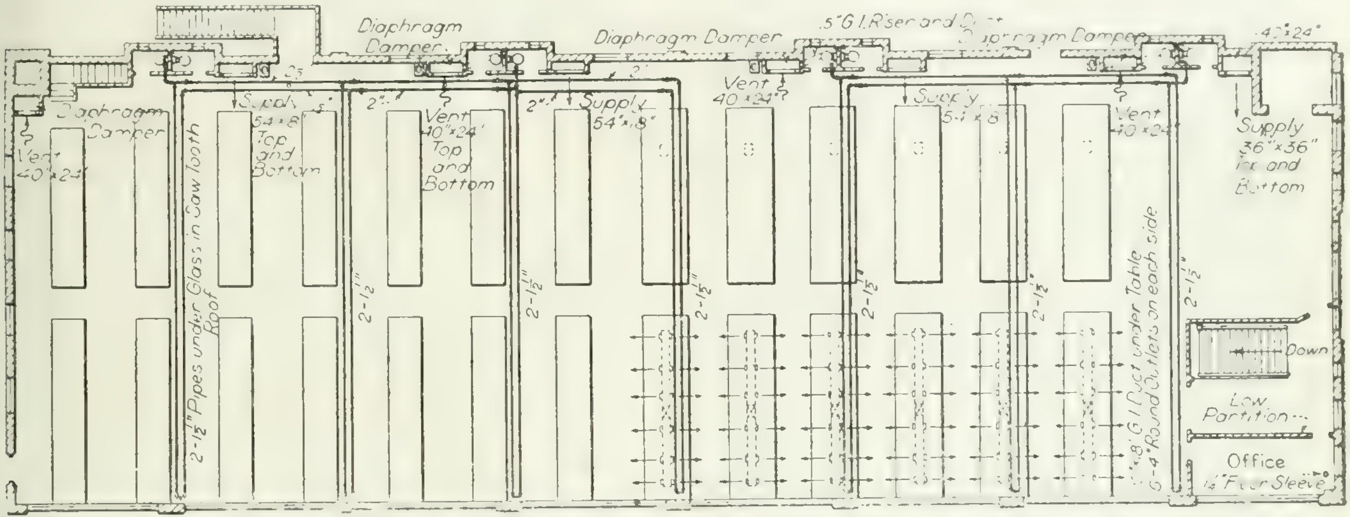
The building [illegible] construction, with [illegible]. The [illegible] are all in steel sash. The roof is of composition, laid on finished plank, and supported on steel trusses. The building is intended as the first of a group of a similar type, surrounding a central administration building and power plant. It is one-half of a future unit, and the division of the apparatus is such that the boiler, fan, coils, etc., for the other half may be added later on. Thus, the cost of the present plant was very little in excess of what it would have been had there been no thought of future additions. The boilers are placed in a sub-basement; one has capacity for all heating, ventilating and manufacturing requirements, and the other is provided for summer use for manufacturing and water heating. The principal manufacturing demand for steam is for heating the metallic forms used in pressing the finished product.

Fresh air is supplied through special steel casement sash, and is drawn through tempering coils and steam jet humidifiers to the supply fan. The steam supply to the tempering coils is controlled by a thermostat so that the tempered air is never cooler than about 60 deg., or warmer than that, unless the outside temperature is higher than 60 deg. The steam jets are controlled by a sensitive element which operates within a range of less than 5 per cent. at the point at which it is set (about 40 per cent. relative humidity). The supply fan delivers this conditioned fresh air through a concrete duct (which also serves as a return [illegible]) to the bases of the various flues. These flues have, near the ceiling of the first floor, individual coils, which have automatically controlled steam supply valves. The thermostats which operate these valves are of the gradual or stage operating type, and reduce or increase the amount of heated radiating surface as the temperature requirements dictate.

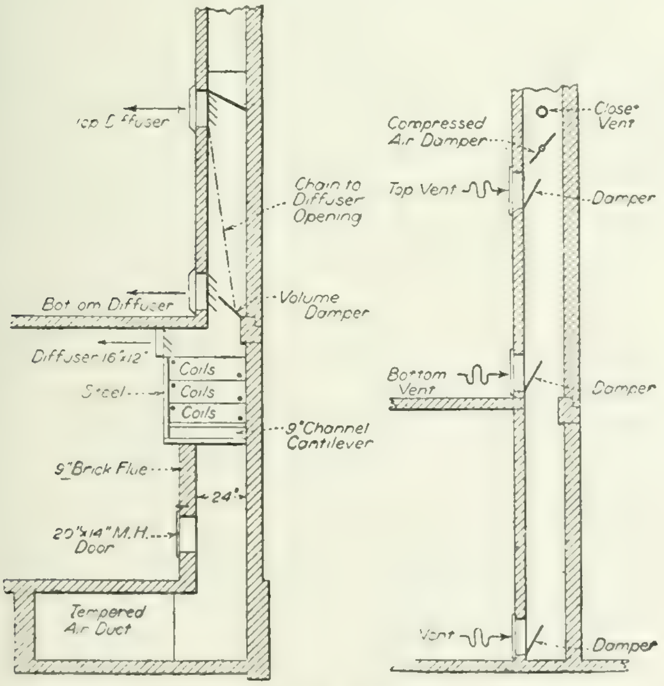
---

*Paper [illegible] Engineers, Detroit, Mich., [illegible]

The various supply flues discharge some air into the first floor, but their principal function is to serve the second floor, where a minimum of 30 cu. ft. of fresh air per occupant per minute is provided. When the building is being heated, the fresh warm air is discharged at a point about 10 feet from the floor through adjustable diffusers. It passes across the skylights and is forced against the almost continuous glass surface of the opposite wall. When the building is warm, however, the fresh air is discharged at the floor line through adjustable diffusers, directly at the lines of operatives. When heating, the exhaust air leaves the room at the floor, but when cooling or merely ventilating, the exhaust air leaves the room at the ceiling. To this end, each supply flue and each vent flue has two openings, with adjustable dampers in each.



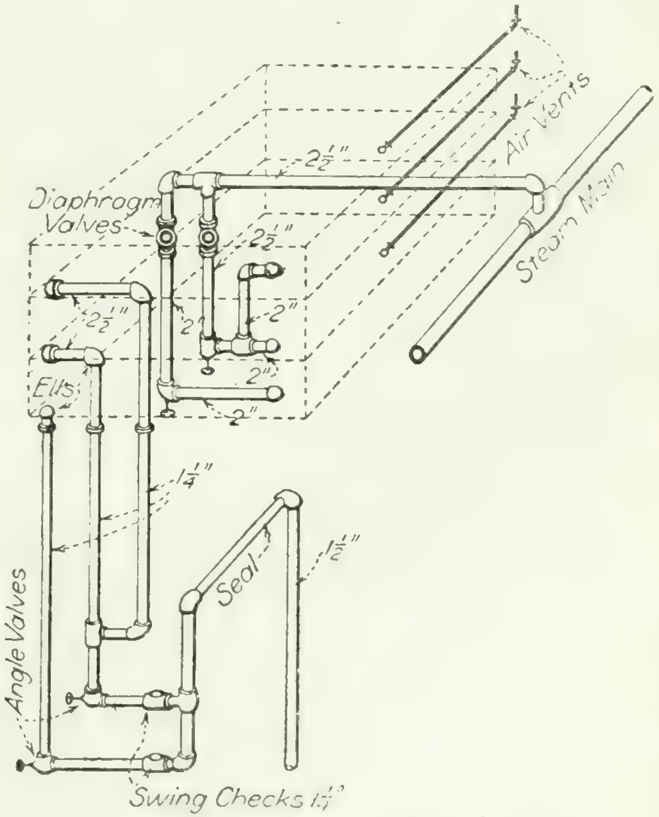
Second Floor Plan, Showing Air Supply Underneath Tables, Heating Coils Under the Sections of the Sawtooth Roof and Location of Fresh Air and Vent Flues.



Typical Fresh Air and Vent Flues.

In order that the operatives at the steam-heated forms may have the maximum of comfort, a 4-in. tempered air inlet at the floor, with an adjustable universal elbow and a blast gate for regulating the volume to each person, is provided. To offset possible cold drafts from the exposed roof or skylights, pipe coils under separate hand control are placed under each saw tooth glass area.

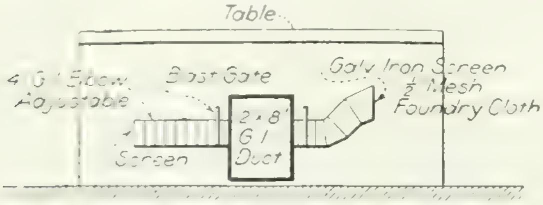
Many of the operatives walk some distance, and are liable to arrive at work with wet skirt bottoms and damp feet and ankles. A floor inlet would be objectionable from sanitary reasons, and so the concrete bench for drying purposes is provided and has proved quite effective. The seat is warm, about 100 deg., and through slots in its face a little above the floor, a strong blast of air is about 120 deg. maximum is delivered parallel with the floor. This air also warms the entrance hall and stairway.



Typical Connections to Heating Coils.

The escape of air from the building when it is unoccupied may be cut off by special dampers in the outlet flues, all being operated by compressed air by one switch valve in the fan room. All toilet fixtures are individually venti [illegible] openings in the bowls to separate vent flues.

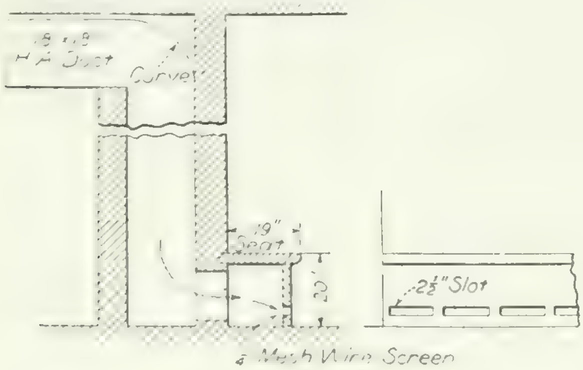
There is no direct radiation. The plant has been in operation through the severe weather of the past winter,



Adjustable Galvanized Duct Under Table.

and has proved entirely adequate. There have been no objectionable drafts, though many operatives sit at work directly alongside the exposed glass surface opposite the supply inlets. It has been found so far that the coils in the skylights are unnecessary.

The ventilation has been excellent. It has been found economical to keep the outlets closed and to rotate the air within the building, taking in no outside air when heating prior to occupancy. There has been increased comfort and no objectionable odor when the humidifying apparatus was in use, and when the temperature was kept down to 65 deg. There was no serious complaint of overheating with the temperature at 70 deg. and the humidity [illegible].



Air Warming Seat in Hall.

The absence of direct radiators contributes greatly to the ease of cleaning, and to the comfort and fuel consumption. With this system, the loss of heat through the glass and wall surface, for instance, is less, since the inside temperature is close to 70 deg. all over, while with direct radiators it would be close to 212 deg. opposite every unit. [illegible] of the building.

◆

CEMENT PRODUCTION.

[illegible]

THE RELATION OF ELECTRICAL ENGINEERING TO OTHER PROFESSIONS.*

By Cano Dunn.

On the wall of a great engineering library is the legend "Engineering is the art of organizing and directing men, and of controlling the forces and materials of Nature for the benefit of the human race."

This is broad and all-embracing, but other professions will find it hard successfully to quarrel with it.

While the immediate object of engineering is a material one, engineers draw from many different channels of human energy, such as generalship, commerce, psychology, mechanics, economics, to say nothing of chemistry and physics and many others, all under an interpretation insight and method that are best described by the term scientific.

It may be asked, Why could not a similar statement of embrasure or scope apply to medicine, the law, the army and other professions?

In part it could, but it is to engineering that it applies pre-eminently.

The subject matter of the older professions, the things about which they busy themselves, and the objects they seek to accomplish have changed relatively little in many centuries. The means have altered but the ends persist. They are approximately the same to-day as they have been throughout history and tradition.

With engineering it is different. There was no such profession a hundred and fifty years ago, and if I may a little anticipate my conclusion, there will be no such profession a hundred and fifty years hence in respect to a large part of what we now call engineering.

Such as it is, engineering is embracing an ever-growing horizon, and is including more and more of the activities of civilization.

When I say activities I refer to material ones and not to the whole of life itself. The human spirit is the greatest fact in the world, and art and literature that interpret it, the acts of our daily life and our personal relations that depend upon it, religion and the vast body of our social and political experience, that go to constitute life form undoubtedly a mass of activities, which are greater, in terms of consciousness, than the material activities which engineering can affect. In other words, the humanities which have been the same for ages can never be invaded by anything that merely rearranges our relations to the material world.

In the material world, however, which is at once the workshop and the throne, the glory and the limitation of the engineer, marvel has followed marvel and shall be followed by more marvels, for we are beginning to catch the tools' true play; beginning to see the vision of our dominion over the earth.

Whether it really is engineering to organize men, to predict the psychology of a fare-paying population, to win the endorsement of a labor union, to treble the yield of a farm by a microscope, all of which successes to-day are [illegible] depend upon the definition that we finally adopt.

It is startling to study the variety and importance of [illegible] showing the world how to increase greatly the lay of bricks, or the Agricultural Engineer working miracles with the soil that for ages farmers have struggled with, to the Civil Engineer establishing a kingdom and building the Panama Canal, we have instances in which the engineer is doing more and more of the world's work.

---

*[illegible] Annual Convention of the American Institute of Electrical Engineers, [illegible]

The history of this class of men so rapidly growing in numbers, so rapidly differentiating in function is almost a romance.

The Encyclopedia Brittanica names the middle of the eighteenth century—that is, 1750—as the time before which there were only Military Engineers—who constructed "engines" of war—and it adds that at about that time there began to arise a new class. Little did this new class realize the army it was leading down the industrial paths of time!

The "new class" has surpassed all bounds. From insignificance a hundred and fifty years ago it has increased almost incredibly in numbers and variety of specialization.

As a local indication, the Engineering Societies' Building in New York is the headquarters of fifty thousand engineers.

As another local indication, the American Institute of Electrical Engineers has in the last ten years increased six fold.

The growth in the variety of specialization has been almost as rapid as the increase in numbers.

Where there were only Military Engineers and the "new class" a hundred and fifty years ago, there are twenty-seven recognized varieties to-day.

Without mentioning all, they range from Civil through Mechanical, Electrical, Mining, Illuminating and Chemical, to Refrigerating, Industrial, Agricultural and Aeronautical. There is even a magazine with the title Human Engineering.

A large and increasing part of the capacity of our colleges and universities is devoted to the education of engineers.

Parts of the engineering curricula are borrowed for what used to be purely classical courses.

The metaphors of the speech of the day often have an engineering basis and—we have a McAndrews hymn.

The man in the street knows something about spark plugs, and many women understand the general principles of the telephone.

The social status of the engineer has emerged from that of a mechanic to one nearly as high as that of the clergyman, the physician or the lawyer.

Relatively recently there has been going on simultaneously with all this, however, hardly noticed, something else—a vast increase in so-called engineering work by men who are not engineers, and at the same time a large drawing off into executive, administrative, industrial, commercial, civic, educational, financial and even legal callings, of men of engineering training.

A history of segregation and disintegration seems to have begun to accompany a history of integration and building up.

For one to say to-day he is an engineer gives very little idea of what he actually does. It does not locate him in one of the twenty-seven recognized classes. It leaves is possible for the hearer to think of him as a "social engineer" or an "efficiency engineer" should he not look like a "civil engineer," but even if he did define himself and say he was an electrical engineer, the hearer would still not know whether he represented the last word on the loading of telephone circuits or his responsibility was to determine whether the great railroad terminals of Chicago should use a third rail or an overhead catenary.

If he should say "I am a teacher," "a physician," "a clergyman," "a lawyer," there would be a much more definite conception attaching to his answer.

There must be, therefore, in the title "engineer" something broader, something not included, or included to a lesser degree in the titles of the other professions or occupations.

A light is shed if we examine the popular definition that engineering is "educated common sense."

Can it be that unlike "physician," "lawyer," "teacher," the term "engineer" does not describe what a man does, but rather how he does it! A method rather than an occupation! It is even so; that is, essentially and with limitations I shall refer to later.

What then is this "method" that has given the engineer his ever broadening domain and brought all kinds of men and callings to his school? He can tell you at once. Here is where he is defined and where his fellows recognize him and each other though they come from the ends of the industrial earth as to diversity of actual occupation.

The method had its birth in Greece, though it was stifled almost to death by the tremendous philosophic, humanistic and artistic energies of the Hellenes. Later it was buried in Europe under the irruption of the barbarians.

The names of Thales, dear to our profession, with his "elektron," and of Aristotle and Archimedes, stand out as having done much for it—especially Archimedes—in spite of the humanistically polarized intellectual atmosphere in which they lived and which they contributed so gloriously to create.

But the Greeks made only a start. To quote an authority, their material thinking was largely based on what has proved to be a wrong method of procedure, the introspective and conjectural rather than the inductive and experimental. They investigated Nature by studying their own minds, by considering the meanings of words, rather than by studying things and recording phenomena. But they saw much of the light with all this.

Though absolutely dead for a thousand years in Europe, "the method" was kept alive during the middle ages in Arabia, although confused with magic, alchemy and algebra.

Then came Roger Bacon, Leonardo da Vinci and Copernicus, and science as we know it began to take shape.

Aristotle had sat down in his chamber and he wrote in a book, "A body twice as heavy as another of course falls twice as fast." Galileo released simultaneously from the top of the Leaning Tower a one pound and a one hundred-pound shot and they reached the earth together, before the eyes of the assembled University of Pisa.

But "the method" was repugnant to the University, and almost to a man they believed their Aristotle, sophistically explained away what they saw, and persecuted Galileo.

Descartes, Newton, Lagrange, Laplace, Francis Bacon connote to engineers the transcendent story, unless for electrical engineers there should be added Ampere, Faraday, Henry, Helmholtz, Kelvin.

The method of doing things that makes an engineer is, therefore, the applying to practical and utilitarian ends the principles and reasoning of science. Engineering is not science, for in science there is no place for the conception of utility. Truth is her sole criterion. In the exalted language of Professor Keyser, "Not in the ground of need, not in bent and painful toil but in the deep-centered play-instinct of the world Science has her origin and root; and her spirit, which is the spirit of genius in moments of elevation, is but a sublimated form of play, the austere and lofty analogue of the kitten playing with the entangled skein or of the eaglet sporting with the mountain winds."

Engineering is Science's handmaid following after her in honor and affection, but doing the practical chores of life.

concerned with the useful and the material; with costs and with expediency, and concerned with the humanities only in so far as they are an incident in some particular scheme of reality, and then objectively, if that may be said.

Her methods merely apply straight thinking to material problems for useful purposes.

Does this constitute a profession? No. Some day it will be the way almost everybody thinks instead of a body of specialists and then the difference between a doctor, for instance, and an engineer will be only in the things they busy themselves about; as is to-day the only difference between kinds of engineers.

The centre of education has been shifting rapidly recently—almost as rapidly as material well being has been increasing.

The application of science to living has marked an age as distinct as the age of the climax of Art in Greece.

The "new class" has been but a pioneer in sowing the seeds of scientific rationalization in a field the value of which was only dreamed of by Archimedes and not actually recognized until, as the Encyclopedia tells us, "about the middle of the eighteenth century," when the "new class" began to arise.

And now, as to the limits within which engineering is a method rather than an occupation.

There will always be engineers, for the methods of Science will constantly advance, and there will be needed continually, to interpret and transmit them to mankind, and to make the first applications of them to useful purposes, a class of men who, by instinct and taste, as well as by the possession of what I later shall call the dynamic component, find easier than other men—and consequently perform better the kind of scientific thinking, observation and action that characterize engineers to-day.

What these men will be busy about it is hardly safe to say, although it is probable the present great divisions of engineering will be more or less preserved. It seems certain that a large mass of knowledge that now is called engineering and forms the basis of many of the engineering specializations, will become general knowledge, and will be absorbed by the community, partly as a result of the shifting of the centre of education and partly through everyday familiarity, and the men possessing this knowledge will no longer be called engineers. They will be called farmers, let us say, in the case of the "Agricultural Engineer"—of course, a farmer of a very advanced kind compared to the earlier one.

But the centre of education will not always continue to shift. It is shifting now only because it has so long been [illegible].

It would be a calamity for it to shift too far, resulting in [illegible] and the utilities.

[illegible] engineering and the [illegible] themselves would languish instead of flourishing, for there would be lacking [illegible] component.

[illegible]

[illegible] personality, [illegible]

turies astray in the direction of their education and contributed to an underestimate of the importance of Science and the study of the laws of nature.

We must not go to the equally wrong other extreme.

So far I have said but little of electrical engineering. It must be brought in if for no other purpose than to justify our title. Although the article on "Engineering" in the Brittanica occupies only six inches of one column, it concludes with the following: "The last great new branch is electrical engineering, which touches the older branches at so many points that it has been said that all engineers must be electricians."

If engineering is a method of doing things, and electrical engineering tends to embrace all other branches, there is an implication that electrical engineering is the latest or most highly developed form of the method—the method that is the utilitarian application of the principles of Science to the material facts of life.

Such is unquestionably the case. Born scarcely more than twenty-five years ago, the "youngest branch," Electrical Engineering had the opportunity of striking its roots into the richest of scientific soils, free from prejudices, customs or traditions. It had no entangling alliances, no political laws to retard or encumber it. The field it preempted was the Terra Nova of Engineering, the New World of Applied Science.

Under the influence of those geniuses of Science, Volta, Faraday, Ampere, Ohm, Kelvin, Helmholtz, Maxwell, Oersted, Henry, and with the metric system for its cornerstone, there developed a comprehensive structure of thought and a related scheme of units. The latter are the admiration of the world for their simplicity, their convenience, their precision and their reproducibility. The scientific method as applying to all phenomena acquired its most perfect embodiment in the electric system and its relations.

But there is a philosophical debt that we electrical engineers owe our units. They school our minds. The ability to measure with precision difficult and complicated quantities enables clear thinking on them and renders reasoning about them possible that otherwise could not be attempted. To name a thing is to know it.

The wonderful electrical units are a fluent language that gives the widest opportunity to thought. By their character they educate our faculties of definition and relation.

They typify all quantitative thinking, not merely electrical.

They are the epitome, the last word of the great minds of our age, as to what the scientific method of thought is, in relation to the whole realm of matter and force.

Therefore, although the subject matter of electrical engineering is covering a wider and wider range—so wide as to be almost incongruous, the electrical method of thinking is applicable throughout. It is spreading far beyond.

As an electrical engineer, I even find myself thinking of the crowds passing in the streets in terms of amperes and volts, and of the fluctuations of the stock market in terms of current, inductance, capacity, resistance and resonance.

That which can impose form upon our thought enables us successfully to think of any kind of thing.

The forms of thought established for electrical engineering are so [illegible], so rich in detail, and so illuminating that engineering does not bound them.

They may be called the manifestation of Science in civilization, the best representation of the scientific method at work for utilitarian ends.

They prove that the profession of Electrical Engineering not only deals with single-phase motors, storage batteries, high-tension transmissions, turbo generators, coronas, carbon transmitters and commutation as an occupation, but that it also is a way of thinking, and as such is not an occupation, but the latest and most highly developed scientific method of solving all kinds of practical problems of matter and force, for the benefit of the human race.

◆

LARGE ROLLING LIFT BRIDGE.

One of the principal bridge building contracts of the year has just been placed by the Great Central Railway Company of England with Sir William Arrol and Company, Limited, of Glasgow, Scotland, for the construction of a large new railway and highway Scherzer Rolling Lift Bridge and approaches across the River Trent at Keadby, in Lincoln, England. The requirements of navigation at this point on the River Trent, just above where it enters into the River Humber, are quite severe and necessitated the most careful consideration in selection of the type of draw span, and the engineers of the railway company visited all of the important modern movable bridges in Great Britain and America before deciding upon the Scherzer type as best fulfilling the requirements of navigation and the very heavy traffic over the bridge.

The structure will be composed of two fixed approach spans in addition to the bascule span and the track girder span upon which the moving leaf rolls in its operation, on the well known simple Scherzer principle. The total length of steel work will be nearly 500 feet. Each span will have three trusses, the centre truss dividing the railway and roadway portions of the bridge deck. The railway section will have a width of 29 feet and the roadway 24 feet centre to centre of trusses.

The movable span of this bridge is of the Scherzer single leaf through type and as it will have a movable length of 160 feet and an extreme width of nearly 60 feet it will be one of the largest bascule bridges in the world. The machinery and power equipment designed for opening and closing the bridge in one minute is very simple and effective for so large and heavy a structure. The power will be electrically generated in a machinery house alongside the bridge and this current will actuate the motors which are placed on the rear end of the movable leaf. These motors are geared to the main operating shafts which drive pinions engaging with racks on independent fixed supports outside of the plane of the movable bridge trusses. This method of operation is one of the special features of the latest designs of Scherzer Rolling Lift Bridges, and reduces the machinery and power required to a minimum even in the largest and heaviest structures.

The substructure will consist of steel caissons carried to about 50 feet below the low water of ordinary spring tides and the masonry piers carrying the superstructure will be founded upon these caissons.

The entire bridge is designed in accordance with the latest practice in both foundations and steel structures to carry the heaviest main line traffic of the Great Central Railway between Doncaster, Grimsby and the large modern Immingham Docks on the Humber River.

Sir William Arrol and Company, Limited, will execute the work under the supervision of Mr. J. B. Ball, engineer-in-chief of the Great Central Railway Company, by whom the foundations and approach spans were designed. The Scherzer Rolling Lift Bridge Company, Chicago, Mr. Albert H. Scherzer, president and chief engineer, designed the superstructure, operating machinery and power equipment of the bascule span, and will maintain a general consulting engineering supervision over the manufacture and erection of that portion of the work in co-operation with Mr. Ball's staff.

LARGEST CLOCK IN CANADA.

The clock that claims the above title has recently been installed in the tower of the Vancouver Block on Granville Street, Vancouver, B.C. The four faces of this clock are each twenty-two feet in diameter. The glass contained in the dial weighs four tons, and is seven-eighths of an inch in thickness. The minute hands are eleven feet long and the hour hands about eight feet.

The clock is controlled by a master clock, which is situated on the ninth story of the building. This master clock is a 60-beat instrument, and transmits its time to the large clock in the tower. It is fitted with a pilot dial, which shows at all times the exact position of the hands in the tower piece. The master clock in turn receives its time through a synchronizing attachment, which delivers McGill observatory time once every minute, thereby assuring accuracy.

Machinery for operating this huge timepiece is all set in the clock tower. It consists in the main of a motor, which propels the hands. This motor is controlled by a magnet attachment, which only permits it to run for a period of fifteen seconds, this being the time required for the large hand to travel one-sixtieth part of the circumference of the dial. Thus the hands are still for forty-five out of every sixty seconds.

The current for running the clock is generated by a small dynamo, which is driven from the electric light mains. The energy from the dynamo is stored in accumulators.

These batteries are of sufficient capacity to run the clock for one week if the ordinary sources of current derived from the lighting mains were to fail. In case the storage batteries were to be put out of commission the generator would drive the clock direct.

Every point of friction in the clock—from the motor to the crown gear and hands—is fitted with ball bearings. The clock can be set either from the office of the superintendent or in the tower.

The hour marks are a single bar ten inches wide and about four feet long. They will be left blank, no numerals being painted on them. The dial is constructed of structural steel, and not, as in most of the older clocks of the country, of cast-iron. The minute divisions of the clock are five and one-half inches wide and about one foot long. The hands are made of aluminum.

The clock was erected by the Standard Electric Time Company, of San Francisco, at a cost of more than $10,000.

◆

TRACK SINKAGE NEAR VANCOUVER, B.C.

The tracks of the Great Northern Railway a few miles south of Vancouver have been the cause of considerable trouble to the trainmen for several days. We recently announced the fact that these tracks were sinking in a bog-hole. Since then we have obtained additional information.

Ardley Station, the scene of the trouble, lies right in the heart of the Still Creek district. Still Creek is really a flat sump for the drainage of the district lying between Hastings Townsite and Burnaby Lake. The land it drains has very little fall, and the creek spreads out into wide areas of muskeg. At Ardley both the Great Northern and the British Columbia Electric Railway Burnaby line tracks run close together.

Every day for two weeks trainloads of dirt, brush and rocks have been piled into the hole in the hope that bottom and a firm foundation would finally be reached. Fifty cars of material per day have been put into the sink without any apparent beneficial effect.

TESTS OF BRICK.

The Canadian Department of Mines recently ordered an investigation of the clay and shale deposits of the Western Provinces, and while this was in preparation sixteen lots of bricks were shipped to Prof. A. Macphail, of the School of Mining, Kingston, Ont.

Each lot of bricks contained about twelve specimens; the lots, on receipt, were designated by letters (A to P), and each brick in this division again designated by a number (1 to 12). The following list gives the series letter, the locality from which the bricks were obtained, and the kind of brick:—

List of Bricks Collected for Testing.

Series. Manitoba.

E.	Alsip Brick and Tile Co., Winnipeg......	Soft-mud.
B.	The Stephens Brick Co., Portage la Prairie	Soft-mud.
C.	A. Snyder & Co., Gilbert Plains....... ...	Soft-mud.
D.	Leary's Pressed Brick Works, Leary Siding	Dry-press.

Saskatchewan.

A	[illegible]	[illegible]
F	[illegible]	[illegible]

Alberta.

G	[illegible]	[illegible]
H	[illegible]	[illegible]
I	[illegible]	[illegible]
J	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

British Columbia.

O.	Enderby Brick and Tile Co., Enderby....	Soft-mud.
P.	John Coughlan & Sons, New Westminster	Soft-mud.

Tests.

Eight separate tests were conducted on the bricks of each series, and these tests are indicated by the letters (a to h). Here follow the specifications under which the tests were made:—

a. Place six thoroughly dried bricks in water to the depth of one inch, and leave them covered over for forty-eight hours. Weigh before and after this partial immersion, to calculate the percentage of absorption in terms of the original dry weight.

b. Test six **dry** bricks flatwise on supports seven inches apart, to determine their transverse strength.

c. Take the six bricks from the absorption test, soaking them some more if they have dried out, and determine the transverse strength of these wet ones.

d. Take one-half of each brick from Series b and determine its crushing strength set flatwise.

e. Take the other half of each of the bricks from b, and determine their crushing strength when set on edge.

f. Take one-half of each of the bricks from Series c, and determine their crushing strength when set on edge.

g. Take the other half of each brick from c, soak it [illegible] in water, and then subject to a temperature of not less than 15° F. for five hours, all faces of the samples being exposed. The bricks are then thawed [illegible] for one hour. This is to be repeated twenty times.

h. Determine the crushing strength on edge of the [illegible] after they have been through the [illegible] test.

With regard to the crushing test, the sides or edges of the brick in contact with the machine are to be made flat and parallel with plaster of paris. The opposite sides should be exactly parallel. The testing machine should be equipped with spherical bearing blocks.

Table I.

Series No.	Test a. Per cent absorption.	Test b. Transverse (dry)		Test c. Transverse (wet)		Test d. Crushing flat (dry)	Test e. Crushing on edge (dry)	Test f. Crushing on edge (wet)	Test h. Crushing on edge (dry) after freezing.
		Breaking load.	Modulus of rupture.	Breaking load.	Modulus of rupture.	lbs. per sq. in.	lbs. per sq. in.	lbs. per sq. in.	lbs. per sq. in.
A	13·5	1533	805	1490	773	6975	5960	5132	4700
B	23·2	887	472	843	472	2208	2358	1547	2196
C	22·1	1150	647	1073	594	2435	2567	1983	3260
D	10·5	1295	622	1273	610	2807	2652	2833	3378
E	23·1	983	473	1432	716	1830	2468	2310	2846
F	25·8	1286	746	977	568	2932	2050	2065	1730
G	25·5	704	337	720	345	2612	1744	1562	1250
H	19·2	825	384	920	428	1692	1868	1628	2027
I	22·2	702	365	617	320	1298	1512	1282	1400
J	24·1	774	337	797	343	1220	1492	1502	1989
K	15·8	640	298	506	237	1320	1494	1310	1732
L	14·4	672	313	598	278	2242	1660	1948	1950
M	15·3	657	267	612	249	2343	1364	1513	1503
N	15·8	808	329	662	270	2420	1640	1296	1190
O	20·8	972	467	983	471	1869	1950	2658	1990
P	14·4	2008	972	1618	776	5242	5735	4028	5115

The results of the various tests are given in Table I., and are the averages of the observations on six bricks in all cases, except those in test "h," where the bricks which were destroyed in the freezing test were, of course, not given.

The modulus of rupture was calculated from the transverse test by the usual formula:—

$$S = \frac{3}{2} \frac{W l}{b d^2}$$

Where W is breaking load at centre in pounds, l is the span, b is the breadth of the brick, and d the depth.

In the case of bricks which had a frog, the area of the frog was deducted from the gross area when the bricks were tested for compression strength on edge.

Table II. Bricks were frozen and thawed twenty times as specified. In the column "Remarks," the numerals denote the number of times the brick was frozen before disintegration began to set in.

Table II.—Freezing Tests.

Series A.		Series B.		Series C.		Series D.	
No.	Remarks.	No.	Remarks.	No.	Remarks.	No.	Remarks.
1	8 cracked, 15 broken.	1	5 cracked, 14 broken.	1	20 cracked.	1	16 broken.
2	11 " 15 "	2		2		2	16 "
3	8 " 15 "	3	5 slight crack.	3		3	
4		4		4		4	16 slight crack.
5		5		5		5	
		6	5 slight scaling.	6		6	
Series E.		**Series F.**		**Series G.**		**Series H.**	
1	8 scaling, 20 broken.	1	20 scaling.	1	2 cracked, 8 broken.	1	Unaffected
2		2	16 broken.	2	2 " 8 "	2	
3		3	3 scaling, 16 broken.	3	2 " 16 "	3	
4		4		4	2 " 16 "	4	
5	5 crack.	5		5	2 "	5	
6		6	5 scaling, 8 cracked.	6	2 "	6	
Series I.		**Series J.**		**Series K.**		**Series L.**	
1	8 scaling.	1	3 scaling.	1	8 scaling.	1	2 cracked.
2		2		2		2	8 "
3		3		3	2 scaling.	3	8 "
4		4		4	8 scaling.	4	8 "
5		5		5		5	2 "
6		6	5 scaling.	6		6	
Series M.		**Series N.**		**Series O.**		**Series P.**	
1	2 cracked, 8 large cracks.	1	7 crumbled.	1	20 broken.	1	16 broken.
2	2 " 8 crumbled.	2	16 "	2		2	8 corner cracked.
3	2 " 8 "	3	7 "	3		3	8 cracks and blisters.
4	2 " 16 "	4	11 cracks.	4	16 crumbled.	4	16 cracked, 20 broken.
5	8 " 11 large cracks.	5	8 crumbled.	5	20 broken.	5	8 " 15 "
6	8 " 16 " "			6	12 corner crumbling.	6	

◆

RAILWAY DEVELOPMENT IN THE KOOTENAY

The announcement of the West Kootenay Power & Light Company, that it will install a third unit in its main plant at Upper Bonnington Falls, below Nelson, to be in a position to furnish electric power to the Canadian Pacific Railway when the latter electrifies its Rossland branch, is one of the numerous ways in which the construction activity of the railway company in the Kootenay is reflected. The plant is hydraulically developed for 32,000 horse-power, and electrically developed for 16,000 horse-power at present. The change to electricity for motive power on the Rossland branch, it is generally believed, is to be the first step in the application of this agent throughout the system in the mountains.

Preceding this change, for the last two years the Canadian Pacific Railway has been steadily improving the whole system tributary to the Crow's Nest branch, and shortly the through route portions will be of a standard equal to the main line.

The construction in the Slocan, which is to extend the Slocan system over the summit and down to Kootenay Lake, is nearing completion. On the Kootenay Lake section, the old Kaslo & Slocan line of the Great Northern has been re-opened temporarily as a narrow gauge line, to take in supplies and bring out ore. Next season the entire system will be standard gauge. The Canadian Pacific Railway, it is just announced, will construct ore docks at Kalso, the port of that region, and the silver-lead ore of the section will be conveyed in barges to Nelson, where it will be transferred to rail for transport to the Trail smelter.

The steel hull for the new Kootenay Lake steamer has arrived from the yards of the Polson Iron Works, Toronto, in five cars, and 150 men are now at work in the Nelson yards on this $200,000 boat, which next year will take its place in the through service.

Overshadowing any of these evidences of the railway company's intentions with regard to this territory is the rate at which the short line is being pushed through toward the Coast. In eight months, at the present rate of construction, the extension of the present Boundary branch, which now is operated to Midway, will be completed to Penticton, on Okanagan Lake. In thirteen months or less there will be connection with Merritt, the present terminus of the Nicola branch from the main line. On the date that that connection is established, the through Crow's Nest route will be diverted at Nelson to the Boundary branch, when a direct train service between Nelson and Vancouver will be inaugurated. This will be the third route between these termini, and will be much shorter than either the Arrow Lakes route or the Great Northern route.

This revolutionary programme requires practically but a year for its completion, and in all essentials the new Crow's Nest through route will be in existence and operation. When the Lethbridge-Weyburn cut-off on the prairie, and the Merritt-Hope cut-off near the Coast range are completed, the Crow's Nest route will originate at Winnipeg, and it will be at least a co-ordinate route with the main line.

REPORT OF CALGARY MUNICIPAL STREET RAILWAY.

The net profits of the Calgary Municipal Street Railway system for the fiscal year ending June 30 last were $107,253.49. This and other interesting facts are set forth in the annual report of Thomas H. McCauley, superintendent of the street railways, to the Minister of Railways.

The net profits for 1911 were $87,206.09, showing an increase in the net profits for 1912 of $20,047.40.

The total operating expenses for the year ending June 30, 1912, were $282,600.56, and the total gross revenue for the period was $479,240.24, or the ratio of operating expenses to gross revenue was 59.44.

Salaries paid to employes totalled $172,521 for 1912, as against $76,686.85 for 1911. The total length of main track for 1912 was 52 miles as compared with 36½ miles for 1911.

The report in detail is as follows:—

	1912. Cost June 30th.	1911. Cost June 30th.
Engineering	$ 4,055.40	$ 4,055.40
Track construction	901,622.29	627,320.71
Line construction	94,551.77	62,330.46
Buildings	24,317.85	15,592.55
Shop, tools and machinery	2,145.65	
Cars	205,431.15	109,114.88
Electric equipment	59,318.50	14,000.00
Miscellaneous	639.56	1,042.89
	$1,292,082.17	$833,456.89

Income Account.

Gross earnings	$479,240.24	$275,434.51
Operating expenses	282,600.56	139,601.98
Income from operating expenses	$196,639.68	$135,832.53
Less		
Real property (taxes)	$ 2,264.18	$ 2,264.17
Interest	[illegible]	[illegible]
Sinking fund	18,160.00	9,370.55
[illegible]	[illegible]	[illegible]
Net profits	$107,253.49	$87,206.09

Operating Expenses.

Way and structures	$ [illegible]	$ [illegible]
Equipment	[illegible]	[illegible]
Transportation:		
General expenses	[illegible]	[illegible]
Trainmen wages	[illegible]	[illegible]
Operating of cars	[illegible]	[illegible]
Total operating expenses	$282,600.56	$139,601.98

Ratio Operating Expenses to Gross Revenue.

59.44	50.68

Employees.

Salaries paid	$172,521	$76,686.85

Mileage, Traffic and Miscellaneous Statistics.

	1912.	1911.
Passenger car miles	1,643,328	801,086
Passenger car hours	195,206	89,776
Passengers carried	11,578,130	6,420,086
Transfers	1,363,400	756,000
Total passengers	12,941,530	7,176,086
Average fare	4.076 cents	4.196 cents
Average fare (including transfers)	3.615 cents	3.615 cents
Car earnings per car mile	28.722 cents	33.632 cents
Miscellaneous earnings per car mile	.440 cents	.750 cents
Gross earnings per car mile	29.162 cents	34.382 cents
Car earnings per car hour	$2.41	$3.00
Miscellaneous car earnings per car hour	.04 cents	.06 cents
Gross earnings per car hour	$2.45	$3.06
Operating expenses per car mile	17.196 cents	17.426 cents
Operating expenses per car hour	$1.44	$1.55

Car, Road, Etc.

Length of road (first main track)	42 miles	26½ miles
Length of second main track	10 miles	10 miles
Total length main track	52 miles	36½ miles
Length of sidings and turnouts	1 mile	
Total computed as single track	53 miles	

Accidents.

Passengers killed	0	0
Passengers injured	1	3
Others killed	3	2
Others injured	0	0

Cars, Etc.

Passenger cars (closed)	48	22
Passenger cars (open)	1	
Total passenger cars	49	22
Work cars	4	5
Sprinklers	2	1
Total cars of all classes	55	28

◆

MONTREAL COMPANIES

The announcement has been made that the Quebec Railway, Light, Heat and Power Company will show a satisfactory increase in earnings in its annual financial report. It is stated, apparently in a semi-official manner, that the following will be the result:—

	1911.	1912.	Increase or decrease.
Gross earnings	$1,280,126	$1,565,000	+ $284,874
Operating expenses	661,907	733,000	+ 71,093
Net earnings	618,219	832,000	+ 213,781
Fixed charges and div.	581,319	620,000	38,681
Organization expenses	10,681	....	....
Extraordinary income	111,100	.	....
Surplus	[illegible]	212,000	.

As the capital stock of the company is $10,000,000 it will be seen that the surplus indicated is equal to 2⅛%. The above comparison fails to indicate the real improvement in the Quebec Railway, Light, Heat and Power Company. Included in the extraordinary income mentioned above for last year was $100,000 which was not earned by the company itself but by its subsidiaries, previous to July 1st, 1910, at which date the amalgamated company began business. In reality, therefore, the surplus of $62,328 might have been shown as a deficit of $26,991 on the year's business, being $37,672, less the organization expenses of $10,681.

The situation, therefore, is that instead of going practically $27,000 behind, as was the case last year, the company will be $213,781 ahead.

The dividend payments amounted practically to $100,000 per quarter. As the dividend was passed some few months ago, these payments will no longer be necessary. Two of these payments were made during the past year, so that had the company not made them, the surplus would have been increased by about $200,000. Assuming that above figures are correct, it is manifest that the situation in Quebec Railway, Light, Heat and Power has improved.

◆

POWER POSSIBILITIES AT CARILLON.

Another new power development in the vicinity of Montreal is being discussed. The site of the proposed development is Carillon, about sixty miles up the Ottawa River from Montreal. Carillon is the terminal point of the Ottawa River Navigation Company. Navigation is uninterrupted, save for canals and locks, from Montreal to Carillon. Here, however, passengers westward bound are compelled to leave the boat and take the train, the cause of the interruption being the rapids or falls of Carillon, and the famous old dam. This dam took some five years to build and cost some $3,000,000.

For many years, a great deal of power has been going to waste at this point. Estimates on the amount of power vary very greatly, some placing it as high as 150,000 horsepower. This estimate, however, is not generally credited. In the estimate made for the commission of conservation, the Carillon rapids are credited with being able to supply 26,000 horsepower from the present possible head of 13.5 feet, but it is added that with the river canalized, and with the water control which is included in the Georgian Bay canal scheme, a head of 40 feet with a total of 200,000 horsepower can be developed.

Mr. Henry Myles, formerly president of the Montreal board of trade, is at the head of the company which proposes to develop the falls. It is claimed that there will be no difficulty in getting the capital, and that the power can be readily sold in the city of Montreal.

◆

NEW FORESTRY ENGINEERS.

At the University of Toronto nine men received the degree of Bachelor of Science in Forestry, and three others are eligible for the degree after passing supplmental examinations. The recipients of the degree were Messrs. R. M. Brown, F. G. Edgar, E. J. Finlayson, H. S. Irwin, R. G. Lewis, C. McFayden, E. C. Manning, W. L. Scandrett and W. J. Vandusen. All of these entered the employ of the Dominion Forest Service. Their present disposition is as follows: R. M. Brown, forest assistant Brazeau forest reserve, Edmonton, Alta.; F. G. Edgar, for assistant Bow River reserve, Calgary, Alta.; E. J. Finlayson, Inspector of Fire Ranging; R. G. Lewis, head office, Ottawa; C. McFayden, forest assistant, Crow's Nest forest reserve, Pincher Creek; W. L. Scandrett, in charge of forest survey party near the Porcupine forest reserve No. 2, Saskatchewan; W. J. Vandusen, supervisor, Crow's Nest forest reserve, Pincher Creek, Alta. Mr. Irwin has since joined the British Columbia forest service.

◆

The State of Wisconsin is overhauling its forest laws, and at the last session no fewer than eight bills were passed dealing with different aspects of the forestry question.

◆

PERSONAL.

J. V. DILLABOUGH, B.Sc., D.L.S., has been appointed office engineer of the Hudson Bay Railway, Fort Garry Court Winnipeg.

MR. J. D. GILMOUR, late of the C.P.R, forestry department, has been appointed supervisor of the Brazeau forest reserve, with headquarters at Edmonton.

DR. A. S. ESTEY, medical health officer of Calgary, Alberta, has tendered his resignation to the mayor and council of that city.

MR. M. J. K. ALLEN, who a few weeks ago resigned as city engineer of Regina, has become manager of the Ontario Asphaltic Concrete Paving Company, which company has just secured contracts for 30,000 square yards of pavement in North Toronto.

MR. G. SKIFF GRIMMER, of the U. of N.B. class of 1908, is engineer and forester for the American Canning Company, near St. Andrews, N.B. The company has a considerable tract of timber and will grow timber for box shooks.

MR. JOHN DUDGEON, of F. S. Dudgeon, Limited, London, England, called at *The Canadian Engineer* office this week on his way home, after seeing to the installation of one of their excavators at the plant of the Tofield Coal Co., Tofield, Alta.

MR. HARRY HARTWELL, who for the past year has been acting as resident engineer on the Sooke Lake waterworks development scheme, has severed his connection with the firm of Messrs. Sanderson & Porter, which is supervising that work, and will hereafter be identified with the F. S. Pearson Engineering Corporation, of New York city.

MR. R. G. LEWIS, B.Sc.F., has been for some time engaged in the compilation of the forest products bulletins for 1911 at the head office of the Forestry Branch at Ottawa. He will leave shortly for the Maritime Provinces, in connection with the compilation of the study of the wood-using industries of the Maritime Provinces, on which the Forestry Branch is entering.

MR. SAMUEL HALE, the new general manager of Algoma Steel, is at present vice-president and general manager of the Wisconsin Steel Company. He will take up his position about October 1st. Mr. Hale is 43 years old, and was born in Chicago. He started in the steel business in 1893 with the Illinois Steel Company, and served with them in various capacities until 1899, when he was appointed assistant general superintendent. He was subsequently associated with the operations of the International Harvester Company, whose steel properties were organized into the Wisconsin Steel Company, of which, as stated, Mr. Hale was made vice-president in charge of the operations. With these he has been associated for the last ten years.

MR. F. H. McGUIGAN, who was awarded the contract for constructing the new filteration plant for the city of Montreal, has notified the Board of Control that he desires to hand over his contracts to his chief engineer, Mr. Norman McLeod. The controllers were notified recently that owing to ill-health it was impossible for Mr. McGuigan to continue the contract, and asking that all of the contracts be transferred. Mayor Lavallee has stated that the controllers have accepted the principle of the transfer.

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer, John Keillor, Hamilton, Ont.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York. Sept. 2 7, 1912 Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memorial Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE · Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

[illegible] BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. [illegible], Vancouver, B.C. Headquarters, McGill [illegible]

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

[illegible] BRANCH—Chairman, J. A. [illegible]; Secretary, E. E. Brydone-[illegible] [illegible] October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

[illegible] ASSOCIATION.—President, [illegible]

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES—[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] OF ALBERTA MUNICIPALITIES.—[illegible]

[illegible] MANITOBA MUNICIPALITIES.—[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer [illegible], Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, [illegible] Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box [illegible], Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box [illegible], Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-31	—Trenching and Backfilling, Edmonton, Alta. (S.)	8-8

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Arcola, Sask., fence, Moose Mt. Reserve	Aug. 20.	Aug. 15.	78
Beaverton, Ont., breakwater, sheet piling and dredging	Aug. 26.	Aug. 1.	78
Bassano, Alta., waterworks materials	Aug. 22.	Aug. 15.	78
Cape Croker, Ont., schoolhouse.	Aug. 26.	Aug. 1.	67
Edmonton, Alta., lighting, Parliament Building	Aug. 31.	Aug. 8.	67
Edmonton, Alta., trenching	Aug. 31.	Aug. 8.	78
Edmonton, Alta., gas plant	Aug. 23.	July 18.	67
Edmonton, Alta., schoolhouse	Aug. 22.	Aug. 15.	67
Fort William, Ont., water pipe	Aug. 28.	Aug. 8.	78
Halifax, N.S., laboratory building	Aug. 26.	Aug. 15.	68
Kempenfeldt Bay, Ont., wharf and approach	Aug. 21.	Aug. 1.	67
Lockport, Man., superintendent's residence	Aug. 20.	Aug. 8.	68
London, Ont., pavement	Aug. 22.	Aug. 15.	80
Longueuil, Que., dredging	Aug. 27.	Aug. 15.	68
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
Ottawa, Ont., supply of coal	Aug. 28.	July 25.	67
Ottawa, Ont., wire fence	Aug. 20.	Aug. 1.	67
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., alterations to Laboratory No. 1, Experimental Farm	Aug. 24.	Aug. 8.	68
Ottawa, Ont., twin screw steel steamer	Sept. 2.	Aug. 15.	68
Ottawa, Ont., creosoted timber	Aug. 26.	Aug. 15.	67
Parry Sound, Ont., wharf and approach	Aug. 26.	Aug. 8.	68
Petrolea, Ont., glazed tile sewers	Aug. 26.	Aug. 15.	68
Point Barracks, Esquimalt, B.C., painting work	Aug. 20.	Aug. 8.	68
Port Arthur, Ont., breakwater	Aug. 28.	Aug. 8.	80
Port Colborne, Ont., repair of headblock	Aug. 21.	Aug. 1.	67
Quebec Harbor, P.Q., water piers	Aug. 21.	Aug. 15.	[illegible]
St. John, N.B., laboratory building	Aug. 26	Aug 15	68
Tilsonburg, Ont., church	Aug. 31.	Aug. 15.	68
Toronto, Ont., sale of Normal School property	Sept. 30.	Aug. 15.	68
Victoria, B.C., breakwater, Victoria Harbor	Sept. 5.	Aug. 15.	80
Vancouver, B.C., club house	Aug. 21.	Aug. 8.	68
Winnipeg, Man., 36-inch pipe	Aug. 28.	July 25.	68
Winnipeg, Man., lighting standards	Aug. 28.	Aug. 15.	68

TENDERS.

Calgary, Alta.—Tenders for the construction of three reinforced concrete bridges aggregating some 25 spans across the Bow and Elbow Rivers within the city limits of Calgary, will be received until August 31st, 1912. Plans, etc., can be obtained from the office of the City Engineer. J. M. Miller, city clerk.

Dauphin, Man.—The Rural Municipality of Dauphin, Man., are calling for tenders for the superstructures of four highway bridges. Specifications and other information can be obtained from J. A. Gorby, Secretary-Treasurer, Box 330, Dauphin, Man. (See advt. in The Canadian Engineer.)

Edmonds, B.C.—Tenders for the erection of a timber bridge 50 feet span, including piling and abutment, will be received until noon of August 24th, 1912. Particulars and specifications may be had at the Engineer's office, Edmonds, B.C. Wm. Griffiths, Comptroller, Municipal Hall, Edmonds.

Edmonton, Alta.—Tenders addressed to L. B. Elliot, district engineer, office of the district engineer, Edmonton, and endorsed "Tender for the purchase of material at Goose Islands, Alta.," will be received until September 4th, 1912.

Moncton, N.B.—Tenders for laying water mains in the city of Moncton, according to plans and specifications, which may be seen at the city engineer's office, and where forms of tender may be obtained, will be received until noon of September 1st, 1912. J. Edington, city engineer.

Montreal, Que.—Tenders for moving the Queen Victoria monument on Victoria Square from its present position to the centre of the square, will be received by the Board of Commissioners, City Hall, until noon of August 29th, 1912. Full information may be obtained in the office of the Engineer Superintendent of the Road Department. L. N. Senecal, secretary, Board of Commissioners, City Hall, Montreal.

Ottawa, Ont.—Tenders addressed to L. K. Jones, Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, will be received until the 12th of September, 1912, for the construction of the section of the Hudson Bay Railway from Split Lake Junction to the Hudson Bay Terminus. Plans, etc., can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Chief Engineer of the Hudson Bay Railway, Winnipeg. (See advt. in The Canadian Engineer).

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, Secretary, Department of Public Works, Ottawa, will be received until August 26th, 1912, for interior fittings, post office, at Port Hope, Ont. Plans and specifications to be seen on application to Mr. James Curtis, caretaker, public building, Port Hope, Ont., Mr. T. A. Hastings, Clerk of Works, Postal Station "F," Toronto, and at the Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, Secretary, Department of Public Works, Ottawa, will be received until August 28th, 1912, for the construction of a wharf at Upper Maugerville, Sunbury County, N.B. Plans, etc., can be obtained at the Department, and at the offices of J. K. Scammell, Esq., District Engineer, St. John, N.B., and on application to the Postmaster at Upper Maugerville, N.B.

Ottawa, Ont.—Tenders addressed to L. K. Jones, Assistant Deputy-Minister and Secretary, Department of Railways and Canals, Ottawa, will be received until noon of September 14th, 1912, for wall at Smith's Falls. Plans, etc., can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa ,and at the office of the Superintending Engineer of the Rideau Canal, Ottawa.

Ottawa, Ont.—Tenders addressed to L. Pereira, Acting Secretary, Department of the Interior, Ottawa, will be received up to noon of September 25th, 1912, for the furnishing of iron posts for the use on the survey of Dominion Lands. (See advt. in The Canadian Engineer).

Ottawa, Ont.—Tenders will be received up to August 31st, 1912, for the purchase of the plant and good will of the Standard Machine Company, Ottawa, Ont. G. H. Bindon, 709 Hope Chambers, Ottawa, will furnish particulars and receive the offers.

Ottawa, Ont.—Tenders will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until September 5th, 1912, for the erection of houses for boatmen and assistant caretaker, Quarantine Station, St. John, N.B. Plans, etc., may be seen on application to Mr. D. H. Waterbury, Superintendent of Public Buildings, Public Works Department, St. John, N.B., also at the office of the Secretary of Public Works, Ottawa.

Ottawa, Ont.—Tenders for the construction of an extension to the breakwater at Souris, King's County, Prince Edward Island, will be received until September 11, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of Jas. B. Hegan, Esq., district engineer, Charlottetown, P.E.I.; C. E. W. Dodwell, Esq., district engineer, Halifax, N.S., and on application to the postmaster at Souris, P.E.I.

Ottawa, Ont.—Tenders will be received until September 4th, 1912, for the construction of a brick and stone station at Point Tupper, Cape Breton. Plans and specifications may be seen at the office of the Secretary of the Department of Railways and Canals, Ottawa. at the station master's office at Point Tupper, C.B.; and at the chief engineer's office, Moncton, N.B. A. W. Campbell, chairman Government Railways Managing Board, Ottawa.

Ottawa, Ont.—R. C. Desrochers, secretary, Department of Public Works, will receive tenders until August 28, 1912, for the construction of pile bent and timber decking wharf at Comaplix, district of Kootenay, B.C. Plans, etc., can be obtained at the department and at the offices of F. W. Aylmer, Esq., district engineer, Chase, B.C.; C. C. Worsfold, Esq., district engineer, New Westminster, B.C.; L. B. Elliott, Esq., district engineer, Edmonton, Alta.; and on application to the postmaster at Comaplix, B.C.

Port Arthur, Ont.—Sealed tenders for the heating and plumbing of a twelve-roomed school will be received up to September 1st next, by Secretary Morgan, Board of Education, Port Arthur, Ont. Plans and specifications may be seen at the offices of Messrs. Hood and Scott, architects, [illegible]

Port Arthur, Ont.—Tenders are called for excavation and [illegible] Plans and specifications can be seen at the Dock Company's office. Tenders must be in by the 25th of August, [illegible]

Port Arthur, Ont.—Tenders for railway materials will be [illegible]

Port Arthur, Ont. [illegible]

Toronto, Ont. [illegible]

Victoria, B.C.—Tenders will be received at the office of the Board of School Trustees, until August 27th, 1912, for the erection and completion of a six-room brick and reinforced concrete school building on the corner of Lionel Street and Adelaide Road, Oaklands. Drawings and specifications may be seen at the office of C. E. Wood Watkins, Architect. Victoria.

Winnipeg, Man.—Tenders addressed to the Chairman of the Board of Control, will be received at the office of M. Peterson, secretary, Board of Control office, Winnipeg, until noon of August 29th, 1912, for supply of all labor and material for the complete installation of navigation lights on the Redwood Avenue Bridge and the Louise Bridge. Plans and specifications, etc., may be obtained at the office of the city electrical, City Hall.

CONTRACTS AWARDED.

Calgary, Alta.—Messrs. Hayden and Skene have been awarded a contract, by the Canadian Pacific Railway, Department of Natural Resources, to construct the residences and outbuildings on fifty-four ready made farms belonging to the company. The estimated cost for this work is $150,000.

Canora, Sask.—At a meeting of the town council the Northeast Electric Co., of Regina, were awarded the contract to install a $20,000 electric lighting system in this [illegible]

Moose Jaw, Sask.—The tenders for the twelve panel switchboard for the new power house were opened by the City Commissioners. Five firms tendered on the work, which includes the furnishing of the switchboard, and also the installation. The tenders and prices were as follows:—Allis-Chalmers Electric Company, $4,700; Northern Electric Company, $5,500; Mariner Electric Company, Limited, $5,000; Canadian General Electric Company, $4,150, and with regulator, $700 extra; Canadian Westinghouse Company, $6,039. The tenders were referred by the Commissioners to Supt. Peters to bring in a report and recommendation.

New Westminster, B.C.—The contract for the erection of the Royal Columbian Hospital has been awarded to Messrs. Adkinson and Dill, of Vancouver, at a contract price of $135,000. Messrs. Lees, Limited, have the contract for the electrical work of the building, the price being $5,900.

Ottawa, Ont.—Mr. A. Farley was awarded the contract for the laying of a mile of concrete sidewalk in the village of Eastview, his price for the work being $11,264.60.

Ottawa, Ont.—The contract for the proposed new Government elevator to be constructed at Port Arthur has been given to Barnett-McQueen Company, Limited, of Minneapolis. The price specified was $1,179,500, and the time set for its completion, September 15, 1913.

Ottawa, Ont.—Messrs. H. C. Hitch and Company, Ottawa, have been awarded the contract for the erection of an extension to the hospital of St. Luke. This work is to cost $100,000. Messrs Horwood, Taylor and Horwood are the architects.

Port Arthur, Ont.—The contract for a 3,000,000 bushel addition to the Canadian Northern elevator has been awarded to Messrs. Barnett-McQueen Company, of Minneapolis, their contract price of $1,179,500 being $335,000 below lowest tender of one Toronto and three Montreal companies. Work [illegible]

Port Arthur, Ont.—The Department of Public Works, Ottawa, has arranged with W. E. Phen and Co., contractors, [illegible] also.

St. John, N.B.—Contracts for the new automobile factory [illegible]

Tarvia
Preserves Roads
Prevents Dust–

Main Street, Wolfville, N.S., Constructed with Tarvia X.

Millions of Yards Treated

FOR a hundred years macadam roads have been standard. The motor driven vehicle, however, added a new destructive element to road wear that macadam had not provided for. A stronger binder than stone dust was found necessary to hold the road together under this traffic.

The new conditions brought forth a variety of bituminous binders. Of these Tarvia, manufactured from refined coal tars, was the first to be used and is now standard for this purpose.

Tarvia is made in three grades—"Tarvia X" for road and pavement construction. "Tarvia A" for hot surface application, and "Tarvia B," applied cold, for dust prevention and road preservation.

Millions of yards of macadam have been successfully tarviated in all parts of the country. The use of Tarvia waterproofs the macadam, prevents its disintegration, keeps down the dust and gives a surface that is smooth, well bonded and automobile-proof.

Towns and cities which have used Tarvia for a number of years are proud of their roads and pavements, while the records show that its use has been most economical—the saving in maintenance expenses having generally more than paid for the cost of the treatment.

Booklet showing roads in various parts of the country treated with Tarvia and giving details of the process mailed free on request.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

St. John, N.B. — The municipal council have awarded a contract to Mr. Fred. Nice for the opening and refilling of a trench for the water main on Queen St. on a basis of $2.75 for rock and 60c. for earth per lineal foot; and for similar work on Clarendon Street at $3.84 and 70c.

St. John, N.B.—The municipal commissioners recommend that the tender of Tobias ad George for constructing sewer renewals on Hazen Alley, Paradise Row and Main Streets be accepted, namely:

45 inch concrete sewer, $7.50 per lineal foot.
24 inch concrete sewer, $6.75 per lineal foot.
18 inch terra cotta sewer, $1.75 per lineal foot.
15 inch terra cotta sewer, $1.60 per lineal foot.
12 inch terra cotta sewer, $1.50 per lineal foot.
Manholes, $5.00 each.
Catch-basins, $75.00 each.

Township of York, Ont.—The contract for the construction of concrete sidewalks on Elliott Street has been awarded to Messrs. J. Richardson & Son, 95 Jersey Ave., Toronto, for $3,450.

Vancouver, B.C.—On the recommendation of the city engineer the following paving contracts were awarded:—Keefer Street, Main to Campbell, Ledingham and Cooper, $65,570; Hornby, Pender to Davie, Ledingham and Cooper. $52,790; Hastings, Columbia to Main, McAdam Construction Co., $7,280; Main, north and south of the bridge, T. R. Nickson and Co., $28,000; Seaton, Burrard to Bute, T. R. Nickson and Co., $20,854; Columbia Street, Broadway to [illegible]

Vancouver, B.C.—A five-story mill construction hotel building for Mr. L. Melekov, will be erected at a cost of about $75,000. Mr. E. J. Ryan is the contractor, while the plans are being prepared by Mr. W. T. Whiteway.

Victoria, B.C.—Two new contracts on the Island division of the Canadian Pacific Railway on the McBride-Courtney extension have been awarded, Messrs. Culleton Brothers, of Spokane, being the successful tenderers, on an additional five-mile contract, beyond their present ten miles north of McBride Junction; and a five mile section south-west from the Trent River was awarded to Mr. J. W. Heard, of Victoria.

◆

RAILWAYS—STEAM AND ELECTRIC.

Montreal, P.O.—The municipal board of control have granted the Canadian Autobus Company a ten year franchise to operate on the streets of this city.

St. Lambert, Que.—In connection with the new yard which the Grand Trunk Railroad is building on their main [illegible] a contract to the John S. Metcalf Co., Limited, Montreal and Chicago, for a twenty-seven stall roundhouse, together with turn-table pit, machine shop, water supply system and accessories. Roundhouse will be of concrete and brick con- [illegible]

◆

LIGHT, HEAT AND POWER

Hamilton, Ont.—[illegible]

Moose Jaw, Sask. [illegible]

Treherne, Man. [illegible]

◆

FIRES

[illegible] **B. C.** [illegible]

GARBAGE, SEWAGE AND WATER.

Brantford, Ont.—The municipal water commissioners have recommended that a four-inch water main be constructed on St. George Street, also a four-inch main on Hart and Esther Streets. T. H. Jones, city engineer.

Kerrobert, Sask.—The ratepayers have voted to install an $82,000 water works and fire fighting system. Messrs. Chipman and Powers are the designers and will call tenders in the course of a few days.

Niagara Falls, Ont.—The ratepayers will vote on a by-law calling for the expenditure of $7,500.00 on a new centrifugal pump. J. C. Gardner, city engineer.

Regina, Sask.—Mr. T. Aird Murray and Dr. M. M. Seymour, Provincial Medical Health Officer, recently paid a visit to Qu'Appelle to oversee well drilling operations going on at that point and to make investigations regarding the quality of the water.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Aylmer, Ont.—Mr. George W. Howse is making preliminary plans and estimates for the erection of a brick block.

Galt, Ont.—The management of the Galt Robe Works have arranged to build an addition to their present plant at a cost of $17,000.

Gerrard, B.C.—The Dominion Department of Marine and Fisheries will erect a large fish hatchery at this point Mr. F. A. Starkey, president of the Associated Boards of Trade of Eastern British Columbia is interested in the matter.

Lethbridge, Alta.—A letter received by the municipal authorities states that a contract calling for the erection of a new post office will be awarded within a few weeks by the Department of Public Works, Ottawa. The estimated cost of this work will be about $225,000.

Medicine Hat.—The management of the Alberta Glass Company have started work on their new plant. The building will cost about $10,000, and there will be required about $70,000 worth of machinery. Mr. W. Walch has been awarded the contract to erect the factory.

Port Arthur, Ont.—The Royal Hotel has been sold to Mr. Theo. Williams, of Winnipeg, Man., acting for an English syndicate and it is reported that a number of large stores will be erected.

Regina, Sask.—The Hospital Board have authorized the calling of tenders for the erection of a power house and laundry building to cost $75,000.

Sydney, C.B., Nova Scotia.—A report states that the management of the Alexander Cross Fertilizer plant are considering plans for the doubling of their present manufacturing facilities. C. R. Walker, general manager.

Toronto, Ont.—A report states that the management of the Canadian [illegible] will construct a large wharf at the foot of West Market Street 600 feet long and 100 feet in width.

◆

BRIDGES, ROADS AND PAVEMENTS.

Bath, N.B.—Shiktehauk Stream railway bridge on the [illegible] has been [illegible] washed out about [illegible] the bridge out of plumb, [illegible]

Moose Jaw, Sask.—The incinerator recently installed has [illegible] consumed.

48 in. CONTINUOUS STAVE LINE.

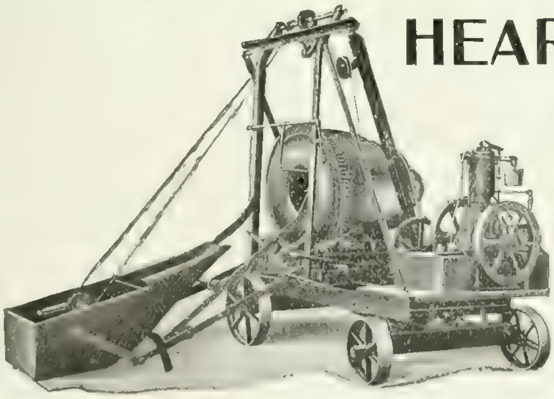
Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

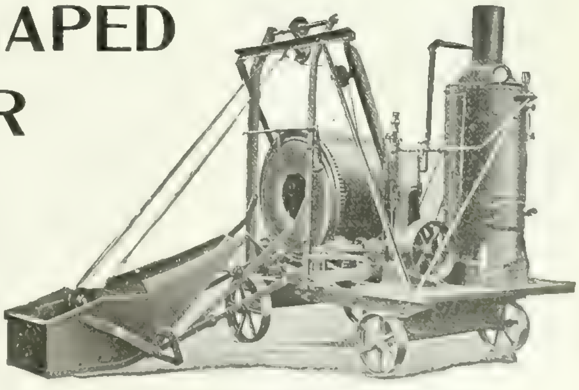
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER
HEART-SHAPED MIXER



Write for 1912 Catalogues.



The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE, TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH. BUFFALO, N.Y.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.,
316 Lagauchetiere St., W.,
Montreal, Que.

Second Narrows, B.C. Plans and specifications of the Second Narrows bridge are practically completed with the exception of those portions depending upon the width of the draw span, and at a meeting of the Burrard Inlet Tunnel and Bridge Co. it was decided that construction work should start as soon as possible, the plans to include an opening span of 200 feet, in accordance with the order of the Railway Commissioners.

Vancouver, B.C. The Parks Commissioners have awarded a contract to have all the roadways oiled by a private firm once a month for the sum of $140.

Victoria, B.C.—The ratepayers of a certain section of this city are angered over the action of the British Columbia Telephone Company in attempting to tear up a pavement just two weeks old. It is probable that an injuction will be secured to refrain this action on the grounds that repaired pavement is inferior to that first laid.

Winnipeg, Man.—The municipal council has given notice of its intention to construct a sewer on Edward Street at an estimated cost of $341. Col. N. H. Ruttan, city engineer.

CURRENT NEWS.

Calgary, Alta.—The ratepayers will vote on the following by-laws, August 23rd:—To spend $405,000 on the enlargement of the water plant. To grant $150,000 to the Board of the Calgary General Hospital to be used in construction work. To spend $32,000 on the purchase of a portion of land to be used for public works purposes.

Cheam Lake, B.C.—W. B. Ellis, of Vancouver, has applied for a lease of the submerged bed of Cheam Lake in the railway belt of British Columbia, for the purpose of pumping or dredging from the lake a deposit of disintegrated lime to be used for fertilizing purposes. The department of agriculture for British Columbia recommends that the lease be granted as there is a great need for crushed lime rock for fertilizing. The term of the lease proposed is five years.

Edmonton, Alta.—A clause in the new building regulations adopted by the municipal council states that all buildings erected in future shall not be of a greater height than ten stories.

Montreal, P.Q. On the mornings of Thursday, August 29th, and Friday, August 30th, there will be held by order of the Board of Control, an auction sale of building materials, stone, brick, wood, etc. The purchaser will be required to [illegible] buildings. Further particulars may be had from [illegible] of Board.

Port Arthur, Ont. [illegible] will vote September 16, on the question of [illegible] the alternative [illegible] from one to two years.

Victoria, B.C. [illegible]

Victoria, B.C. [illegible]

CITY ENGINEER'S REPORT, HAMILTON, ONT.

According to a report recently received from the office of A. F. Macallum, city engineer of Hamilton, Ont., expenditure of public moneys on municipal engineering work has been well proportioned and in many instances well within the amount set aside in the appropriations and may be tabulated as follows:—

Sewers expenditure to Dec. 31st, 1911	$ 6,78[illegible].10
Board of Works expenditure	105,606.60
Sewage disposal expenditure	21,454.50
Street lighting expenditure	39,680.58
Street watering expenditure	27,795.12
Waterworks expenditure	66,991.67
Garbage expenditure	42,354.78
Permanent roads expenditure	123,722.98

The local expenditures for the same period are tabulated thus:—

Sewers	$231,289.57
Cement walks and curbs	44,377.05
Waterworks construction	105,108.23
Roadways	10,097.73

During the year several alterations and changes were made in and about the Beach pumping station. A battery of five new boilers was placed in connection with the steam pumping engines, and these engines repaired and placed in good condition. Valves were placed in the wells and conduits so that each well and either conduit could be cut off if necessary. One conduit across the Lottridge inlet was uncovered and surrounded with six inches of concrete. This conduit was also emptied and repaired from within throughout its length wherever necessary.

While the electric pumps, recently installed, each pumped 6,000,000 gallons, as guaranteed, together they pumped but 10,500,000 gallons per twenty-four hours. By enlarging the impellers, which has just been done, this deficiency has been overcome, and the combined capacity of these pumps is now over 13,080,000 gallons per twenty-four hours.

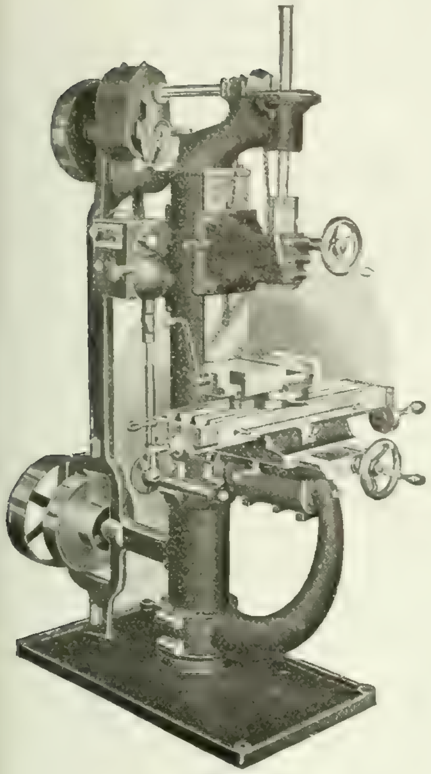
The crib on the end of the short intake to the lake, having been destroyed by ice, was rebuilt, and there is now less danger from blocking up with ground ice.

A new air compressor was placed in the Wentworth Street pump house, and a smaller one of insufficient capacity removed.

The present population of the city is 82,095; the acreage is 6,260, and the assessed value is $52,749,884.

NOVEL CANAL BOAT.

A railroad car driven by axle motors supplied with energy from a power plant carried on board, was recently tried out with considerable success in this country, but what will doubtless prove to be a still more novel combination is expected to appear on the Canadian canals in the near future. This will be a freight ship operating on the same plan, equipped with internal combustion oil engines, shaft-connected to dynamos instead of to the propeller, and the electric power thus developed will be used for driving the screw and handling the other mechanical equipment of the vessel, the captain handling them by switches from a bridge. Many experiments have been made along this line during the past few years in Scotland, and a fifty-foot model vessel was built and successfully operated before the contracts for the ship were let. Although it will be next year before the vessel appears in Canadian waters, the experiment is being watched in naval circles with great interest, and if it proves a success it is likely to be widely adopted not only for canal and lake work, but



You Need a Machine Like This on a Dozen Different Jobs

It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows :—Spindle of crucible steel, ground bearings ; working surface of table, 29 × 8½ inches ; feed, longitudinal and transverse ; floor space, 60 × 68 inches ; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

[illegible] for the smaller types of war vessels in the British [illegible]

This novel vessel has just been contracted for by the Montreal Transportation Company as the outcome of suggestions and designs made by Messrs. John Reid & Co., of Montreal and Glasgow, with the Electric Marine Propulsion Company, of Glasgow, who are working out this new system of marine progress. The ship is being built to their plans by the Swan, Hunter, Wigham & Richardson firm, while the electric system to be adopted is the invention of Mr. H. A. Mavor, of Glasgow, who has taken a leading part in the adaptation of electricity to marine propulsion.

OLD TIN CANS.

Before the invention of the automatic solder wiper the collection of old tin cans and the heating of the same over a slow fire for the collection of the solder formed the means of profitable employment to certain rag and metal junk men in some of the larger cities in the United States. There has not been much heard of the industry of late owing largely to the economy of the manufacturers in the making of the tin and of the recent improved seam joint that permits of the manufacture of a water-tight can without the use of solder. Lately, however, a firm in Germany began to buy up shipments of scrap tin all over the world and had certain lines of tramp steamers call at stated periods and remove the rubbish from the manufacturing plants. The operation has proved so successful that they are now making propositions to many of the municipal authorities in the larger cities with a view of purchasing all the old tin cans that are now collected as garbage. The offer, as made to the city of Montreal, states that two tin presses would be forwarded and loaned to the council free of charge and that the sum of $6 per ton would be paid for the materials f.o.b., and it was suggested that the garbage collector throw the tins to one corner of his wagon as he makes his daily rounds. The German metallurgists detin the scrap and then melt the sheet iron for pig.

WATER PURIFICATION.

In the presidential address at the annual meeting of the Institution of Water Engineers, recently held in Cheltenham, England, Mr. J. S. Pickering, after a reference to works of [illegible] large [illegible] under construction in this country, urged the vital importance of the quality of a public water supply. Whatever might be the nature of the supply itself constant supervision by a competent engineer and staff was absolutely essential, and what was equally important was systematic and methodical ex[illegible] practice in submitting samples for analysis and bacterio[illegible]

[illegible] initial cost, and working expenses, and might frequently be used where a slow sand filter would be impracticable. The pressure-filter had been given preference over the gravity-filter, chiefly because it could be introduced on the service-main without much loss of head. Mechanical filters, properly arranged, would give as good results as slow sand-filters. The weak point in both types was their impaired efficiency after cleaning, but whereas the former generally had to undergo this operation very thoroughly at least once a day, the latter might continue for weeks without even the surface film being removed.

In many cases where ordinary slow sand-filters were in use, mechanical filters might be introduced as pre-filters with considerable advantage. Experience had proved that after the filtering skin had been removed a filter lost much of its power to remove the micro-organisms from the water, and it was only after running the water to waste for some time and reducing the speed of filtration that it gradually regained its efficiency. These precautions were recognized as necessary by all water engineers, but those who had charge of filters realized the difficulty of carrying them out in practice, particularly as there were no means of really testing the work a filter was doing except by bacteriological examination of the filtrate. As a safeguard, then, against the inefficiency of a freshly scraped filter, and as a second line of defence, as it were, against the passage of pathogenic bacteria into the supply mains, pre-filters were of the greatest value.

Sterilization.—The time would probably come when nothing short of complete sterilization would be acceptable. Many substances were capable of destroying infectious germs, but their application to drinking water had been rendered objectionable owing to a harmful residue left in the water after treatment. The use of ozone was not attended with this difficulty, and in recent years this had been adopted for the sterilization of the water supplies in many large towns. The chief disadvantage was the cost of working, and, until this could be greatly reduced, the process was not likely to become extensively used in this country. The use of hypochlorites had met with success, and had the advantage of being comparatively inexpensive in working. The bactericidal action of the ultra-violet rays had also been applied to the sterilization of water on a fairly large scale. In the "De-Clor" system, in operation at Reading, through the agency of a minute dose of chlorine the objectionable bacteria were destroyed, and the residual chlorine was eliminated by means of charcoal placed within the filters. The "De-Clor" apparatus took the place of ordinary sand filters, the river water undergoing preliminary treatment through coarse pre-filters.

CENTENARY EXHIBITION OF STEAM NAVIGATION IN EUROPE.

Captain James A. Stewart, of 551 Tenth Avenue, Vancouver, B.C., has in his possession a copy of an advertisement of August 5th, 1812, dealing with the Comet, the [illegible] in Europe. The advertisement [illegible]

"Steam Passage Boat, The Comet, between Glasgow, Greenock and Helensburgh, for passengers only. The [illegible] fitted up a handsome vessel to ply upon the River Clyde between Glasgow and [illegible] wind, air and steam, he [illegible] the Broomielaw on Tuesdays, [illegible] and to leave Greenock on Mondays, Wednesdays and Fridays in the morning, to suit the tide.

Volume 23 Toronto, August 29, 1912

Contents of this issue on page 389

The Canadian Engineer

An Engineering Weekly

EDMONTON BENCH-MARKS.

By C. C. Sutherland, Roadways Department, Edmonton, Alberta.

The first bench-mark in the city of Edmonton was chosen on top of a stone ledge of the Bank of Nova Scotia. From this ledge levels were carried out and other bench-marks established, generally on the rim of manhole covers or on nails in electric light or telephone poles.

With the improvement of streets the manhole covers were adjusted and the poles removed, so that it soon became necessary to put in some permanent bench-mark system.

In 1908 a number of brass bolts, turned up at one end, were placed in public buildings throughout the business section of the city. The cost of the brass bolts was $1.25, and when established made a bench-mark costing approximately $3.25 each.

It was intended that as a district developed a complete system of bench-marks would be installed in this way, but for some reason the heavy buildings in the city do not stand well on this soil, and hence do not make good bench-mark supports. For example, we placed a bench-mark on the new Government post-office, and found by comparing it with old-established bench-marks that after one year it had settled 0.10 of a foot.

During the fall of 1909 bench-marks were placed at street intersections over a part of the city. These were made by boring a six-inch hole in the ground to a depth of four feet and refilling with concrete. In the top of the concrete was placed a rounded cast-iron bolt. The location of these bench-marks was kept as uniform as possible, being placed one foot off main streets and six inches from the property line. By this location it came at the inside edge of the plank walk, and was not disturbed by building operations except in some cases where the grade was lowered. The costs when complete was approximately $5. In dry, well-drained soil the elevations seem to remain constant, but in wet places it is found that the bench-marks have risen, probably due to frost.

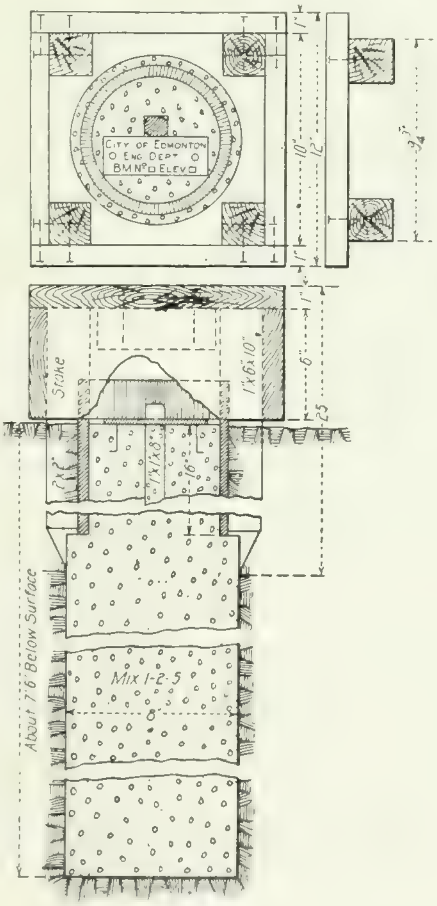


Fig. 1.

In view of these facts it was thought advisable, in the spring of 1911, to lay the basis for a complete new system. As the city is crossed and recrossed with railways, it was decided to place this system along the right-of-way of the different railways, each bench-mark being about one-half mile apart. Upon the advise from the railway engineers they were located two feet from the boundary of the right-of-way as the position least liable to be disturbed.

These bench-marks were made by boring an eight-inch hole seven feet six inches below the general ground elevation and refilling with concrete. The last eighteen inches of concrete was placed in a piece of six-inch cast-iron water pipe, which acted as a casing, and allowed the top of the bench-mark to be raised six inches out of the ground. In the top of the concrete was placed a square brass bolt, 1 x 1 x 8 inches long, and a brass number plate, as shown on Fig. 1. The bench-mark was then covered with a wooden box, made with four pointed legs, that were driven down over it.

In establishing the levels in this main system the original elevation was taken from the top of the brass bolt in the corner of the Bank of Nova Scotia, this elevation being transferred from the stone ledge above it, which had been taken as the first bench-mark in the city. From there levels were carried to bench-mark No. 1, and hence around the system.

In carrying the levels two rods were used with each instrument, and by cross-reading two turning points were obtained for each set-up. The ground was covered three times, and an average of the six elevations taken. The closing error in approximately thirteen miles was 0.06 of a foot, this error being distributed proportionately to the distance from bench-mark No. 1. This formed the outline of a rectangular system, having its longest sides above two miles apart.

From this main system secondary bench-marks are run out to cover the entire area within the city limits. The secondary bench-marks are of three kinds: those used in undeveloped and outlying districts; those constructed in boulevard or residential districts, and those constructed in business districts. In the outlying sections of the city it is found that a railway spike driven in a telegraph or electric light pole makes a good bench-mark. The pole may be painted white underneath the spike and the elevation painted on in red.

For residential districts a bench-mark similar to the main system is placed in the parking of the boulevard, and is located out from the corner of the block so that it may be seen from different directions. In some localities it may be desirable to use the cast-iron cover instead of the wooden box.

In business districts, where the entire area is covered with sidewalks or roadway, we are locating bench-marks in the sidewalk area, at a corner along a property line, and three feet back from the curb face. The construction, which is shown in Fig. 2, is similar to that used in the main system, except that it is fitted with a cast-iron cap that locks into the iron casing. This cap is brought flush with the sidewalk level. By placing this bench-mark three feet back from the curb face it is out of the way of telephone or electric light conduits, and may be seen from four ways on intersecting streets. Where possible, those bench-marks established on buildings which have had time to settle and those of the earlier systems are used as secondaries.

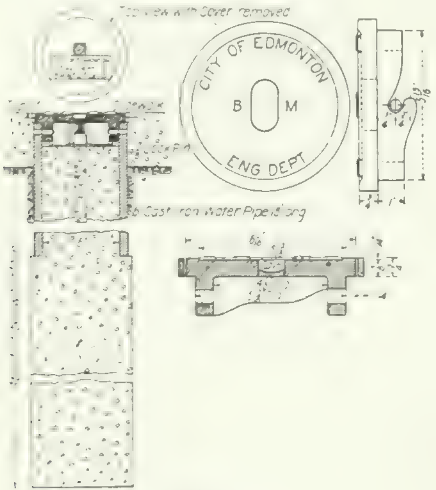


Fig. 2.

The city has now a belt line of bench-marks running two miles apart throughout the length of the city. The elevations, as shown by the closing error, are nearly perfect. From this belt line secondaries are run out a mile on each side. This gives a system of elevations distributed over the total area of the city that are as correct as it is possible to make them with an ordinary engineer's level.

◆

THE GRAND RIVER CONTROL.

The Ontario Government was approached on Wednesday, August [illegible], by a deputation representing the Grand River Improvement League. The deputation asked that a commission be appointed to investigate the conditions existing along the Grand River, and to recommend some method of improvement of conserving the water supply, prevent flood [illegible], and to [illegible] the advisability of instituting some plan of river control by a Board of Commissioners. The deputation was a large and influential one, representing [illegible] Mr. J. T. Jaffray, of Galt, [illegible] of the League, head of the committee. Mr. L. H. Breithaupt, M.L.A., C.E., presented the engineering aspects of the situation to the members of the Government.

[illegible] the different [illegible] were presented, Premier [illegible] expressed [illegible] sympathy with the movement and stated the Government would consider the [illegible] as [illegible] with regard to the entire province.

Mr. Breithaupt's argument is given in full herewith.

The Grand River from its source in Melancthon Township, Dufferin County, within twenty-four miles of Georgian Bay, to its outlet into Lake Erie, below Dunnville, has a length along its windings of approximately 140 miles. Its course is mainly southerly. Its drainage basin contains approximately 2,600 sq. miles, about one-sixth the area of the peninsula of south-western Ontario, and comprises nearly the whole of the Counties of Wellington, Waterloo and Brant and parts of Dufferin, Halton, Oxford, Wentworth, Norfolk and Haldimand. Tributaries of the Grand River are the Conestogo from the west, rising near the source of the main river, the Speed from the east, and the Nith from the west.

In topography South Western Ontario presents a high tableland, at elevation of from 1,400 to 1,700 ft. above sea level, near the northerly limit of the peninsula with slopes, abrupt toward the north and east, gradual toward the west, and at first steep, then gradual and becoming flat, toward the south-west and south, to the almost level rim of water of Georgian Bay and Lake Huron, with elevation of 581 ft. above sea level and Lake Erie, elevation 572. Its original condition was one of dense forestation. This has, except to small extent, disappeared, without, however, materially affecting precipitation, rainfall and snowfall, as shown by records extending over the past 60 years; the large surrounding bodies of water maintain humidity.

On or near the high table land rise practically all the larger rivers of the peninsula. Originally half or more of this headwater area was in dense swamp, excellent natural reservoirs for maintaining streamflow. During the past thirty to forty years these swamps have also been cleared and drained so that very little of them remains.

The great change that has come with deforestation of the country has been in the rate of run-off, of water precipitation, as shown in the flow of streams. Where formerly run-off was retarded and stream flow well sustained, the water now goes off rapidly, with the result that there are great floods at times of snow melting and floods after any heavy rain, with smaller stream beds dry and larger ones approaching that condition, during the dry months of the year.

The upper part of the Grand River, extending well into Waterloo County, and including the Conestogo tributary, is the part on which fluctuation of flow most largely depends. The drainage area of the upper river is at first flat and extended; further along it is steep.

High floods occur only once in the year, in the spring, with snow melting on the upper river. These floods have steadily become higher and the low water flow less. This year occurred the highest flood on record, in quantity of water discharge.

The prevention of damage by floods is to large extent practicable in many places by enlarging the regular waterway and by raising the banks by means of levees or dykes. This is well demonstrated on the Grand River by what the city of Brantford has done. Such control gives local relief only, and this is the only benefit. A method of control which benefits the whole river below where it is applied, and gives not only flood relief but also the great benefit of sustained flow, is of much greater advantage. Such a method is storage in sufficient quantity. Reforestation on a large enough scale to have proper effect would require so large an area as to render it of doubtful practicability on the Grand River.

The conditions determining requirement for storage are:

(a) The flood flow of the river;

(b) The amount of sustained flow, for low water period, that can be provided for.

The maximum flood discharges this year, obtained approximately at Elora, at St. Jacobs on the Conestogo, at Bridgeport, at Galt, and at Brantford, demonstrate that if a flow of 12,000 to 15,000 cub. ft. per second for 48 hours can be held, flood control is entirely practicable, and enough water can be stored to give a minimum flow of 400 to 500 cub. ft. per second throughout the low water period and therefore throughout the year.

The drainage area of the main river above Waterloo Township is approximately 460 sq. miles, and that of the Conestogo River to its outlet approximately 330 sq. miles. Precipitation on this area is indefinitely known; it is taken to be between 30 and 40 inches of water per annum. On run-off there are no data. It appears likely that the minimum run-off is not under 12 inches of the precipitation, and this for 600 sq. miles of drainage area would give sufficient water.

A dischargeable storage capacity of two and one half billion cubic ft. would be ample to effect the desired purpose. This would mean an area of 5 sq. miles with 18 ft. average depth. It could be in several separate basins. The first thing to be ascertained is whether the topography of the river valley offers suitable basins and in location with enough contributary drainage area. There are various sites that appear to be well adapted.

The minimum summer flow on the lower part of the upper river (from a drainage area of more than 800 sq. miles) has been under 40 cub. ft. per second, while the maximum flood flow this spring at the same place was approximately 24,000 cub. ft. sec.; the low water flow one-sixth of one per cent. of the maximum flood flow.

A sustained flow of 400 to 500 cub. ft. sec. would mean a gain of 4,000 to over 5,000 h.p. on existing water power developments on the lower river alone and there would in addition be large available horse power, below the range of lowest level, at the storage basins. The gain in water supply, sanitation, and general benefit, due to well sustained flow of the river would be inestimable.

GRAPHITE MINING IN CEYLON.

An interesting account of the methods of mining graphite in Ceylon, the largest producer of this useful mineral, is contained in an advance chapter on graphite by Edson S. Bastin, of the United States Geological Survey, from "Mineral Resources" for 1911. The graphite is mined either from open pits or through vertical shafts connecting with underground workings. Most of the mines are not deeper than 100 feet, though a few go as deep as 400 or 500 feet. In a few mines steam pumps and hoists are employed, but as a rule the mining methods are still crude, the acme of mechanical ingenuity being reached in a windlass operated by five or six men for hoisting the graphite in a sort of tub. The workmen usually ascend and descend by means of rough wooden ladders, tied with jungle ropes, and rendered exceedingly slippery by the graphite dust and water.

The mineral as it comes from the pits is conveyed in bags to a dressing shed, where it is picked over and the impurities reduced to 5 or 10 per cent. It is then packed in barrels for transportation to Colombo or Galle. At these ports it is unpacked and submitted to further treatment known as "curing." The graphite merchants have fenced yards or "compounds" for the final preparation of the graphite for the market. The large lumps and the screened pieces are broken with small hatchets by Singhalese women to remove the coarser impurities, such as quartz, and are then rubbed by hand on a piece of wet burlap, and finally on a piece of screening to give them a polish. Finally, various grades coming from several mines or differing in size or texture are blended to meet the requirements of purchasers.

The poor material is usually beaten to a powder with wooden mauls or with beaters shaped like a rolling pin and is then sorted into different grades.

One of the most important uses of graphite is for lubricating. The addition of graphite to oil results in a lower frictional resistance than would be obtained by the use of oil alone. The quantity of oil required for a given service is also reduced and a lighter grade of oil may be employed without decreasing the quality of the lubrication. A small quantity of graphite only is required, and the benefits derived from its use persist long after the application has ceased. Both the amorphous and the crystalline varieties of natural graphite are extensively employed for lubrication.

The use of graphite in the manufacture of pencils is probably both its oldest and its best-known application. This industry in Germany and England is several centuries old, and many of the modern factories manufacture hundreds of varieties of pencils, yet the percentage of graphite used for this purpose is not large, being undoubtedly less than 10 per cent. of the world's production, and one authority estimates it as low as 4 per cent.

The manufacture of artificial graphite is conducted by means of the electric furnace, an anthracite coal carrying small amounts of evenly distributed impurities being the material from which the ordinary grades are made. For obtaining the purest grades of graphite, petroleum coke is substituted for anthracite. The process for the manufacture of graphite was patented in 1896 and its commercial development has been so rapid that at present the output of artificial graphite in the United States is greater than the whole domestic production of natural crystalline graphite.

WOOD PAVING BLOCKS.

Consequent upon several articles appearing in the Weekly Report of the Department of Trade and Commerce relating to the opening in Great Britain for Canadian wood paving blocks, the commissioner interviewed the Secretary of the Highways and Paving Department of the Manchester Corporation, and the following information was obtained, viz.:—

"The area of wood block paving laid in public streets in Manchester is 37,634 square yards.

"Nearly the whole of the above paving is laid with Australian hardwood, Karri and Jarrah; the remainder is creosoted English beech.

"Wood paving is not considered suitable to the traffic of Manchester, and team owners strongly object to it. It is a costly pavement to lay and maintain and in consequence of these objections it has been laid only in front of public institutions (hospitals, schools, &c.) and in places where applicants have paid the cost of laying it.

"There is no prospect of an increasing trade in Manchester. The sizes of blocks used are 3 inches wide, 8 inches or 9 inches long, and 4 inches or 5 inches deep for Australian hardwood, and 6 inches deep for beech. The Australian blocks are not specially treated, but the beech is creosoted.

"A new length of wood pavement, requiring about 50,000 blocks, is about to be laid opposite a school, and creosoted deal blocks 3 inches wide, 8 inches long and 5 inches deep are specified for the work. The blocks will probably be Baltic timber, and the creosoting will be carried out at the place where the blocks are sawn, i.e., probably at the port of entry.

"Prices for delivered into Manchester vary from £6 to £8 10s. per thousand blocks, i.e., deal blocks."

STREET CLEANING AND REFUSE DISPOSAL.*

By F. W. W. Doans, City Engineer, Halifax, N.S.

In this [illegible] it is admitted generally that sanitary science and public health have made such rapid progress as to become a part of the order of every careful person's life.

Public health and sanitary science have many and varied phases of approach. The medical officer keenly dissects from week to week the vital statistics of his district, for by so doing, he is enabled to discover the cause of death and disease, together with the locality where such are especially prevalent.

The measure of success which the sanitary inspector meets in the performance of his detailed work among the people often ranks with the diligence with which he applies preventive measures. "Prevention is better than cure," and the most eminent scientists and medical men of the day are ever striving not only to "cure" disease but to educate the community in the best methods which may be applied to "prevent" disease.

When disaster overtakes a citizen through a defective sidewalk, street or sewer, woe to the official who knowing of the defect, failed to remove the danger. His negligence will cost the town many dollars and may cost him his position, and his family bread and butter. Nay, more, it may cost a human life. Is not the man equally negligent who, knowing the danger to the health of his fellow-citizen and knowing also how that danger may be removed, makes no effort to give his fellow-man the benefit of his knowledge.

The foundation and the most important feature of sanitary science, is "scavenging." Sewers and water supply are secondary considerations if scavenging is neglected.

During the last century, our cities and towns have become congested areas, densely populated, and each producing a vast amount of filth in its midst. Irrespective of the many perhaps at present unavoidable unsanitary areas in almost every city and many towns, there will always remain to be dealt with the natural filth products from the population and business connected with all cities and towns.

It is because of this latter factor more especially, that within the last quarter of the century there has been brought to the front that great preventive science for the suppression of the cause of diseases, "scavenging," as applied through the machinery of a scavenging department under the control of a superintendent with scientific knowledge.

A few years ago this department was created in some of the larger cities when it was regarded as a luxury, but to-day the smallest town realizes that something similar is an absolute necessity. Why? Because it has become recognized generally that filth and noxious refuse in or around the centres of communities has more to do with the creation of disease than any other one [illegible]. Each town has [illegible]

[illegible]

The people who are tied to the town and more especially the slum area, have neither time nor thought for public or even personal health. The insanitary conditions of their district and its surroundings have become second nature to them, and if they think of them at all, they resign themselves to the conclusion that it is a penalty attached to their station in life, and must be endured.

It is here that scavenging can work wonders. This science properly applied, cleanses the streets, purifies the air these people breathe, the houses they live in, the shops they work in and the yards and recreation grounds (too often the streets) their children play in.

The principal that should control every scavenging department is to provide such measures as will enable it to get in touch with all the filth and refuse as soon as it is created and to keep hold of it until it is permanently destroyed. This immediate action will lessen the danger of it becoming disseminated. Dirt and refuse upon the roads, streets, or in the back yards of dwellings cannot be said to be under effective subjection. It is so only when it has been collected, stored in some suitable receptacles (whether it be a garbage cart or a sewer) and is on its way to final sanitary disposal.

There is no section of municipal work under the public eye so persistently as that of street cleaning. The public watch every movement and are prompt in lodging their complaints. The work is one which deals wholly with dirt in one form or another, and is always objectionable and an ever-present asset to the fault-finding taxpayer. Sometimes the objector has good grounds for complaint, consequently the object of any system of cleaning should be to remove the cause as rapidly as possible and with the least amount of inconvenience to the citizen. The object of street cleaning should not be to obtain a favorable appearance only, but to insure sanitary conditions.

Street sweepings consist of the waste products of hundreds and thousands of human beings and animals and include the constant wastes that are being thrown off by the industries in our midst, the debris caused by the wear and tear upon the road surfaces, the dust and dirt from the pulling down or repair of buildings, soot and fine ashes from hundreds, perhaps thousands of chimneys, twigs, bark, and leaves from trees, pollen seeds and spores of plants, the expectoration from human beings, the excrement and urine of dogs and horses, and the leakage of the contents of loaded vehicles both in transit and while loading and unloading.

Even the scavengers add very materially to the filth of a town. The horses contribute droppings and urine and the carts are sometimes so imperfectly suited to the duty they have to perform, as to distribute in part the filth they are supposed to collect.

The streets of a town are the avenues over which its produced filth has to be carried and each receptacle deposits its quota on the road as it journeys through.

Shopkeepers sweep out their collection of dust and dirt and housekeepers shake their mats on the highway to make a further addition to the miscellaneous accumulation of filth that finds its way into the streets and pollutes the air. This custom should be prohibited and each such offender should be obliged to dispose of refuse in such a way as will not menace the health of his neighbor.

If the public were only educated in these things and taught what not to do, many lives might be brightened and lengthened. As conditions now prevail we inhale particles of filth which are being continually stirred up by passing traffic. Our food and even the liquids we drink are affected by [illegible] of these street filth, that it [illegible] our clothes and [illegible] blackens our buildings and doubtless tends to lower vitality.

---

*Paper read before the Union of [illegible] Municipalities, [illegible].

Now what do we do with this filth? The custom in most towns has been to use it to fill up low places in streets and sidewalks in the suburbs, and low ground elsewhere. It is absolutely necessary that stringent regulations should be made and carried out under which street sweepings should not be deposited on roadways or sidewalks to make a wearing surface. On the roadway, passing wheels fling its fine particles into the face of pedestrians and from the sidewalk it is carried on hundreds of boots into the home. It should be used at finished grade only for the boulevard part of the sidewalk and should be covered with a thin coat of good soil and sown or sodded as soon as possible after it is deposited. On the travelled part of the road or sidewalk it should never be deposited except to fill up below grade and then only when it can be covered with good clean material. In all towns there are streets which require thousands of loads to fill them up to passable condition. Thousands more may be disposed of on the town property and when such town places of deposit are exhausted there are many private properties on which there is low ground to be filled up.

The deposits removed from the catchpits should be used exclusively for the redemption of waste land, but no such disposal of catchpit or street cleanings should be permitted except by permit from the local health authority. A record should be kept of such dumping grounds. The date and character of the deposit should be recorded and no permit should be given for the erection of a building on such made ground until the health authorities are satisfied that nature has rendered the foul matter harmless.

In Halifax for some years the ashes collected by the city scavengers have been used to fill up low places in streets and sidewalks. Recently nearly all such available material has been utilized for sidewalk repairs except that in the summer it is used as a frost cushion under concrete sidewalks. During the past year the City Health Board has protested against this practice, on the ground that outbreaks of such diseases as scarlet fever and diphtheria have been caused by it. Whether or not their contention is correct, I am not prepared to express an opinion to-day, but it cannot be denied that the danger is possible.

It is claimed that householders empty sweepings into the ashpan and not into the stove. Although this is done in violation of the regulations of the Health Board, it is by no means an easy matter to prevent it. Frequently the kitchen maid finds it much more convenient to empty the dustpan into the ashes than to remove for that purpose the pots and kettles that cover the fire. The dust and dirt particles which may include the scarlet fever carrier, pass under the scavenger's eye without detection and consequently the regulation prohibiting the removal of ashes mixed with any other matters fails to protect.

Another objection urged is that householders expectorate in the ashes. I must confess that I have not been convinced that this practice is so dangerous as the deposit of sweepings, yet while there is any danger it should not be defended. It is not desirable to encourage such a custom, yet next to the fire, the best spitoon for any householder who cannot afford a cuspidor, is the ashes.

By the time the ashes are turned out of the pan into the barrel, turned out of the barrel into the cart and turned out of the cart on the place of deposit, the sputum is well covered with ashes and is not such a menace to health as it is when deposited on the dry impervious pavements where it can dry up and blown about. The ashes contain carbon, charcoal and recalcined lime which are deodorants and disinfectants. It is doubtful, however, if the natural process of humification becomes active in ashes as soon as deposited.

The natural soil is primarily derived from the subsoil which may itself be regarded as the weathered portion of the underlying soft or hard strata. Science has taught us that the upper layers of the soil are teeming with forms of or-organic life whose hunger is inexhaustible and whose power of absorption is so active that anything that is even thrown on the surface of the ground speedily disappears, and whether animal or vegetable, becomes humified and so incorporated with the soil as to become actually indistinguishable from it.

In time the objectionable matter in the ashes would undoubtedly be reconstituted into harmless mould by the action of micro-organisms and earth worms. The doubt, however, respecting what may happen in the meantime, prohibits us from defending the general use of such ashes in repairing sidewalks in the neighborhood of residences. "Separation of ashes from all other refuse under whatever system of collection, is always more or less imperfect and incomplete. Some house or store dirt will find its way into the receptacle intended only for ashes, and house dirt is peculiarly exposed to infection and is doubtless often really infected dirt. Hence it follows that not even ashes can be regarded as certainly free from infection, while garbage must be recognized as peculiarly exposed to it. There is one class of ashes which is so little exposed to infection as to belong in a group by itself, and that is the ashes from factories and other large establishments into which food does not enter.

It would be safer to dispose of the house ashes in the same manner as suggested for street sweepings and the same precautions should be taken by the health authorities respecting buildings on such deposits.

The best method of disposing of the house garbage cannot be determined so readily. A brief statement of the problem with an outline of general methods adopted for its solution may be of timely interest.

In Minneapolis the citizens are required to drain off all moisture from garbage and to wrap the solid in paper before putting it in the garbage barrel or can. If the collector reports to the scavenging department that the garbage is not properly drained and wrapped in paper no further service is rendered until the rule is complied with. If the householder then fails to care properly for his garbage or have it cleaned up, he is brought into court and fined.

It is claimed that the drained garbage will neither smell badly in hot weather nor freeze and stick to the can in cold weather.

Under existing conditions in almost every town, the can or the barrel is frequently a greater nuisance than the garbage itself. In primitive days, the Indian when the offence from the waste product of his house-keeping became too noisome, moved away, but in our day and generation we remove the garbage and keep the odor. With the presence of heat, moisture and flies, garbage very soon becomes a foul, maggotty, fly-breeding mass of putrefaction.

In the humble opinion of the writer, the Minneapolis regulation is admirable, although it may be a half measure only. A by-law requiring the draining of garbage is a good regulation but only half as good as it would be if it provided for burning in the kitchen fire after draining.

At a house in Halifax, which I visit frequently, although it has been occupied for over a dozen years, not one ounce of kitchen garbage has been removed from the premises by the city. All garbage and other combustible refuse is burned in the kitchen stove, the burning being carried out when there is a good bright fire. A removable strainer basket is kept in the corner of the kitchen sink. It costs 50c. and will last for years.

Peelings, the scrapings of plates from the table, porridge, soup or vegetable pots, pans, &c., leaves from the teapot, solids in the dishwater after washing, all go into the strainer in turn, and shortly afterwards into the fire. Fat skimmed from soup, gravy, &c., is cooled in a cup or saucer and then burned. Bones meet the same fate. There has never been a garbage can about the premises nor has one been needed. The only refuse which requires removal is bottles and cans.

As a result of practical experience, therefore, it is claimed that a by-law compelling householders not only to drain their kitchen garbage but to burn it, would be a great improvement on the draining alone.

It would not be a panacea, however, for all garbage ills. In summer, especially, in some houses the cooking is done on oil or gas stoves. Hotels and boarding houses have too large a quantity of garbage to burn, while some means must be provided for disposing of the garbage from grocery, provision, fruit, meat and fish stores, and many other properties where there are no fires in summer.

The most important part of this problem which we are called upon to solve is the method of final disposal. When a town has advanced sufficiently in population and public spirit to warrant a co-operative effort to handle and dispose of its household waste, the method of disposition invariably adopted in the first place is to gather all the refuse which would create a nuisance and be a menace to health at the individual residences and haul it all to one spot where it is dumped. It will be admitted readily that this method although so widely used, does not really dispose of the nuisance. It simply changes its location, and as the town extends, new dumping sites have to be found, with the added expense of a longer haul in order to place the danger at a more or less safe distance. It is questionable, however, whether there is any safe distance within cartage limits of a town.

With our present day knowledge of the causes and dissemination of disease, two minutes thinking should convince anyone that to collect decaying and putrid vegetable and animal matter and spread it out in the open atmosphere is unsafe, insanitary and unscientific.

A visit to a refuse dump will show it to be a breeding place for flies, rats, etc., and a source of offensive unwholesome odors, which are carried by the wind for long distances. Flies from such a place may be expected to carry disease into any residence they may enter. The danger to public health is further increased by the sorting over of the refuse by men and women and boys, who find articles which they consider of value. The fact that these articles have been in contact for hours, perhaps days, with the mixed refuse and garbage, together with the fact that the articles are not likely to be free from filth and disease germs themselves, [illegible] the risk of [illegible] these [illegible] back again to the [illegible] of dirt and disease germs.

The [illegible] and refuse in a manner conforming to sanitary law, is becoming a matter of vital importance and should receive the immediate attention which so important a factor in the welfare of the town deserves. It is most essential that adequate means be provided for the efficient disposal of all decomposing refuse, including dead animals and night soil. Sanitary authorities agree that the complete destruction of garbage or a complete change in its characteristics is the only solution that will satisfy sanitary [illegible].

[illegible] which [illegible] the reduction [illegible].

[illegible]

The reduction method which consists of passing the garbage only, through a digestive process and extracting its oils and grease, is not popular for the following reasons, namely, that it is expensive to install, it is very difficult to carry on the process without causing a nuisance by offensive odors, it deals only with the garbage, and some other means must be provided for disposing of the night soil and remaining refuse. Separate collections must be made and the town must compete in the open market to sell its grease and tankage. In a few towns night soil is disposed of by dumping into large intercepting sewers. It must be done in an enclosed chamber and under town supervision. The location must be chosen where an abundant supply of water is available and the carts used should be of the latest design.

The most successful means of disposing of town wastes is by incineration.

Furnaces are in use to-day in many towns having a population of only a few thousands and are solving the refuse disposal problem satisfactorily and economically. Time will not permit a description of the method employed.

Inquiries from Windsor and other members of the Union prompted me to prepare the foregoing information in the hope that it might make investigation easier for municipal officials who are convinced of the necessity for some improved method of refuse disposal.

FOREST RESOURCES AND MILLS OF NEWFOUNDLAND.

Reporting on conditions in Newfoundland, United States Consul James S. Benedict, of St. Johns, says of the forest resources and growth of the paper mills during 1911:—

"The resources of the forests are a steadily increasing factor in the development of Newfoundland. During 1911 there were fifteen lumber mills working under license, and 271 fishermen's mills without a license. The latter are permitted by the Government to operate for the sole purpose of supplying the fishermen with material for the construction of their buildings, vessels, etc. The output of the mills for the season amounted to 53,187,000 feet, as against 45,000,000 feet for 1910. The pulp wood cut amounted to 100,000 cords, as against 30,000 cords during the previous year. The men employed in the woods numbered 3,715 and in the mills about 1,500. For the fiscal year 1911, 6,085,000 feet, valued at $125,270, were exported, as against 7,707,000 feet, valued at $144,666 for 1910. The export of laths amounted to 2,315,000 pieces, valued at $4,768, as against 4,868,000, valued at $9,646, for the previous year. The local building operations consumed the larger portion of the lumber and laths manufactured, and there is an increasing demand.

"The pulp and paper mills at Grand Falls and Bishops Falls got fairly under way, and the two companies exported 21,064 tons of news paper during the fiscal year 1911, valued at $[illegible], and [illegible] tons of pressed ground wood pulp, valued at $[illegible]. For the last six months of 1911 the export value of the products of the two mills amounted to $[illegible], and for the calendar year 1911 the estimated value of paper and pulp was placed at $2,250,000. The importance of the paper and pulp industries may be seen by the fact that the company at Grand Falls at present employs about [illegible] men in its mills and 100 to [illegible] more in loading vessels. The total wages paid amount to about $[illegible] a year, and the mills, with the new machines installed, are expected to have an annual output of at least [illegible] tons of ground wood pulp and about [illegible] tons of paper. The company at Bishops Falls also employs a large number of men in similar work. At present it is at work on the extension of the pulp-making plant, and further extension within a year is contemplated for the manufacture of various grades of paper."

REPORT ON RAIL CORRUGATION.*

By Arthur Busse, Chief Engineer of Way Grosse Berliner Strassenbahn.

The investigation into the cause of rail corrugation which has been continued by this association during the past two years has brought out a number of facts which have been more or less new, as well as opinions of many of the member companies on this subject. Some of these follow.

The Amsterdam Tramways believes that for a given composition of rail the length of the corrugations will depend on the speed of the cars. This opinion, however, is contrary to that enunciated by this committee in its last report that the metal of the rails itself contains the germ which gives rise to rail corrugation. Moreover, we believe that such a theory would be difficult to sustain. In our reports of 1906, 1908 and 1910 we showed that corrugations on a railway over which cars were run at the same speed varied in length when measured at two neighboring points. These measurements were taken not only on straight track, but also at stops and stations. There was no relation between the length of the corrugations and the speed of the cars.

The Antwerp General Tramway Company has observed small corrugations on the heads of new rails, but it does not consider that these are sufficient to start real rail corrugation, and has found that after a short period of service they disappear and the surface of the rail in contact with the wheel becomes polished. It does not believe that the method of rolling causes corrugation. Thus it calls attention to the development of corrugations in cast-steel special work, even in cast manganese-steel frogs, as noticed by other companies, although such material never passes through a rolling mill. In this connection the committee might add that such corrugation has been noted in Berlin in a section of cast-steel rail laid in an experimental track by the Berlin Tramways. The depressions were slight, but were visible, and their origin, in the opinion of the committee, is attributable to the method of manufacture. Manganese steel in track is not immune from corrugation, as shown by the experience of the Berlin Elevated Railway. In Antwerp the company report that the rails most corrugated are those on the outside of long curves and grades. The corrugations on the up grades are spaced 7 cm. (2.8 in.) apart and on the down grades 11 cm. (4.4 in.) apart, whereas on straight track the spacing is usually 9 cm. (3.6 in.). For this reason the company does not think that the incipient cause of corrugation exists in the rail before it is put in service. The committee, however, does not agree with the company in this conclusion, because if the active agent for developing this incipient corrugation is the sliding of the wheels the different lengths on up grades and down grades can easily be explained. Those on the down grade should be longer and those on the up grade shorter than those on level track, and the average should be about half way between the two, as shown in Antwerp.

Another company in Berlin, the Antwerp Tramway Company, is inclined to adopt the theory that corrugation is the result of a cold rolling of the rails by the wheels, according to a theory advanced by Mr. Beaumont in Engineering for September 8th, 1911, but differs with the conclusions of that gentleman in believing that the movement of the metal in the head of the rail is toward the sides of the rail, and is checked on the inside only by the pressure of the wheel flange. This checking force is not continuous, but intermittent, as the flange strikes against the side of the rail, and the effect of these two forces, one vertical and one horizontal, is to produce nodes.

The Bamberg Electric Tramway Company has found corrugations in light sections of rail, but not in heavy sections, and thinks that the light rail is too light. But, as the committee has already shown on other roads, corrugations occur on certain sections of rails, but not in others of exactly the same section when both are exposed to the same traffic conditions.

The Bern Municipal Tramways reports that corrugation developed in track laid on a bridge on a base of concrete. In 1906 a wood flooring 3 cm. (1.2 in.) thick was placed between the rails and the concrete for a distance of 60 m. (200 ft.). Since that time there has been no corrugation on this section, although elsewhere on the bridge the rails have become badly corrugated. The management believes that an elastic roadbed will reduce the trouble.

The Berninabahn, in Switzerland, which believes the process of rolling to be the initial cause, cites among other interesting facts that a part of its system some time ago was operated by steam, and the rails on straight track of this steam road developed corrugations. Later, this line was equipped electrically, and during the past three years there has been no change in the conditions either for good or bad. Later, some new rails were installed in a part of the line on which no corrugations had previously formed, but they developed the trouble.

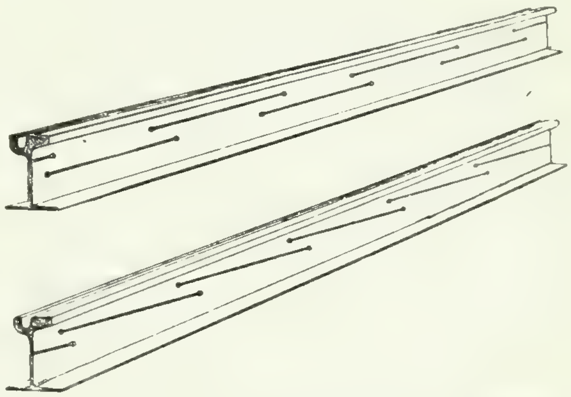


Fig. 1.—Rail with Slotted Web, Used in Cöteborg.

The Municipal Tramways of Dresden has conducted a number of experiments, and is of the belief that corrugation is due essentially to the sliding of the wheels, although it may have had its origin in the method of rolling. In some recent track it laid alternate sections of hard and soft rail, the hard rail with an ultimate resistance to tension of 80 kg. per sq. mm. (114,000 lbs. per sq. in.), and the soft rail of 67 kg. per sq. mm. (95,000 lbs. per sq. in.). Corrugations appeared without an appreciable difference in both kinds of rail. It had been able, however, to reduce corrugations by laying rails on wooden ties. The conclusions of the Dresden company correspond with those of the committee, which, in its reports of 1906, 1908 and 1910, held sliding of the wheels to be one of the causes of corrugation, but expressed the belief that the initial cause was to be found in the method of rolling. The report from Dresden also tends to show that low-carbon rails, when used with low-carbon wheel tires, wear less rapidly than high-carbon rails with high-carbon tires. The Dresden company also found corrugation in its overhead trolley wire, which is of silicon bronze, confirming previous observations made by the committee.

---

* Abstract of a report submitted at the biennial convention of the International Street and Interurban Railway Association, Christiania, Norway, July 2nd to 5th, 1912, and recently published in the Electric Railway Journal.

The Geneva Tramway Company has experienced trouble with corrugation in the Phœnix 18-C rail, but not in the Phœnix 5-F rail or in a T-rail. The 18-C rail was generally laid in concrete and the T-rails are on wooden ties. The corrugations did not appear on steep grades, but on level track and slight grades. The committee thinks that the difference in corrugation between the 18-C rail and the 5-F rail may have been due to their difference in height and method of support, and its absence in T-rail to the different method of rolling this section.

The Göteborg Railway had experienced corrugation not only in rails, but in special work which is not rolled. It has also tried in experimental service some rails with slotted webs, as shown in Fig. 1, finding that corrugations disappeared in rails so treated. It believes that the corrugations observed on new rails have the same origin as those corrugations developed in service; that is, that the former are caused by the chattering of the rolls, and the latter by the vibratory wear of the wheels, but that the car wheels alone will produce corrugations, even on rails not initially so predisposed, and that the remedy is an elastic construction. The committee adds that the Berlin Tramways noticed some four years ago that very low rails do not seem to become corrugated. In consequence, it has, as an experiment, laid a section of track with a rail only 100 mm. (4 in.) in height. This rail is mounted in a concrete block. The experience with this section of rail, so far as absence of corrugation is concerned, has been so satisfactory that the company is planning to adopt a modified type of elastic rail, which it is working out in detail. The experience of the Berlin company indicates positively that the corrugations may be attributed initially to the method of rail manufacture, and that light and elastic sections are less subject to the trouble, and are often exempt from it.

The Leipzig Tramways reports that grooved rail mounted on concrete or stone ballast is rapidly attacked, and T-rails on wooden ties on stone ballast are entirely exempt.

The Hamburg Tramways Company attributes the difficulty principally to the method of rolling. The tendency to corrugation is increased (1) when the number of passes at the mill is large, but especially during the formation of the groove, when the change in shape of the metal is rapid, and also (2) when the tensile strength of the metal in the rail is high and the modulus of elasticity is small. The committee adds that its views coincide exactly with those enunciated.

The North Side Holland Traction Company lays stress on the necessity for elastic foundations. It notes that there is necessarily some slipping of wheels on the rails, both when they pass around a curve, and even when they move on a straight track, on account of the nosing of the cars. This slipping causes a vibration, which is transmitted by [illegible] and the company thinks that it is this varying pressure between the rail and the wheel which causes corrugation. An elastic track is better [illegible] in the present conclusions of the committee.

The Christiania Electric Tramways proposes to experiment with the [illegible] rail now being tried in [illegible].

[illegible] the opinion that corrugation is due to the method of rolling [illegible]

be made to overcome the differences in temperature existing between the different points of the same billet and the differences in pressure during the eleven or twelve passages which the wheel makes in the mill.

The Nuremberg Tramways states that on its system the rails which have been corrugated and afterward carefully ground down have developed other corrugations without exception, but in places different from those embodied by the first. It has found corrugations in T-rails as well as in grooved rails, but a longer time is required to develop corrugations in T-rails. In cases which are not favorable to the production of corrugation, such as short-radius curves and low speed, the initial corrugations have disappeared at the end of about three to six months. Light rails resting upon a basis of sand are immune, but heavy rails, even those rolled in the same way as the light rails and of the same metal, have been attacked. The corrugation has been particularly rapid in rails laid in a bed of sand on a foundation of ballast. Hence it does not appear that it can be avoided, even with an elastic foundation.

The Shanghai Tramway Company, China, has part of its system laid on ties with stone ballast, the other part on concrete. The former section has shown but slight corrugation and the latter a great deal, although the rails were secured from the same mill and rolled at the same time.

Edgar Rhodes, New York, calls attention to the Romopac duplex rail, which has not been attacked in Leeds, England, although ordinary rails under similar conditions have become corrugated.

Discussion by the Committee.—The committee in considering these reports says that in general they accord very closely with the opinions published in previous reports and the conclusions reached in other years by the committee. These conclusions were briefly that the factors causing corrugation were:—

(1) The quality of the rail. (Recent observations indicate that this is the principal cause of corrugation.)

(2) The use of hard tires.

(3) Too rapid braking at high speeds.

(4) Too rapid acceleration.

(5) Too high speeds.

(6) Nosing or side oscillation of the car, which can be produced by (a) the usual rigid mounting of two wheels on the same axle; (b) unequal diameters of the two wheels on the same axle; (c) difference in elevation of the two rails in the same track; (d) unequal division of the weight; (e) variations in resilience of the different springs of the same car; (f) play in the journal boxes; (g) irregularity in the gauge of the wheels; (h) irregularities in the surfacing of the track; (i) effect of torsion and distortion due to the method of driving the axle at one side; (j) axles out of square; (k) bad construction of the car; (l) too short wheel base.

(7) Large radius curves.

(8) Character of track substructure.

In the opinion of most of the companies of the association the nature of the metal in the rails (No. 1) is considered as the principal cause for corrugation, and the points mentioned under Nos. 2 to 8 favor the development of corrugation, but do not cause it. Many experiments have shown this. Thus, rail bought from different manufacturers, or from the same manufacturer, but rolled at different times, were laid without any particular order on the same trunk line, so that the operating conditions were the same, but it was found that their wear was entirely different. Those from one manufacturer or from one rolling showed a marked corrugation, whereas those from other manufacturers or from different rollings were not attacked. The railway companies and the manufacturers are equally interested in endeavoring to find a metal which will resist the wear.

Several years ago at the meeting of the Iron and Steel Institute of Great Britain Thomas Andrews called attention to the quality of metal in the rails. His analysis showed that there was often considerable free carbon, sulphur and phosphorus at certain points, and that this condition would not have occurred if the ingots had been allowed to stay longer in the annealing pits before rolling.

Mr. Peterson, manager of the Municipal Tramways of Dortmund, who has made an exhaustive study of this subject, has reached the opinion that conditions inherent in the process of manufacture, such as the rolling of the rail at too low a temperature and insufficient malleability of the ingot during the rolling, are the cause of the trouble.

An interesting discussion in Stahl and Eisen for March 7th, 1912, also appeared, by Karl Neu, on observations upon steel ingots during rolling. These observations are especially remarkable, as they contradict the general opinion on the processes of cooling of steel ingots. They were made on ingots, some of which had remained in the soaking-pit the usual length of time, and on others which had been in the soaking-pit for an abnormally short length of time only. In one case an ingot weighing 1,800 kg. (3,960 lbs.) was first cooled in the ordinary manner, and then placed in a reheating furnace, since no soaking-pit was available. The ingot was taken out after seventeen minutes and rolled down to a cross-section of 170 mm. to 200 mm. (7 in. to 8 in.). A notable thing was that after the first passes the ingot presented an expansion at the middle. While according to laws of solidification the metal should be purest on the outside and the largest cavities should develop in the interior, the opposite was found to be the case. A second ingot, 2,010 kg. (4,420 lbs.) in weight and 450 mm. x 450 mm. (18 in. x 18 in.) in section, was allowed to remain fifteen minutes in a pit which was not heated. Then it was rolled down in twenty-five passes to a section 175 mm. x 220 mm. (7 in. x 8.4 in.). Here again there was produced an enlargement which resulted after the third pass in a split forming in the direction of the rolling, and liquid steel ran out of the crack. The explanation suggested by Mr. Neu is as follows: When the central part of the ingot is still in a fluid condition before rolling it is naturally predisposed to be occupied by the impurities, although the exterior or that already solidified presents a great degree of purity. When rolled too soon the plastic material in the centre is forced into the outer parts of the ingot. This suggested to the author the desirability of leaving the ingot in the pit longer so as to improve the quality of the metal.

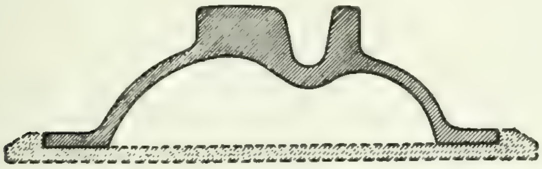


Fig. 2.—Rail with Double Web Being Tried in Germany.

L. Potin, another recent contributor to Stahl and Eisen, states as the principal cause of corrugation a too high temperature of the material when the rolling is begun and irregularities in the manufacture of the rail. He points out that when a rail is being rolled there are many abrupt differences between the speed of travel of the rail and of the rolls. When this difference of travel is large there is the drawing of the metal from behind the roll and a wave of the metal in front of the roll similar to that which occurs on a canal upon the passage of a boat. This produces a series of waves in the rail, and these will be particularly noticeable in the rolling of the head, where the cooling has been most rapid. He suggests that the way to avoid this trouble is to include in the specifications a limiting temperature for the last pass.

Dr. Poppe, of Breslau, disagrees with these conclusions, and says that it is erroneous to believe that corrugation began to appear only at the time when the mills commenced to roll rails at a high temperature. He also says that the soft iron rails of previous years were rolled much warmer than the steel rails employed exclusively today. He points out that the "creepage," or difference of speed between the rails and the rolls in the mill is much greater when the temperature is low. Consequently, corrugation ought to be less when the rails are hot, and not greater. He thinks that the length of corrugations depends on the speed of the cars and their weight, and hence it is unnecessary to impose special specifications on the rail-makers. These ideas ought not to pass without protestation.

G. E. Pellissier, in an article in the Electric Railway Journal for September 30th, 1911, believes corrugation due to a crushing of the surface of the rail by the wheel, and seeks for improvement in a different form of head. But this theory can hardly be admitted. If it was a question simply of superficial pressure, there would not be a difference in corrugation between rails rolled at different times, as has been observed, nor would there be corrugation of third rails, as shown on the Elevated and Underground Road of Berlin. Moreover, photographs of corrugated rail show that the corrugation extends the entire way across the head of the rail.

An interesting discussion on methods of measuring rail wear has appeared in recent issues of the Zeitung des Vereines Deutscher Eisenbahnverwaltungen. Theoretically, the ability to stand wear is in direct relation to the resistance to abrasion of the steel. Practically, the tests given are shock and rupture tests. Several methods have been proposed actually to determine the ability to stand wear. One is by an abrasion machine operated by electricity, a measure to be taken of the electrical energy required to remove a certain amount of material. Another method is to subject the rail to a blast of sand, a plan which should give good results if a basis of comparison could be chosen. A third method is to measure the effect produced by the rolling and the sliding simultaneously of steel wheels on the rail.

There is no doubt that the mills ought to endeavor to produce a metal more uniform as regards structure, density and durability. Railway companies at the same time ought to turn their attention to means of lessening the rigidity of the track structure, such as by using lower rails or a more elastic roadbed. By this means only can the trouble be reduced. As already cited, the plan of the Berlin Tramways is to use a low rail, and that of the Göteborg Tramways is to use the roll with a slotted web. Another effort toward introducing elasticity in the rail, shown on this page, has recently been patented in Germany. It has a double web, and compared with the centre web rail presents the great advantage of being rolled in such a way that at each pass in the roll the head tends to become more dense.

Conclusions.—The conclusions reached by the committee this year are not greatly different from those of preceding years. Nevertheless, there is added evidence that the primitive cause of corrugation is the method of rolling. Great interest attaches also to the use of elastic rails.

Appendices.—The report contains two appendices, one a report of some tests made by Mr. Peterson, manager of the Dortmund Municipal Tramways, on rolling lead ingots. These showed marked corrugation after they came from the rolls. The second appendix is a paper on the subject of rail corrugation read by Messrs. Schwartz and Cunliffe before the Institute of Electrical Engineers at London, March 18th.

PROBLEMS OF ROAD CONSTRUCTION.*

By Major W. W. Crosby.†

Possibly the problems of organization, administration, planning and recording might easily be considered to be included under the title of this paper. But to attempt to consider properly all these items would require the writing of a book, and even to attempt to touch on all of them in the limited time available for the speaker, would require so hasty a skipping "from crag to crag" as to result in almost entire waste of effort on the part of both the speaker and yourselves. Consequently, the speaker conceives it to be best to confine his remarks to details of actual work, out on the job itself.

Generally speaking, the first operations are those of grading and of installing the underground structures, such as culverts, abutments for bridges and underdrains.

If any clearing or removing of trees and old stumps is to be done it should be done promptly and thoroughly. Where practicable, the removal of trees should be accomplished by cutting off the roots around the tree a little distance away from the trunk and then pulling the tree over so as to rip out the stump proper. The roots thus left in the ground will do no serious harm unless within a foot of the road surface. It is sometimes the practice of the speaker to allow trees to be cut off close to the ground and the stump to remain, provided that there is to be not less than two feet of new fill between the top of the stump and the bottom of the surfacing. It may be trite, but it is at least safe to remark that in no case should a foreign stump be allowed to be placed in any embankment.

Underground structures, especially those that cross the road, should almost always be started as early in the proceedings as practicable. Such procedure not only insures their being out of the way of the later work and gives more opportunity to conveniently handle the public traffic generally to be provided for over a road, but also allows more careful construction and better results in the backfill. Only too often serious defects and extra expenses occur in the surfacing over culverts too recently installed before covering them. In this connection, the speaker will state that it is his practice to use vitrified clay pipe for all culverts 12 ins. to 24 ins. in diameter where the covering over them is not less than 2 ft. in depth and concrete boxes or cast iron pipe where the headroom or cover is less. He has experimented in a very few instances with corrugated wrought iron culvert pipes, but is as yet unconvinced of their general desirability. In his experience, he has had no difficulty with the use of first-class vitrified clay pipe even under heavy fills of, say, 20 ft. or more. Above 24 ins., the speaker prefers what is called "double strength" if clay pipe is to be used, but generally concrete boxes would be cheaper. Of course in the use of clay pipe, care must be exercised in the laying and backfilling, especially to prevent the presence of anything like a stone nearer the pipe than, say, one foot. The speaker has seen a stone about the size of one's two fists forced by the fill above directly through the wall of an 18-in. clay pipe.

The bed on which a pipe culvert is to rest is a consideration frequently slighted. [illegible] allowed to [illegible] changes. This is of especial importance where [illegible] of pipe are used. A bed of sand or fine gravel on which to lay the pipe is often desirable and advantageous. Even oyster shells or crusher screenings may be used. The speaker had one case some ten years ago where a road crossed a bight of salt marsh by a pile trestle about 200 ft. long. It was proposed to fill in the space, instead of making the necessary renewal of the old wood work, and to care for a small stream crossing the road through the marsh by means of a double line of 30-in. cast iron pipe. The surface of the marsh was at about mean high tide and the marsh mud of unknown depth. Therefore, along the slight stream depression through the marsh, the speaker laid a bed of oyster shells—the cheapest available mineral material—about ten feet longer than the pipe and about 12 ft. in width. The shells were dumped from carts through the floor of the old bridge and spread out as necessary to probably an average depth of 2 ft. and with their upper surface level and just above high tide. The pipe was then laid on the centre of this bed and the filling over them placed. The results have been entirely satisfactory.

Especial attention to drainage is necessary in Maryland work owing to both the prevalence of loamy or clayey soils and to the "open" character of the winters. A great deal of "French drain" is used. The pipe is vitrified clay and generally 4 ins., though sometimes 6 ins. in diameter, with bell and spigot joints. Stone, gravel or shells may be used for backfilling with apparently equal results. We think it preferable to install the underdrain just ahead of the surfacing work in most cases.

Practically all pipe ends should be protected by masonry head walls as a matter of protection and economy, to say nothing of appearance. Generally our masonry is concrete on designs made in our own office. Flat slabs or girders, reinforced when necessary by twisted or corrugated steel rods, are usually sufficient. Occasionally, special circumstances warrant an unusual design. In such a case, bidders are given the opportunity to submit their offers with their own designs. These latter are checked by our office and the comparison made between the offer and the office plans and estimates so that a decision may be had.

Of course, the key to successful bridge work is in a proper foundation and this is a subject by itself. Not much more can be said here than that almost all kinds of foundations have their place and the real problem in each case is one of proper selection.

Preliminary to the placing of the surfacing comes the preparation of the roadway for it, or what is generally known as "subgrading." The speaker considers the matter of a proper subgrade one of the most important of all construction problems and regrets to be obliged to state that it seems to be one too often neglected. In his judgment more failures in the surfacing have had their rise in defects of the subgrade than in any other source. In fact, the importance of a proper subgrade can hardly be overestimated. A proper subgrade should be firm, even and as little susceptible to damage by water as possible. Gravel, preferably sandy or with no excess of clay, gives an ideal subgrade when properly shaped and rolled. Clean sand will furnish a most satisfactory one, though it may bring about some waste surfacing material. In many localities, neither sand nor gravel is available. Crusher screenings may be substituted with very satisfactory results. Some clays will make a very good subgrade, if not so wet as to be muddy or rubbery, nor so dry as to be dusty, provided the surfacing and underdrainage are so installed as to keep the clay in good condition. Other clays cannot be handled thus. The speaker has secured satisfactory results in some instances by the use of a layer of gravel, sand or screenings 4 ins. to 6 ins. thick immediately below the surfacing.

---

*Read before the American Road Builders' Association, [illegible]

†Chief Engineer, Maryland State Road Commission.

Also, rolling a layer of stone into the subgrade after shaping it but before applying the first course of the regular surfacing, frequently relieves the defects in the subgrade. Another way is to prepare the subgrade by shaping and rolling as usual and then applying a first course of the macadam of special composition. That is, instead of using for this course, one size of stone, to mix with the ordinary No. 1 stone, say 50 per cent. of sand or screenings (for instance by running the screenings and No. 1 together from the screen). Then spread this mixture on the prepared subgrade, harrow it, and then roll. This has proved a very satisfactory solution in many cases where otherwise the failure of ordinary 8-in. macadam was almost certain. Probably the fine material in the No. 1 stone prevented the coming up of the subgrade material into the macadam and thus its destruction in freezing and thawing wet weather.

In passing, the speaker wishes to state that he considers that this matter of subgrade is only too often neglected in city work where a concrete base is to be used under the surfacing proper. In many cases too much dependence is apparently placed on this concrete base and even unnecessary expense is had for such concrete when by proper attention to the subgrade beneath it, not only better results, but also much saving in cost, might be secured.

In the reconstruction of old roads, it frequently happens that but slight changes of grade are desirable. Many of these old roads, such as the "pikes" have been "stoned" in the past and so massively, but withal so crudely, that they now present to travel surfaces that are solid beds of stone (mostly large) whose unevenness and roughness furnish the main, if not the only, reason for their treatment. Many of the audience will recognize readily a statement from the speaker to the effect that those familiar with such an old road are hostile to any idea of digging into or removing the old roadbed, if only for the purpose of breaking up the large stone. Nevertheless such a procedure is often the economical thing. If it cannot be done for any reason and the old stone bed must be allowed to remain, then the grades for the finished surface must be properly adjusted so as to provide at least a minimum thickness of new surfacing on top of the high points of the old stone. And this minimum cannot successfully be less than 4 ins. in the case of water bound macadam. With proper care in bituminous work it can probably be reduced to 2 ins. and possibly in some cases to even less.

Further, in such work on an old road, the depressions to be removed present a problem. It will not do to fill them with an absorbent material like clay or loam, and filling them with surfacing stone may be necessary even if expensive. Frequently, however, a cheaper roadside stone of inferior quality will answer. The same remarks apply to thin layers of material to come between the old roadbed and the bottom of the new surfacing.

In what may seem perhaps to have been rather a cursory way, the speaker has at last reached the problems of surfacing. And here perhaps a breath should be taken in view of the vast outlook.

Are there anything but "problems" in the subject of surfacing? And what a wide field of them, a field yearly becoming wider and more diversified, thanks to the activity of the proverbial American ingenuity, offers itself! To discuss, or even to review, a list of all the problems in this field, would be beyond the bounds of the present conditions, so the speaker will, in closing, merely mention a few salient points under the various kinds of surfacing on which he has convictions, or to which he feels it might be proper to direct your attention.

With sand-clay surfaces, it is important to get an intimate, even, and properly proportioned mixture of the sand and clay. With unscreened gravel surfaces, it is necessary that the gravel be free from stones larger than, say, a goose egg, and from an excess of fine material, i.e., either sand or clay. It must have, however, sufficient "fines" to fill the voids of the gravel stones, and preferably these fines should be of a highly cementitious character. If too weak in cementing qualities naturally, then something such as pitch, must be added to make up for the lack of bond among the round gravel stones and thus to remedy their tendency toward displacement under traffic, especially in very wet or very dry weather.

With screened gravel surfaces, when the correction of the sizing is had by the screens, the same remarks then apply. In some cases, screened gravel may be satisfactorily "bound" with limestone screenings. With marl surfacing the problem is to secure the necessary uniformity of the material and then to properly compact it in place. Plentiful watering and rolling is important.

With broken stone macadam, in the experience of the speaker, the most necessary, and at the same time, the most difficult thing to obtain is apparently the proper compaction or interlocking of the broken stone. Almost always the rolling of the different courses is less than it should be for the best results, and the deficiencies in rolling are attempted to be made up for by using the screenings too soon and too profusely. Another problem is the securing of the utmost degree of uniformity in the macadam layer as to thickness, evenness and homogeneity—no irregular depths of stone, no irregular thickness of courses, no pockets of material which varies greatly in size, etc.

And with all these surfaces just mentioned, the speaker, at the risk of repeating, must again call attention to the problem of getting proper rolling or compaction.

With bituminous surfaces, the main problem is perhaps again the securing of uniformity; practically all defects may be traced to the lack of it. The use of mechanical appliances of course always helps in securing regularity and homogeneity and generally tends to ecomomy as well. Their desirability is beyond question.

With pavements of various kinds, perhaps a general statement might be made that one important problem is to get them as dense as possible, that is, with sheet pavements, such as asphalt, bitulithic, concrete, etc., the mineral portion must be so proportioned that the voids will be at a minimum and the cement must then fill the voids. The other necessities of homogeneity, or uniformity and compactness also apply. With block pavements, the joints must reach a minimum and then be properly filled. The blocks themselves need uniformity and they must be placed evenly and solidly.

The speaker trusts he may have given an idea of the problems to be encountered in construction, if not a solution for all of them. In solving them, one and all, no factors will count more than carefulness and experienced intelligence.

The mines branch of the government department of mines states that its demonstration of the commercial possibilities of peat as a fuel in Canada has been successfully completed, and that henceforth the activities of the branch would be applied in another direction, probably the economic production and testing of fuel, concerning which the department already has a man in the west. The peat industry in Canada will now become a matter of private enterprise. There are two big plants under construction, one at Alfred, Ont., and another at Farnham, Que., which are expected to supply Ottawa and Montreal and possibly other cities with cheap fuel. Their capacity is about 30,000 tons per year.

ROAD WORK IN MASSACHUSETTS.*

The Massachusetts Highway Commission during 1911 was successful in applying some of the extremely heavy bituminous materials with a pressure distributor, the pressure being provided by an ordinary air pump operated by steam from the traction engine. This has been applied in grouting as well as in surface treatment, and it seems probable that in the future it may be possible to use some of the more lasting bituminous materials containing large quantities of asphalt by this method and thus secure more permanency in both construction and surface treatment.

During the year the commission used over 1,500,000 gallons of various bituminous materials in the construction and surfacing its roads, including various tars, tarvias and asphaltic oils sold under different contract names. The chemist for the state Board of Health, H. W. Clark, reports that from a laboratory point of view the materials were rather better during 1911 than formerly; that there was, however, altogether too much variation between the different lots of what purported to be the same materials, sold under the same trade name, and that altogether too many of them frothed badly when heated. This lack of uniformity in the materials is largely responsible for the fact that while some of the roads on which these materials were used are now in very good conditions, others are not. For instance, one asphaltic oil had a viscosity of 390, while an oil sold under the same name and used at another point had a viscosity of 540, and still another shipment had a viscosity of 590. Another asphaltic oil varied in viscosity from 240 to 340.

Some of the sections that were treated with oil or tar two or three years ago have had to be treated. On the other hand, some roads which had considerable automobile travel were treated with a surface coating of asphaltic oil three years ago and are now in very fair condition, nothing having been done to them since except to patch the holes.

It now seems to the commission that a surface coat of asphaltic oil would not prove to be economical or satisfactory on a road which has a large amount of heavy teaming though it is satisfactory, or has been up to the present time, on roads which have a large amount of high-speed automobile travel, with but few heavily loaded teams.

The state highway in North Beverly was given a coat of heavy asphaltic oil, one-half gallon to the square yard, in the summer of 1910, but it did not wear satisfactorily. It began to wear out first on the north side of the road, where heavily loaded ice teams travelled. The other side of the [illegible] in fairly good condition for a longer period of time. By the end of the sea- [illegible]

---

*[illegible]

In general, other failures, not due to excessively heavy team travel, have been due to the qualities of the materials themselves, though in some cases they have been due to faulty application or to the fact that the road was not properly cleaned before the oil was applied.

It seems probable now that quite a few miles of the roads which had a surface treatment three years ago will only require extensive patching to carry them through another season, and that on others a little patching and a coat of one-quarter of a gallon of asphaltic oil to the square yard, instead of the half gallon which was first applied, will be sufficient to carry them through two seasons more.

◆

COST OF ROCK BALLAST.

The following figures of the actual cost of putting stone ballast under track, taken from the Railway Age Gazette, are of interest to track men as illustrating what can be done in this work with a good organization, where attention has been given to a careful planning of details. This work was done on a heavy traffic line where it was necessary to pass a large number of trains daily, the total raise amounting to about 10 in.

Number of yards	58,883
Digging out, unloading, putting under and dressing up	$ 7,763.40
Labor cost, per yard	$0.1318
Stone, 58,883 cu. yds.	$30,619.16
Digging out, unloading, putting under and dressing up	7,763.40
Engine service	2,385.00
Stone inspection	222.00
Total	$40,989.56
Cost per yard	$0.696
Putting in 9,310 ties, putting on 8,400 tieplates, gauging	$ 893.76
Cost per tie	$0.096

◆

REGULATION OF ST. JOHN RIVER.

A system of storage dams and other devices for regulating the flow of the St. John River is the principal recommendation by a board of consulting engineers to the International Commission, appointed some time ago to remedy conditions which now obtain. About a million dollars will be needed for the work, the expense of which will be borne jointly by Canada and the United States.

Beginning at a short distance above Grand Falls, N.B., where Canadian capitalists are now planning the erection of large pulp and paper mills, the river becomes international, and is the boundary between the United States and Canada. There have been recurrent difficulties in regard to the log drives, and at one time there were open hostilities, culminating in what is known as the Allejash War, when a dam was blown up by Canadian interests, and men employed by the American mill proprietors crossed the stream armed and threatened to shoot up those of the rival concern.

The commission appointed to enquire into the flow of the river, in order that uniformity at different seasons might be established, consisted of M. G. Teed, K.C., and John Keefe, of St. John, for Canada, and Hon. G. A. Murchie, of Calais, and Hon. P. C. Keegan, of Van Buren, Me., for the United States. S. Jefferson Chapleau, of Ottawa, and H. S. Ferguson, of New York, were joint engineers.

ELECTRIC FRANCHISES.*

By L. A. Cannon, K.C., Alderman of the City of Quebec.

The word "franchise" has various significations, both in a popular and in a legal sense, and confusion often arises from a failure to discriminate in what sense the word is used.

Thus, in a broad and popular sense, it embraces the right of trial by jury, the right of habeas corpus and political rights of subjects and citizens like the elective or electoral franchise.

In a strict legal sense franchises are special privileges which are conferred by government on individuals, and which do not belong to the citizens of the country generally of common right or by the operation of the "common law."

Franchises are of various kinds and may include amongst others, the right to construct and maintain electric lighting plant, the power to exercise the right of eminent domain, and as such, are of paramount interest to municipalities. It must be noted that the use of the streets of a municipality for delivering electricity to the consumer is a franchise—Parnell v. McLean, 96 Md. 589, 56 Atl. 83. But the right to produce and sell electricity as a commercial product is not a prerogative of government but is open to all, and hence is not a franchise.

Corporations or bodies politic, or the privileges conferred thereon, are the most usual franchises. The right to exist as a corporation is itself a franchise, and in addition to this the different powers and privileges which may be exercised by the corporation are, as a general rule, also franchises, but a corporation may possess powers which are not strictly franchises, such, for instance, as powers which belong to individuals by common right.

There is a marked distinction between a franchise which is essential to the creation and continued existence of a corporation—a right to exist as an artificial being, a right conferred by the sovereignty of the state—and those rights subsidiary in their nature by which the corporation obtains privileges of more or less value, to the enjoyment of which corporate existence is not a prerequisite. State v. Topeka Water Co., 61 Kan. 547, 558, 60 Pac. 337. In People v. State Bd. Tax Comr's, 174 N.X. 417, 435, 67 N.E. 69, it is said: "The general franchise of a corporation is its right to live and do business by the exercise of the corporate powers granted by the state. The general franchise of a street railroad company, for instance, is the special privilege conferred by the state upon a certain number of persons known as the corporators to become a street railroad corporation and to construct and operate a street railroad upon certain conditions. Such a franchise, however, gives the corporation no right to do anything in the public highways without special authority from the state, or some municipal officer or body acting under its authority. When a right of way over a public street is granted to such a corporation, with leave to construct and operate a street railway thereon, the privilege is known as a special franchise, or the right to do something in the public highway, which, except for the grant, would be a trespass."

It is essential to the character of a franchise that it should be a grant from a sovereign power.

The grant of a franchise, in so far as it is ambiguous, is to be strictly construed against the grantee and in favor of the public, and nothing will pass unless it is granted in clear and explicit terms.

Accordingly some of the authorities lay down the rule that a municipal corporation cannot confer a franchise, grants or privileges by municipalities being regarded by some of the courts as mere licenses or contracts. On the other hand it is held in some cases that the state may indirectly grant franchises, acting through the agency of a municipality.

When the application of electricity for light, heat, power and traction purposes was first introduced, the promoters of these different public utility corporations were looked upon to a certain extent as public spirited citizens who were investing their money and energy for the benefit of their fellow citizens, in ventures of a more or less secure character. Hence the very general tendency to grant to these persons or companies extraordinary privileges for the use of public streets, for the laying of tracks or the erection of poles, and the stringing of wires. These charters granted, as far as the Province of Quebec is concerned, from the early eighties to quite recent years, are now the cause of difficulties and problems with which municipal administrations have to contend.

In the Province of Quebec, special legislation must be obtained to incorporate a company for the construction and operation of either an electric or steam railway; companies, however, for the purpose of manufacturing, selling and distributing light and power can be incorporated either under Letters Patent granted under the Federal or Local Companies Act, or by a special act of Parliament or of the Legislature.

As a rule, however, since the organization of this Union of Canadian Municipalities, through the efforts of our representatives and officers, the Legislature of the province, and also, I believe, the Dominion Parliament, have protected the rights of the municipalities as to the control of their streets.

In our province the Legislature has even gone so far as limiting the powers of the municipal councils to grant franchise. The action of the elected representatives of the people must in some cases be ratified—to have full force and effect—by a special direct vote of the electors.

As a general rule, in the Province of Quebec, whenever a municipality grants to any person, firm or syndicate the privilege, right or franchise, for over ten years, of running a tramway or introducing an electric or gas lighting system in the municipality, the by-law or resolution relating thereto, must, before having force and effect, be approved by the majority in number of the municipal electors who vote on such by-law or resolution. Such vote must be taken within three months after the date in which the by-law was passed by the council, otherwise the latter would be null and void.

It must be said, however, that in a great many instances, under the terms of their charters, companies have been exempted from the operation of this clause, which, in some cases involving a large expenditure of money, might prove repellent to capitalists.

I may be permitted, before closing these remarks, to expose in a few words the situation of the city of Quebec with respect to this question of electric franchises.

For the last few years the ancient capital of Canada has been handicapped by the effects of inflated public service corporation capitalization. Since the consolidation, under the guidance of a well-known Montreal financier, of the different companies who had been competing together to furnish traction, light, gas and power to our population, the price of electric light and power had become prohibitive for industries intending to establish themselves in Quebec. You must bear in mind that the capital stock and bonds of the Quebec Railway, Light, Heat and Power Company amounts to nearly $20,000,000, which is out of all proportion to the size of the community which it serves. Quebec and Levis have a population of about 100,000 and in order to pay interest on this capitalization, the amount to be levied from the citizens is probably heavier than anywhere else in Canada. Although the company have done their best to swell their income, the operating expenses are too heavy, and the directors of the merger have been compelled to pass dividends on the common stock. It has been figured that each family in Quebec would have to pay about $200 yearly for traction, electric light and gas, in order to warrant the payment of such dividend.

---

*Paper read at the Convention of the Union of Canadian Municipalities at Windsor, Ontario, August 28th, 1912.

In 1910 the municipal elections were fought on this issue, and Mayor Drouin pledged himself to encourage competition at least for electric light and power.

A company, The Dorchester Electric, was organized with a capital of $1,000,000 to carry out this purpose, and, despite numerous difficulties which had to be overcome, was in a position to tender for lighting of the city streets for a period of ten years. This was a rather valuable contract and our call for tenders was framed in such a way that the interest of the consumer would be protected. The tenderer, besides quoting prices for the lighting of the public streets and squares, was called upon to bind himself to sell, during the period covered by their contract with the city, electricity to the public at a price not exceeding a certain maximum to be agreed upon. I will now quote some of the clauses which we have embodied in this contract and in the resolution granting them the right to enter the city of Quebec which had been previously given them. Our experience in the matter may be useful to younger municipalities who may have to deal with similar situations.

When the Dorchester Company applied for the authorization to introduce and sell electricity in the city of Quebec, we tried to ensure permanent competition by inserting the following conditions to prevent, as far as possible, the merger from taking control of the new company, either by buying a majority of the common stock or by obtaining their withdrawal from the field:—

(a) The said company binds itself not to cede or sell to any other company the powers conferred upon it by its letters patent, as regards the city of Quebec, without having previously obtained the consent of the city and the payment [illegible]

(b) If the company ceases to exercise its franchise in the present and future limits of the city during the ten years following the first of January, 1912, it will be subject to a [illegible]

(c) [illegible] ten cents per kilowatt hour for the price of its electricity in the present and future limits of the city, and that the maximum rate cannot be changed without the consent of the city.

(d) The company binds itself to pay to the said city of Quebec as a penalty $1,000 for each infraction of the above conditions, save in the case where a higher penalty has been [illegible]

[illegible]

[illegible]

year before the end of the contract then in force. Our call for tenders contained the following clauses:—

(a) The tenderer will be required to mention the price at which he binds himself to supply the current, lamps and lamp renewals, including the cost or rental of the electrometer for residential purposes in the city limits, at a maximum price not to exceed so much per k.w. hour net, and the rate charged to remain in force till the expiry of the contract with the city.

(b) The tenderer will be required to mention the price at which he binds himself to supply the current, lamps and lamp renewals, including the cost or rental of the electrometer for commercial purposes in the city limits, at a maximum price not to exceed so much per k.w. hour net and the rate charged to remain in force till the expiry of the contract with the city.

(c) The tenderer will be required to mention the price at which he binds himself to supply motive force in the city limits, at a maximum price not to exceed so much per horse power net, and the rate charged to remain in force till the expiry of the contract with the city.

The Quebec Railway, Light, Heat and Power Company did not care to bind themselves under these clauses, and the Dorchester Electric secured the contract under conditions entirely satisfactory to the public and at the same time a fair price that will enable the company to make a reasonable profit for their shareholders in view of their moderate capitalization.

The merger has been charging 15 cents per kilowatt hour for current consumed by private customers, while the Dorchester Electric Company will only charge seven and one quarter (7¼) cents for the same service for the next ten years. The city will pay nearly 50% less to the new company than they are paying under the present contract, and for lamps of the newest and most improved type. This should bring the conclusion that, although the universal high cost of living has manifested itself in Quebec as elsewhere, Quebec will not have cause for complaint in so far as the electric lighting and power business is concerned, when the new competing service begins operation next fall.

We have also decided to begin the installation of a system of ornamental posts on the principal streets designed to carry clusters of five lamps. These poles will be supplied, erected and wired by the city, and we will endeavor before the expiration of the contract to build a complete system covering the whole city.

I am strongly convinced that all municipalities should at least, even when the idea of a municipal plant for the production of electricity does not meet with favor, become owners of a complete system of poles and wires to distribute electricity all over their territory. This would make the city much more independent when renewals of contracts come, would secure cheaper rates for public lighting and would also be in the interest of the companies. The municipality would simply have, like all other private consumers of power, to buy the current at the switchboard direct from the producer and use it in its own plant or distributing system.

The company, not having to take into account when preparing its tender, the heavy cost of erecting, for a period of [illegible] years, a very expensive distributing plant that might prove useless if it failed to secure a renewal of their contract, would necessarily quote much lower figures not only for the lighting of streets and squares, but also for the current sold to consumers for ordinary commercial and residential purposes.

Thus we feel that, at any time, with a city-owned electric lighting plant, we will be in a splendid situation to municipalize the service if we deem it advisable.

There are many other aspects of this question of electric franchises that I would have liked to consider, but I must, under the rules of the association, close these remarks and thank you for your indulgence and kind attention, hoping that the foregoing may prove useful to some of our sister municipalities.

THE OVERHEAD PLANT OF A MODERN TELEPHONE SYSTEM.*

By Sergius P. Grace.

The public is ever wanting all poles removed and sees no reason why it should not be done, since the success of the underground wire distribution in the business districts of so many cities has been thoroughly demonstrated.

Now, all progressive telephone companies believe most thoroughly in underground distribution and are extending their underground conduits as rapidly as good economy for the benefit of both the public and the company will permit. Underground wires are cheaper to maintain than overhead wires, but the additional fixed charges brought about by the large sums required for underground work, make underground distribution prohibitive except in thickly settled business districts and along main feeder routes to the residence and other sections of the various cities.

In curve No. 1 are shown the varying costs between underground and overhead construction, from which it can be seen that not until we reach 800 to 900 pairs along a route can we truthfully say that underground construction in annual charges will be cheaper than overhead construction. The economical point will, however, vary in different parts of the country. Consequently the publicly despised pole lines must be brought into use on many streets and alleys of our various cities if we hope to give the public telephone service at a reasonable cost.

Those who are familiar with the congested and thickly settled cities of the East, such as Philadelphia, New York, Baltimore and Washington, where the entire city area covers a few square miles only, and, therefore, a large amount of underground conduits for distribution purposes is perfectly justified, perhaps do not realize the different conditions existing in some of the western cities, and particularly Pittsburg, where, because of the river valleys and the extremely rough topography of the surrounding hills, the city must necessarily spread over many square miles of area. Pittsburg, rather than being a condensed city, consists of a series of settlements, usually connected together along main business arteries through the valleys. For these reasons, we have had to confine our underground construction principally to the feeder routes through the valleys and rely upon side pole lines for distribution.

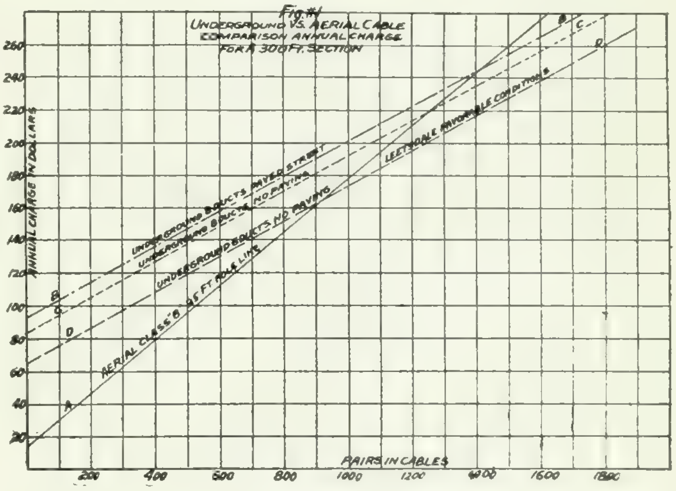
To have attempted a comprehensive scheme of underground distribution for each individual block throughout the city's territory would have been so enormously costly as to have financially embarrassed the company. Nevertheless, we have in Pittsburg about 110 miles of trench feet of conduit, in which is contained approximately 78 per cent of the total wire mileage of the city. You can see from this percentage, the part the main feeder routes play in the carrying of the main cables.

Realizing that in the present state of the art, we must make use of pole lines for distribution in cities, let us for a few moments trace the development of the pole line for telephone distribution service in exchange areas. The telegraph lines with high poles and bare iron wires on cross arms were developed before the invention of the telephone, and, with the introduction of telegraph engineers in the telephone business, it was only natural that the distribution lines should be patterned after the existing telegraph lines. Therefore, in the earlier days of distribution of telephone wires, wherever pole lines were used, it was the almost universal practice to erect very high poles, fifty to sixty feet high, and equip them with eight, ten or more cross arms, as the cases demanded.

These old-fashioned bare wire lines through city streets were very unsightly, and besides, gave an exceedingly large amount of trouble. In those days, the line trouble was very much greater than the switchboard or instrument trouble, and the bare wire distributing plant was usually considered to be the offender when any troubles occurred in the service.

When no more cross arms could be added to a pole line, recourse was had to short sections of cable, which were considered merely as auxiliaries to the bare wire lines.

In the territory of the Central District & Printing Telegraph Co., it was early seen that this type of distribution was practically impossible because of the winding streets, heavy grades, ravines and river valleys which are the accompaniments of a topographically rough country. Therefore, about 1896, to obviate these difficulties in the growing plant, the engineers of this company, principally Mr. Snyder and Mr. Donaldson, started a development and design of the aerial cable system of distribution which is standard to-day among all companies.



Curve No. 1.—Annual Charges of Underground and Aerial Construction.

The development of these designs changed the entire appearance of the overhead plant. Instead of high poles, with many cross arms filled with bare wires, we find to-day low poles, usually not over thirty-five feet in height, with aerial lead cables attached near their tops, no cross arms, but tapping boxes at alternate poles, with arrangements for connecting the distributing wires to the buildings. Practically no wire is carried back and forth along the lead, since by the multiple tapping scheme, a certain number of pairs are brought out to the terminals on alternate poles, so that, even for party line connections, the service wires may be run direct from the terminal to the subscribers' premises. The aerial plant of the C. D. & P. T. Co. now represents 36 per cent. of the total plant investment, over one-third of which is cable.

Besides greatly improving the appearance of the overhead plant, and thus lessening the chances of public criticism, this style of construction has greatly reduced the troubles from the wire plant. In studies which we have made of trouble in modern plants, we find about the following percentages:—

---

* Paper read before the Philadelphia Telephone Society and published in the Telephone News.

Switchboard trouble ....58 per cent.
Inside wiring and substation trouble....28 per cent.

This leaves only 14 per cent. as chargeable against the outside plant between the terminals on the main frame and the terminals of the protectors at the subscribers' houses.

In other words, the outside wire plant, which is exposed to all the elements, is responsible to-day for only 14 per cent. of the total service interruptions. This is a direct reversal of conditions in the older days, and perhaps the principal comment would be that there is no necessity for so much switchboard and substation trouble. The maintenance of substation apparatus costs as much as the maintenance of the entire outside plant.

There are a variety of opinions as to the economy of party line service from a plant standpoint, particularly in exchanges of 500 to 2,000 stations, in which places the outside plant is nearly always an aerial cable system. It has been said that any existing party line plant could be changed to single line with a comparatively small investment in cable pairs. This is true, but our exchanges do not grow that way in lumps, but gradually. Additional new lines would cost still more, or, because of the increased number of lines and reduced annual charges per line, party line service could be given more cheaply than ever.

In a gradually growing plant, if supervision is given to effecting party line combinations of an average of 1.8 for two-party and three for four-party, our studies indicate that the annual cost of a single line station is 1.5 times more than for a two-party and 2.3 times more for a four-party station. Curve No. 2 shows this relation for exchanges in which the annual cost constant varies from $20 to $32 per line. The annual cost constant is for all the outside plant except drops and substation apparatus. There is clearly plant economy in party line service.

The principal units entering into overhead construction are poles, cross arms, cable, insulators, hardware and wire. In this country practically all telephone poles are of wood. The kinds of wood most generally used are cedar, chestnut and creosoted pine. Each has its locality where it is most economical and most generally used. There is, however, an increasing tendency to make use of other kinds of timber, particularly after being given a creosoted treatment.

Steel poles have been used very little in telephone work, although extensively used by the railway companies for trolley poles. In large sizes they are many times more costly than wooden poles, and, besides, require constant upkeep in the way of painting. I feel sure that in the next [illegible] properly designed [illegible] present the least [illegible]

[illegible] to reduce the number of poles in the various municipalities. It must be admitted that this is a reasonable request on the part of the [illegible]

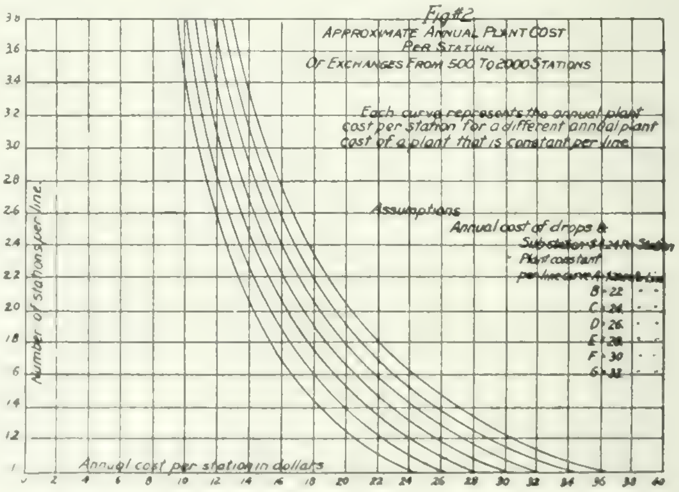
[illegible]

[illegible] joint pole line construction is safer to life and property than separate lines.

In many parts of the country, joint agreements have been perfected with the light companies, the standard specifications of the American Telephone & Telegraph Co. being substantially followed.

As a word of warning, I wish to say that unless we voluntarily go into these joint pole propositions, we will in a short time be facing regulation of our construction by the engineers of the various public service commissions, which is very likely to introduce special methods for each State. At the present time the Bell system is national in its scope and we are able to effect great economies in engineering and construction by uniform design. To have this great advantage in uniform methods set aside would be a decided step backward.

Of course, you have all heard of Pittsburg smoke and are willing to believe that Pittsburg is just as black as it is painted. It would be futile for me to argue with you on this subject, and tell you of the glorious sunrises I see from my home on Squirrel Hill, when Dooley is authority for the statement that in Pittsburg every other building is either a blast furnace or a Carnegie library. We do have smoke in our river valleys and blast furnace fumes in the air, which, aside from their esthetic effect, are decidedly destructive to our pole line hardware, such as braces, bolts, terminals, hangers and strand. For years we have had rigid specifications for this class of material and found it necessary to use only the best of galvanizing for protecting the steel.



Curve No. 2.—Annual Plant Costs per Station, Different Size Exchanges.

Unless one is thoroughly familiar with the principles underlying the protective action of galvanizing or zincing, when applied to steel, he will be deceived at the apparent long life of even defectively galvanized or cracked materials. Zinc is electro-positive to iron, and when a scratch or worn part goes through to the iron, there will be an electro-chemical effect set up which slowly consumes the zinc, but protects the iron from rusting; consequently for several months or years, the exposed iron or steel will show very little rust or corrosion until finally the surrounding zinc has been so thoroughly eaten away that it can no longer protect the iron electro-chemically, and then rusting will start at a rapid rate. This is why galvanized material that has stood up well, for perhaps four, five, six or seven years, may [illegible] of two additional years be completely rusted away.

Having heard so much about it, I know that you will be interested in an analysis of Pittsburg air made by Doctor

Phillips, of the University of Pittsburg. Doctor Phillips collected samples or rain-water at the beginning, the middle and the end of various showers. This water, having passed through the atmosphere, would naturally collect any foreign gases soluble in water and would also carry along with it any soot particles with which it came in contact.

The most remarkable thing about these tests, and the least expected, was the fact that rain-water collected, after passing through the Pittsburg atmosphere, contained no trace of sulphuric acid. There was, however, found a small amount of ammonium sulphate, showing that the nitrogen in the air had combined with the sulphur dioxide and neutralized it. The amount of carbon dioxide was only two-thirds greater than in normal air, such as is found in Northern Canada. Whatever nitric acid might have been generated had been converted into ammonia. The atmosphere seemed to be entirely free from acid; in fact, was quite alkaline. It was found, however, that there was an active corrosive agent in the Pittsburg atmosphere. This is the soot, which, being very porous, absorbs a considerable amount of sulphur, and when wet contains about two per cent. of free sulphuric acid. Apparently, then, the corrosive action in the Pittsburg atmosphere is largely due to the collection of soot upon the surface of the coated metal and the liberation of sulphuric acid during the rain-storms.

The recent introduction of loading coils in aerial toll lines has made it particularly necessary that the insulation of these lines be kept very high. This has led to the very careful maintenance of the right of way of the pole lines and the trimming of all tree limbs that might come in contact with the wires. Also on some of the longest lines, porcelain insulators, which have a higher insulation resistance during rainstorms than glass, have been used to good advantage.

In the Pittsburg district, where the toll lines traverse the river valleys in the neighborhood of the steel mills, we find it difficult to maintain a high insulation due to the accumulation of soot, and on a number of routes we have had the utmost difficulty in keeping the lines working because of the accumulation of iron ore dust on the insulators and cross arms. This dust is of a metallic nature and floats through the air because of slips which frequently take place inside the blast furnaces during the feeding.

For toll line purposes, where bare wire is necessary, the universal practice is to use hard-drawn copper, with the possible exception of certain rural districts, where it is certain that no very long distance calls will be made. Under ordinary atmospheric conditions, copper is practically indestructible. There is an authentic case of a sheet copper statute in one of the interior towns of France, that in 200 years has lost in thickness only 1/1000 of an inch. Copper wire in the Pittsburg district does not seem to deteriorate except in the vicinity of coke ovens, whose fumes contain the hundreds of coal tar derivatives.

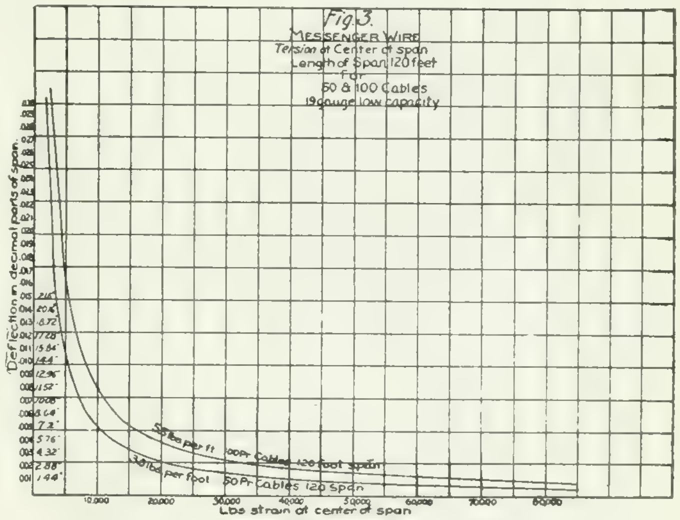
In some locations we have had to renew copper wires every three or four years. Iron wire is of practically no value in the Pittsburg territory except in the remote interior country sections. In exchange distribution, because of the introduction of the aerial cable system of distribution, there is very little need of bare wire for distribution purposes. There are a few places, particularly suburban districts, where bare wire on cross arms is more economical during the initial period than cable or insulated wire.

Generally speaking, the distribution in exchanges to-day is made almost entirely with cable and twisted pair distributing wires. There are many advantages in the use of twisted distributing wire, among which may be mentioned the freedom from trouble with electric light and power crosses. The twisted wire does not need to be strung on expensive cross arms, but can be attached, by means of small iron brackets and porcelain insulators, direct to the pole itself. The labor of stringing is very much less than bare wire, and the same thing may be said of removing the wire after it is out of service.

It makes a very convenient and economical type of unit construction, which can be used for establishing service prior to the time it is thoroughly demonstrated a cable will be warranted along the route. When the cable is placed the drop wires can be connected directly into the terminals, and that portion of the twist strung along the pole line can be taken down and used for other drop wires. The transfer expense is therefore small.

Until March, 1910, it was the general practice to use, for distributing purposes, No. 14 B. & S. gauge copper, rubber covered and braided distributing wire. This made a first-class installation, but the wire was needlessly large and contained more copper, rubber and braid than necessary. Since the drop wire is usually connected to a 22-gauge cable pair, it can readily be seen that No. 14 copper wire was used for strength alone and not for its conductivity.

For the past two years the practice has been to use No. 17 B. & S. gauge copper steel, rubber covered and braided distributing wire. This wire has nearly the same tensile strength as the old No. 14 wire, but because of its lesser weight per foot, has a much greater factor of safety under all conditions of sag and ice-loading. Its cost is about $25 per mile less than the old No. 14 wire.



Curve No. 3.—Tension of Messenger Wires in Centre of Span.

While on the subject of rubber covered wire, I would like to state that a good rubber wire is an economical investment, whereas a poor rubber wire is the poorest kind of an investment.

During the early period of the introduction of the aerial cable system in our territory, we were particularly careful as to the quality of the rubber wire we purchased. As a result all of the earlier wire has stood up in practice exceedingly well and undoubtedly has had a life of at least ten years. As an argument in proof of this statement, I wish to give you tests we made on samples of rubber wire from Wheeling, W. Va., which we were positive had been in service for a period of ten years.

Except for a few spots where the wire was mechanically injured it was in fairly good condition and capable of giving several years' additional service. The rubber still had considerable life and, when the wire was subjected to a tank insulation test, showed an insulation resistance of 232 megohms per mile after an immersion of 18 hours.

(To be continued.)

HYGIENE OF THE STEEL TRADE.

Before the Industrial Hygiene Section at the Royal Sanitary Institute Congress at York, on July 31st, Professor J. M. Beattie (University of Sheffield) read a paper on the above subject, in the course of which he said that a great deal of attention had been centred on the dust problem, and much of the legislation relating to the industries with which they were dealing was concerned with the protection of the workers from dust inhalation. To his mind the much more serious problem, the prevention of infection with tuberculosis, had not received justice at the hands of factory inspectors and factory legislators. During a five years' experience in Sheffield it had been abundantly demonstrated to him that the cutlers and grinders die from tuberculosis, and not from non-tuberculosis fibrosis of the lung.

Professor Beattie exhibited a number of lantern slides, showing how dust blocks the lung tissue, and expressed the view that whilst the tubercle bacillus obtained an easy lodgment in these parts, yet its spread was hindered by the fibrous tissue. The means for the distribution of the tubercle bacillus were obvious to anyone walking through the grinding hulls. The men spat on the wheels in the trough in which water for the wet grinding was contained, and on their hands as they got renewed grips on the blade they were grinding. During the grinding process the blade was dipped constantly into a bucket of water, which the man had at his side, and the sputum which had got on to his hands and on the blade was washed into the bucket, which soon became a perfect storehouse of tuberculosis. The spray, loaded with bacilli, was scattered over the hull, the man himself and his fellow workers. This applied particularly to the wet grinder, who was not supposed to inhale much dust. The grinders themselves said they inhaled no dust, but very little inquiry soon showed the fallacy of this assertion. The wet grinder acknowledged that he got a considerable amount of irritation about his throat, but attributed this to fumes resulting from the heat generated during the grinding process. There was no doubt that the finer particles of the stone were dried by the heat generated during the process of grinding, and that this fine dust was inhaled, and he (the speaker) believed the irritation to be due to this. He did not wish to take too much of the view that fibrosis hindered the spread of tuberculosis, but he thought there was room for further investigation as to whether the inhalation of a mixture of dust and tuberculosis was not less likely to produce rapidly spreading tuberculosis than an inhalation of tuberculosis alone.

It is unnecessary to deal specially with the dry grinder and the cutler. It was unquestioned that the tuberculosis from one man might infect a whole workshop if that man's sputum was allowed to get mixed up in any way with the dust. In fact, the distribution was more easy with the dry grinder than with the wet. He would urge much more care in eliminating the tuberculosis from the workshop. So long as they allowed people infected with tuberculosis to work among their fellows, and at the same time did not enforce the strictest regulations to stop spitting, then all the elabor- [illegible]

◆

THE SPOUTING OF CONCRETE.

[illegible]

Having given the proper proportions to the ingredients it is absolutely necessary that enough water be added to the conglomerate to produce a specific gravity such that the rock is held in suspension; the mixture will then flow like a thick gravy with no sign of excess water; in other words, it should have a saturated amount of water and no more. This particular mixture is surprisingly slippery and flows readily around all steel. It has an oily nature which is due to the cement.

In placing concrete by the gravity system there are three operations: The mixing of the ingredients, stone, sand and cement, in a suitable batch mixer; hoisting of the mixed concrete by skip to an elevated hopper; and the transferring of the concrete through pipes leading from this hopper to the point where it is desired to be poured.

The following general instructions for operating a spouting system may be of value:

1. Run about 10 feet of water in skip.

2. Charge mixers, using mostly sand with the cement and plenty of water.

3. Run up skip with water and drop at once, following up as quickly as possible with a charge of concrete.

4. Run the mixture so that it may have the consistency of a thick gravy, so that when it levels off the rock is seen held in suspension. If when dumped in the skip it stands up, it is too thick; if it levels off and shows one inch of water, it is too thin.

5. There should be a man in the tower to operate the concrete gate on the hopper to regulate the flow of concrete through the pipes. The stream should fill about one-third of the conveyor pipe and the charge should be so timed that the stream will be as continuous as possible.

6. The continuous and successful running depends on the uniform mixture. Be careful not to get it too thin. After a shut down of over ten minutes, flush the pipe by sending up ten feet of water in the skip.

7. At the end of the day's run clean out the mixers with two charges of water. Send these through the pipes.

8. All pipe joints should be oiled with thick grease so as to prevent sticking.

It is in general not advisable for any contractor to use the gravity system for the first time on a job of less than 2,500 cubic yards. However, it has been successfully used on jobs as low as 250 cubic yards. In these cases the apparatus was on hand and the men were acquainted with its operation.

◆

LABOR UNREST STILL ON THE INCREASE.

Industrial conditions were seriously disturbed by labor disputes during July, the number in existence in that month being considerably greater than the number existing during June. The number actually commencing, however, during July compares favorably with that of the previous month. In all, forty-six disputes were reported to the Department, an increase of nine as compared with June, and an increase of [illegible] as compared with July, 1911. About [illegible] employees were affected by these disputes as compared with [illegible] during June and 19,000 during July, 1911. A termination of the garment workers' strike in Montreal occurred during July, which caused a resumption of operations by more than four thousand employees after nearly two months of idleness. Few of the disputes commencing during July were individually of serious consequence as factors in disturbing industrial conditions.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404, 7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, AUGUST 29, 1912. No. 9

CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Double-Deck Street Car 389
The Control of Our Rivers 389
The Panama Canal Bill 390
Development of Montreal Port 390

Leading Articles:

Edmonton Bench-Marks 371
Grand River Control 372
Graphite Mining in Ceylon 373
Street Cleaning and Refuse Disposal 374
Report on Rail Corrugation 377
Problems of Road Construction 380
Road Work in Massachusetts 382
Electric Franchises 383
Overhead Plant of a Modern Telephone System 385
New Breakwater for Victoria, B.C. 391
Bridge Renewals 393
An Interesting Report on Destruction of Refuse 394
Electrolytic Action on Reinforced Concrete 395
The Cleaning of Water Mains 396
Canadian Pacific's Expansion 397

Engineering Library 398
Personals 401
Coming Meetings 402
Engineering Societies 402
Market Conditions 24-26
Construction News 67
Railway Orders 74

THE DOUBLE-DECK STREET CAR.

An aid towards the solution of the problem of handling transportation in the larger cities of the States has materialized in New York and Pittsburg in the use of double-deck cars. These cars have been introduced almost simultaneously, and are now in operation. Their use in these cities will be viewed with considerable interest.

Their use is attended by many favorable conditions. The double-deck car takes only the track space of one car, but gives the seating capacity of two. At the times of congested traffic this is a decided advantage, in that it will allow the doubling of the number of cars on any one street. In England the double-deck car, or omnibus, has been used for a considerable period of time, but these cars are the first appearance on this continent. The operating expenses will be lessened by their use on account of only one crew being requird to operate the car.

If these cars are a success, as in all probability they will, no doubt their use will be taken up by the larger Canadian cities where congested conditions exist. Their use, for instance, in Toronto in the down-town areas would do much to relieve conditions during the rush hours.

◆

THE CONTROL OF OUR RIVERS.

The increasing damage resulting from floods on the streams of the more settled sections of the country will necessitate, in the near future, some adequate action for the control of the water during times of freshet. A deputation waited on the Ontario Provincial Government last week to secure action with regard to the control of the Grand River. The deputation from the Grand River valley urged the Premier to initiate an investigation into the effect of spring floods on that river with a view to taking some preventative action.

The Grand River question has been brought to the attention of the Government before, but as yet no move has been made towards conducting an investigation. In this argument presented to the Government it was shown that not only could the damage by floods to a great extent be obviated by control, but that the increase in the minimum summer flow as the result of storage would mean a considerable gain in horse-power on the existing water-power developments of the river, with the addition of new water-power possibilities. Water supply, sanitation and general benefit would be the result of securing a uniform flow on the river. The Grand River drainage area and the hydrographic conditions surrounding it appear to point to storage as the economic and feasible solution for the control of its water. Reforestation is of doubtful practicability in connection with this river.

The Premier seemed rather cool towards the delegation. His answer that the people in other sections of the province were troubled in the same way is quite true, and the subject opened up is a large one. Nevertheless, it is time that some action was taken with regard to the problem. Before any constructive work can be done it will be necessary to investigate the conditions existing, and this will take some time. It is desirable, therefore, that some immediate action be taken towards securing the necessary data, and it is hoped that the provincial government can see their way clear to provide the funds for an engineering invesgation.

THE PANAMA CANAL BILL.

One more milestone was reached when the United States Senate two weeks ago passed the Panama Canal administration bill. This bill contains a provision exempting United States merchant ships from the payment of canal tolls, while foreign ships remain subject to them. That exemption is a direct violation of the Hay-Pauncefote Treaty, which was ratified in 1911. The bill was passed in the face of direct protest registered by the British Government and against public feeling in the United States as expressed by the responsible newspapers. We feel satisfied that the prevailing sentiment throughout the United States is against this action on the part of the Senate. It will have the effect of making nations dubious about trusting to the honor of the country in future negotiations. It is no light thing in international politics to repudiate pledges made by one responsible country to another.

Aside from the effects of this breach of faith on the part of the Senate, it is an open question whether it is good business to subsidize water-borne commerce. It is a well-known fact that water rates are adjusted to fall slightly below the rates of the railroad. The coast shipping of the United States, which is expected to benefit by the exemption of tolls, is well able to pay the same tolls as the ships of foreign register, and there is no reason why they should not pay these tolls to help cover the investment in the Panama Canal.

The western harbors of Canada have a great future ahead of them in the opening of this new avenue of commerce. Even if Vancouver is penalized to the extent of $1.25 toll over Seattle, there remains a great future for the port as a result of the opening of the Canal. It is pleasing to note that the Canadian harbors on the Pacific are being prepared for the greatly increased development to be expected in the near future. In this issue of *The Canadian Engineer* some details are given of the improvement to be made at once on the Victoria harbor. The Government is alive to the necessity for prompt action with regard to the development of the western ports.

◆

DEVELOPMENT OF MONTREAL PORT

The Harbor Commissioners of Montreal have in view a comprehensive plan for the development of that port, a plan, in fact, which involves the expenditure of many millions and the practical transformation of dockage facilities. When the commissioners took office some years ago, they paid immediate attention to future requirements as well as to those of that time. As a result they had the engineers prepare plans which they expected would take a dozen years to materialize. These plans are gradually developing as the work proceeds.

Among the objects of the commissioners is that of reducing the flow of water which now meets the ships coming up the current in front of the city. For that purpose they have considered plans by which much of the water will be diverted between St. Helen's Island and the south shore. The reduction of the current in the upper part of the harbor and the possible changing of the inlet to the Lachine Canal are under discussion.

The commissioners may likely construct a bridge to connect the city and the south shore. The city end of the bridge would apparently rest upon the end of [illegible] pier to be built outward from the city. The other end would rest upon the west end of St. Helen's Island. From there to the south shore, the work will be a simple matter. By following this route, the difficulty of carrying the bridge above the masts of incoming steamers disappears, as the vessels do not proceed so far upwards from the sea. Residents both of Montreal and of the south shore welcome the announcement. No doubt street car facilities will be provided.

◆

EDITORIAL COMMENT.

The Canadian National Exhibition is again in full swing, bigger and better than ever this year.

* * * *

Hamilton is up against the sewage disposal question. The city has grown so fast that the present methods of handling city sewage are considerably overtaxed. The city engineer has impressed on the council the necessity for prompt action. It is to be hoped that such action will be taken without the necessity of intervention on the part of the Provincial Public Health Department.

* * * *

The City Council of Kingston appear to know more concerning technical matters than their expert advisers. They have decided to enlarge the present steam plant in the face of the advice of their consulting engineers, who are strongly opposed to such a step. The education of our public men must be developed in the near future, if the public are to secure the economical spending of money for public utilities.

* * * *

The Medical Health Officer of Toronto certainly understands the art of procuring advances in salary to hold his employees. The civic position of epidemiologist has been created to keep one of the assistants in the Medical Health Department of the city. If the city engineers of some of our cities were as earnest in the securing of reasonable remuneration for their assistants, the engineering profession in Canada, as a whole, would be on a higher plane.

* * * *

During the progress of the inquest at the time of the Neilson building collapse at Toronto, we had occasion to refer at different times to the methods of carrying on the City Architect's Department. Since that time serious criticism has been levelled at this department from many sources. It is time that some adequate endeavor was made by the city officials to put this department in shape. The complaints of the structural engineers of the city justify energetic actions at once.

◆

THE NEW TRANS-AUSTRALIAN RAILWAY.

The placing of contracts for the immense amount of material required for the construction of the Kalgoorlie, W.A.-Port Augusta, S.A., railway has been delayed owing to a difficulty which had arisen between the Commonwealth and South Australia. The point in dispute was that of the land desired by the Federal Government, and this issue has now been settled by compromise. Tenders for 135,000 tons of steel [illegible], [illegible] tons of iron dog spikes, 2,200,000 sleepers (reinforced concrete, timber or steel), and [illegible] pairs of wheels and axles, are now under consideration. The total amount of expenditure on materials is estimated approximately at [illegible]. It has been decided to call [illegible] tenders for the supply of points and crossings, and [illegible] of the railway. While the State Government of Western Australia stipulates that the railway will require a large number of local (jarrah) sleepers, it has not yet been definitely decided whether the sleepers will be of wood, steel or reinforced concrete.

NEW BREAKWATER FOR VICTORIA, B.C.

Plans and specifications for the construction of the breakwater from Ogden Point, Victoria, B.C., have been prepared by the Department of Public Works. Tenders will be received from contractors up to September 5th. The work is to be completed in three years. The specifications provide that the construction is to be commenced immediately that the successful tenderers have been notified, and must be proceeded with in such a manner as will satisfy the Department of Public Works that the whole work can be completed within thirty-six months from the date of notification of acceptance of the tender.

The breakwater will extend from Ogden Point for a total length of 2,580 feet. It will run 330 feet south and thence westerly 1,500 feet, and curve thence northwesterly 750 feet (Fig. 1). The plans and specifications provide for a rubble mound surmounted by a wall of mass concrete for the whole length, with heavy granite blocks on the seaward side.

This is the first part of the harbor works to be provided to properly equip the port of Victoria to handle the great shipping trade that will follow the opening of the Panama Canal. It will shelter five modern concrete piers to provide berthing space for twenty or more of the larger steamers. These piers will be equipped with warehouses, cranes and all modern facilities for cheaply and expeditiously handling cargo. Spacious basins will be provided between the piers, and when the whole scheme is complete it will offer a harbor second to none on the North Pacific coast.

The plans under which the breakwater will be constructed are shown in the figures, and indicate the character of the work. The rubble mound will be 64 feet in width at the line of extreme low water at the ordinary stage of the tide. From this elevation the mound will slope on the exposed side at an inclination of 1½ feet horizontal to 1 foot vertical, and the slope on the harbor side will be 1 foot in 1 foot. These slopes will be continued when the concrete, topping the mound, is completed. A core of quarry stones will be allowed to a height of 35 feet, with a width of 62 feet at the top, and with a slope of 1 in 1 to the bottom. The remainder of the stone in the mound, except the large blocks shown in Figs, 2 and 4, on the exposed side, will be built with stone blocks of approved quality at least half weighing not less than a ton each.

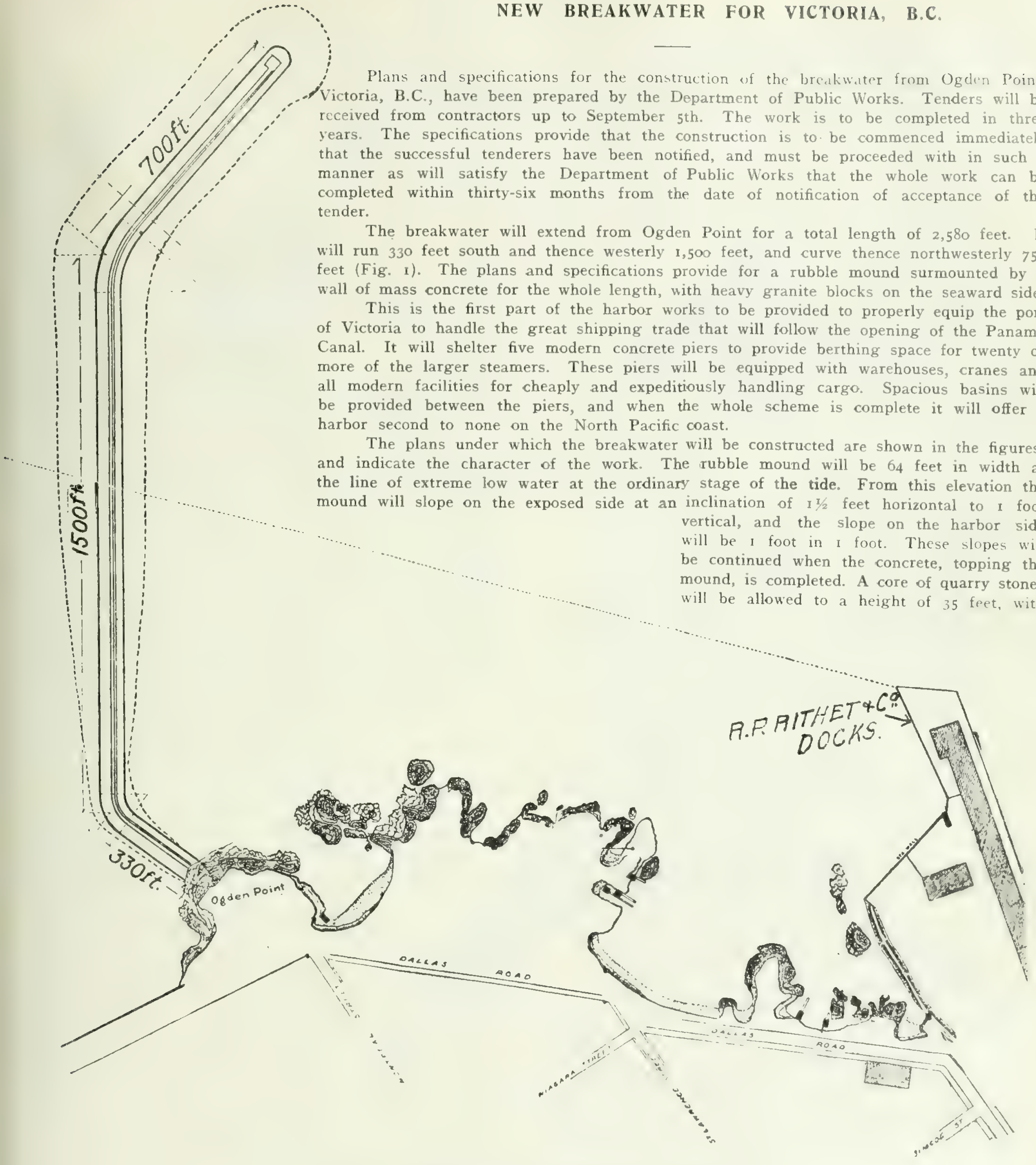


Fig. 1.—Location of New Breakwater at Victoria, B.C.

The large blocks on the exposed side, from a depth of 20 feet below water level, and averaging 18 feet in thickness, will be built of granite blocks weighing not less than six tons each, and 50 per cent. of the facing stones of this part shall weigh not less than eight tons each. These stones are to be carefully quarried, cut in rectangular blocks, laid so as to bond well, the joints not to be wider than eight inches in any part. All of the stone used will be durable rock of approved quality, to weigh not less than 170 pounds to the cubic foot, the least dimension of any stones to be not less than a quarter of the largest dimension. The large blocks on the exposed face will be all of granite.

The concrete wall will be built the full length of the breakwater. The bottom of this wall will be built on the top of the rubble mound, 20 feet wide at the bottom, and 26 feet in height. The bottom of the concrete wall will be about the height of extreme low water, and will batter on the harbor side to a width of 15 feet at a height of 21 feet, and the remaining five feet will be 10 feet in width. The section shown in Fig. 3 indicates the elevation of this wall and the manner in which it will be battered and stepped. Provision will be made for the construction of a lighthouse at the end of the breakwater.

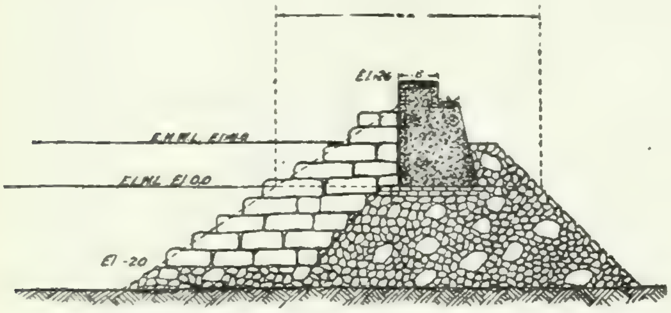


Fig. 2.—Section Through Breakwater at Shore End.

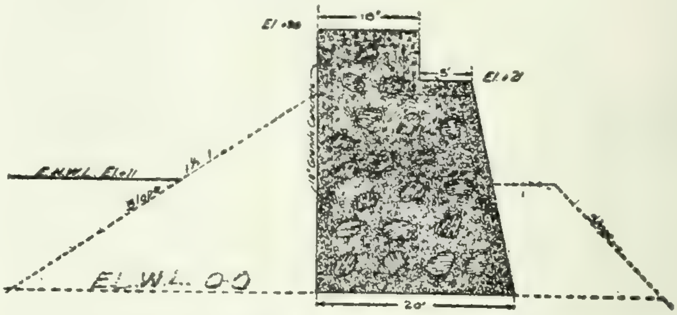


Fig. 3.—Section Through Concrete Wall of Breakwater.

The specifications provide for the fair and proper treatment of workmen who will be given employment. The contractor will be obliged to conform to regulations respecting the accommodation, medical treatment and sanitary protection of all workmen on the work.

All workmen shall be residents of Canada, unless the Minister is of opinion that Canadian labor is not available, or that emergencies or other special circumstances exist [illegible] this.

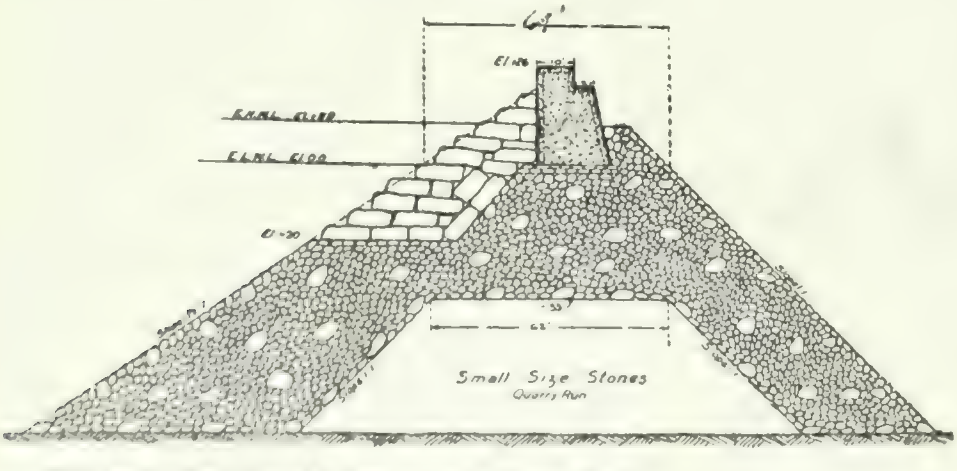


Fig. 4. Section Through Breakwater at Outer End.

No workman shall at any time be paid less than the [illegible]

[illegible]	$4 75
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Hand drillers	3 00
Powder men	3 50
Quarrymen	3 00
Laborers	3 00
Diver, with outfit	15 00
Diver, without outfit	10 00
Driver, with one horse and cart	5 00
Driver, with two horses and wagon	7 00

The following minimum monthly rates of wages are to be paid, in addition to boarding men, as follows:—

Tug captains	$100 00
Tug engineers	90 00
Tug firemen	60 00
Deckhands	45 00
Scowmen	45 00
Timekeepers	65 00

The bids to be submitted will be compared on the basis of estimated quantities of work to be done, the quantities to be considered as approximate, and the Department reserves the right of increasing or diminishing any or all of the items. Core stone, quarry run, 306,381 tons; rubble stone, 50 per cent. to the ton, 719,838 tons; granite blocks of six tons and over, 113,322 tons; concrete for facing, 9,031 cubic yards; concrete, 39,832 cubic yards.

◆

INDUSTRIAL ACCIDENTS.

During the month of May there were 108 fatal and 272 non-fatal accidents recorded by the Department of Labor. This is an increase of 46 fatal and 38 non-fatal accidents compared with the record for June, and an increase of 10 fatal and 73 non-fatal accidents compared with July, 1911. Accidents recorded in which more than two workmen were killed were: One as the result of a falling derrick at Kenogami, Que., on July 1st, by which seven men were killed; one by which four railway construction hands were killed by a premature explosion of dynamite on July [illegible], near [illegible], Ont.; one at Kenogami on July [illegible] by which four men were killed. Two accidents were occasioned as the result of a falling pile driver coming in contact with live wires at Meaford, Ont., on July [illegible].

◆

The municipal council of Toronto has recently awarded a contract for the manufacture and installation of a number of target light reflectors for the night illumination of various clocks about the city that are under the care of the council. These appliances are to cost $[illegible] each.

BRIDGE RENEWALS.

A number of wooden Howe trusses on the Louisville division of the Pennsylvania Lines West have been replaced with steel girder or truss spans during the last few years, and in the work of replacing these bridges considerable care has been taken to eliminate the necessity for heavy false work, and also to economize in the use of work trains by substituting a light maintenance derrick car whenever possible. Two examples typical of the methods used in this work were described recently in the Railway Age Gazette and are illustrated herewith.

In the first case, shown in Fig. 1, a 146-ft. 5-in. Howe truss and three spans of trestle approach were replaced by three deck girder spans, one 40 ft. long and two 70 ft. long. A spur track was built immediately south of the old bridge, and from this track all material used in the work was handled by the derrick car under its own power. The masonry was first completed and the iron bent for the central girder support was erected on the new pier. The 40-ft. girder replacing the old trestle approach was placed in the usual manner. Two additional floor beams were inserted in each panel of the old truss and the truss was raised about 20 in., the elevation of the rail being kept constant by removing the ties and stringers and spiking the rails directly to the floor beams. The two main-girder spans were assembled and floored on the spur track and were put in place on two successive Sundays when a period of 5½ hours between trains was available. A yard engine was brought 10 miles for the purpose of moving the girders. The rails, floor beams and lateral bracing of the old bridge being removed, the girder spans were lowered into place with jacks, the track was replaced and the load carried on the girders. False work was then driven under the Howe truss and it was dismantled and loaded. As shown in the illustration, this false work was very light, as it carried only the dead weight of the old truss and was only in place for a short time.

In the second case, shown in Fig. 2, a 160-ft. through truss was replaced by two half through girder spans, each 80 ft. long. The delivery of the iron was contracted for in December, making it certain that work would be under way during the winter season when trouble can be expected from running ice and drift. All the masonry work was completed during the early fall except the portion of the abutments under the old through truss. Three heavy cluster pile bents were driven adjoining the abutments and the centre pier on the down stream side, being anchored to bed rock and built strong enough to carry the girders under traffic. A light trestle was erected between these cluster bents 18 feet from the main track centre to centre, and a spur with a capacity of three cars was built north of the bridge, the fill being widened for the purpose. When the girders were received the four cars were set on this spur and the girders unloaded and placed with cribbing and jacks on the new masonry and the cluster bents. The division derrick car worked on this track under its own power, placing the floor beams and stringers and removing the light trestle as it receded. The riveting and flooring of the girders were then completed and the fill was widened south of the bridge so that the main track could be carried around the old bridge over the new girders. This track was used at a speed of 10 miles an hour during the dismantling of the old truss. As the derrick car had the freedom of the old main line for the dismantling work there was no necessity for the use of travelers or work trains. The trestle that had been removed from the run-around was driven under the old truss to support it during dismantling. When the truss had been removed and the bridge seats finished to conform to the masonry plan, the girders were moved sidewise into place between trains and the main track restored to its original location. While this work was under way there were two floods, clearing the stream of heavy ice, and on neither occasion was there any false work in the channel to obstruct the flow. This work was done under the direction of D. B. Johnston, division engineer to, whom we are indebted for this information.

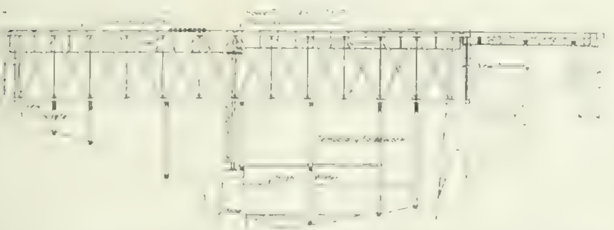


Fig. 1.—Replacing a Howe Truss with Plate Girders.

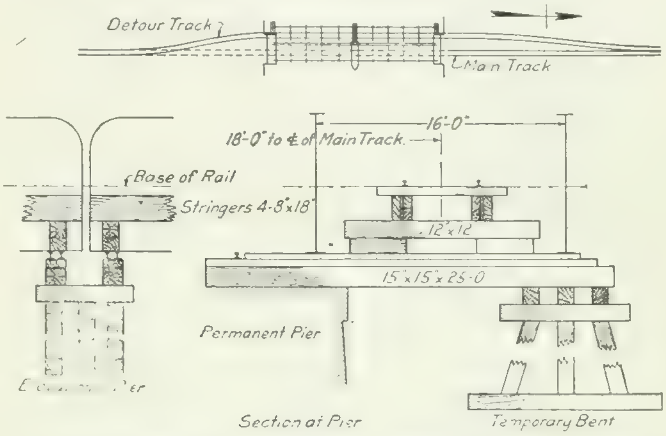


Fig. 2.—Method of Supporting Temporary Track at One Side During Construction.

* * *

PANAMA CANAL BILL MAY HELP CANADIAN RAILWAY.

Without intending it, the Panama Canal bill in its present form may give enormous advantage to the Canadian Pacific Railway, thinks the Wall Street Journal. Ownership of ships by the railroads of the United States trading through the canal is extinguished, while the Interstate Commerce Commission is given power to regulate ships trading elsewhere so owned. But it is diplomatically impossible, on all construction of international law, for this country to decree the ownership of foreign vessels using the canal. This necessarily gives the Canadian Pacific an enormous advantage, in the ownership of its fleet, over the Southern Pacific or the New Haven, to say nothing of its competitors in the North-West with no ships at all.

This advantage would be emphasized by the possibility of retaliation by Canada in the matter of its own ships canals, which would not be subject to the question of discrimination in favor of our own coastwise trade through the Panama Canal. The American tonnage through the Canadian canals is 18,250,000, as against 1,118,000 for Canadian vessels. A preference to the latter would be of far-reaching consequence, and would, of course, help all the Canadian railways.

AN INTERESTING REPORT ON DESTRUCTION OF REFUSE.

Mr. James Bee, superintendent of the Street Cleaning Department of Blackpool, England, in his annual report states that the quantity of refuse dealt with at the destructor last year amounted to 18,372 loads, the weight of which was just over 18,943 tons. This quantity, though considerably below last year with regard to the number of loads removed, is only a slight decrease as regards tonnage, the figures for 1910-11 being 18,734 loans and 19,000 tons. The difference is accounted for by the carts taking larger and heavier loans.

There has again been a slight reduction in the cost of dealing with the town's refuse, which during the year averaged 1s. 0¾d. per ton, whereas the average cost per ton for the previous year was 1s. 1d. It is worthy of note that the cost has gradually decreased from 1s. 6½d. per ton in 1906-7.

Profits from By-Products.—There is, it appears, a steady increase shown in the profit-earning by-products.

"I have pleasure in being able to report," says Mr. Bee, "that the tremendous increase which has taken place within the last half-dozen years in the revenue from the sale of by-products at the destructor has been maintained. During the year the unprecedented sum of £1,660 was derived from this source, an increase of £55 on the income obtained from last year's sales. To show the wonderful possibilities which lie in what is apparently the waste material of the town, it is only necessary for me to point out that during the year 1904-5 we were deriving what was then considered the respectable sum of £248. We have thus increased our revenue in eight years by £1,412."

A table of statistics shows how the money is obtained. Compared with 1910-11, there are considerable decreases in the sale of ashes and clinkers and mortar, but the yield from fish manure has risen from £558 to £815, which brings about the total increase. During the year 2,327 loads of ashes and clinkers were disposed of, a decrease of 782 loads, which represents a loss of revenue of £102. The quantity of mortar manufactured was 1,490 tons, or 570 tons less than last year, which created a record by bringing a revenue of £470. This year the amount was £330.

Dust Collection.—The work of removing the town's refuse has again been carried out in a satisfactory manner, a daily collection having been maintained in connection with the hotels, hydros, restaurants, and the larger boarding-houses; while from the ordinary company-houses the refuse has been removed from two to three times weekly. All other premises have had attention weekly.

[illegible] large and [illegible] medium galvanized [illegible] cost price, to replace the less sanitary wooden receptacles.

[illegible] the beginning of the year, of [illegible] to be collected by private enterprise, [illegible] by the corporation.

[illegible]

carting 3s. 5¼d. per ton, making a total of 5s. 5¾d., an increase on last year of ¾d., accounted for on carting.

Street Cleansing.—The system of collecting street sweepings by means of orderly trucks has been so successful that six additional trucks have been obtained. On the Promenade and in the main thoroughfares men are continually at work. During the past year, for instance, Bank Hey Street was swept no fewer than 4,181 times. All the principal streets are swept from ten to twelve times daily. The less important thoroughfares receive attention daily, and the back streets weekly.

The quantity of sweepings removed during the year shows a large increase, 4,969 loads having been removed by the carts, and 38,237 bins by the orderly trucks, making a total of 8,155 ordinary cart loads, this number being an increase of 485 loads on last year. The corporation carts engaged on this work were employed for 10,306 hours, and were supplemented on 2,447 hours by hired carts, making a total of 12,753 hours. Last year the total was 11,814 hours. The streets swept within the borough during the year amounted to approximately 100 miles.

The expenditure in wages for carrying out the work of street sweeping for the year has been £6,777 for labor, and £713 for team labor and horse hire, a total of £7,490. This is an increase of £305 on the previous year, when £7,185 was expended. This does not include washing streets. The cost per mile has been £74 18s.

During the twelve months washing operations were carried out by the carts on 72 days. The water used amounted to 640,500 gallons, of which 15,050 were fresh water, and the remainder salt water.

In four days in January 1,209 loads of snow were taken away, at a cost of £108. The cost per load works out at 1s. 10d., or 1s. 2d. for labor and 8d. for carting.

It was necessary to grit or sand the streets on 184 days, compared with 211 the previous year.

Street Watering.—Mr. Bee adds: "During the past summer the utility of the new salt water main extensions was very early demonstrated, for during the prolonged drought, when we were prohibited from using fresh water, a plentiful supply of salt water was available, and this enabled us to water the streets without any restriction whatever. Moreover, this work can be done more efficiently and economically by using salt water, for after a road has been watered with it consecutively for three or four days it is practically dustless, even to the fastest motor car. Its deodorizing properties are also a factor in support of its use, not only for street watering, but for flushing gullies and sewers. The salt water mains have now been extended so as to make us entirely independent of fresh water."

Street watering operations were carried out on 162 days. The quantity of water used amounted to 4,898,250 gallons, of which 3,975,300 gallons were salt and 922,950 fresh water. No fresh water was used after the beginning of June. As showing the economy of using salt water, last year the total consumption was 5,056,250 gallons. Fresh water used was 2,129,150 gallons, and salt water 2,927,100 gallons. The quantity of water used last year was the lowest on record. The cost of street watering was £[illegible], or £[illegible] per mile.

◆

SHAWINIGAN POWER COMPANY.

Shareholders of the Shawinigan Water and Power Company will be asked at a meeting called for September 3rd to authorize the issue of $[illegible] additional capital. The authorized capital stock of the company is at the present time $[illegible], of which $10,000,000 remains unissued.

ELECTROLYTIC ACTION ON UNREINFORCED CONCRETE.

In a brief paper before the International Association for Testing Materials, Mr. Cyril de Wyrall, Chief Inspector, Interborough, Rapid Transit Co., New York City, cites observations indicating the destruction of plain concrete by electric currents. We abstract a portion of his remarks as follows:

Four years ago an inspection was made of a concrete wall, which was erected in 1902. This wall, which carried no load, is below tide level, is 3 ft. thick, and is made of 1:2:4 mixture of cement, sand and trap rock. It was placed with care and under competent superintendence. The examination showed a disintegration to such an extent that the surface was practically mush. A year later another examination was made, and large sections, from 4 to 6 ins. thick, which crumbled in the hands, could be pulled off the face Last year still further deterioration was found to be in progress, and a chisel could be driven 12 ins. into the wall by hand alone. A voltmeter test showed that current under 11 volts pressure was passing through this structure. It was believed at the time of the second examination that the "failure" was due to the action of salt water alone, and no test was made for stray electrical currents until lately.

This is not an isolated case. There is an exact duplicate in almost every particular, except that the latter structure was erected a year later and different brands of cement were used. In the summer of 1911 the writer made an inspection of some concrete tunnels and bridges erected by three different railroads entering New York. This work has been only recently finished. Each of the railroads had its own cement laboratory, and the different brands of cement used were rigidly tested. The structures are all above tide level, and wet only in spots. Where the concrete is wet, from one to five volts was found, and the concrete is deteriorating, though not as much as in the former instances. Where the concrete is dry no voltage was found and the concrete is in excellent shape; this occurs in the same tunnel. the concrete apparently being the same mixture and placed at the same time. It seems to make no difference whether the concrete was placed in cold or warm weather, deterioration goes on just the same, the only difference being between the wet and dry places.

It is a known fact, although wet concrete is an excellent conductor, dry concrete is practically a non-conductor. The combination of electric current and water seems to act as a disintegrating agent on the cement, destroying its cohesion and reducing it to a paste, which when dried can be pulverized with the fingers. This condition demands immediate remedial measures, or serious trouble will undoubtedly ensue.

It is only the effects, which careful and continuous examinations have shown, which are brought to your attention. One efficient means of preventing the damage may be mentioned, however: waterproofing thoroughly all parts of a concrete structure that is surrounded by earth. Such protection acts in two ways; it keeps the structure dry and it insulates against electric currents.

ABITIBI PULP LIMITS SOLD

Greater activity is evidenced in the development of Northern Ontario. Settlers are entering the country more rapidly, but are not likely to patronize that region in large numbers until the advent of ready made farms. Messrs. Shirley Ogilvie and F. H. Anson of Montreal, are the successful tenderers for the Abitibi pulp limit offered by the Ontario Government. The amount of the bonus to be paid to the government is $5,000 per year, distributed over a period of twenty-one years, making $105,000 from this source alone. This represents only the right to cut pulpwood and timber on the limit, which comprises 1,560 square miles, and entitles the successful tenderer to obtain a lease, upon the usual terms, of Iroquois and Couchiching Falls for power purposes.

An additional undertaking, not required by the government, which Messrs, Ogilvie and Anson have inserted in their offer, is that during and after 1913 they will advance for the purpose of being expended or shall expend $50,000 in preparing buildings and land for settlers in the neighborhood of Iroquois Falls. None of the land on the limit goes with the lease, so the conditions under which this money is to be expended will be decided by the Minister of Lands, Forests and Mines, although a lien will be retained on all property sold until the purchasers repay the amount on each farm in easy instalments.

The tenderers also agree to buy wood and agricultural products from the settlers and covenant to promote as far as in their power the development and settlement of the district.

A joint stock company with a capital of $1,500,000 is to be organized to carry out the enterprise.

An integral part of the scheme is the construction of a pulp mill costing, with equipment and machinery, not less than $500,000, with a daily output of one hundred tons of pulp and the employement of two hundred and fifty-nine hands on an average for ten months in the year. This investment is distributed—$100,000 during the first year; $200,000 during the second year; and the balance during the third year. Cutting may commence on the limit so soon as $100,000 is expended on the mill.

The successful tenderer is also under agreement to erect a paper mill on the order of the Lieutenant-Governor in Council, which shall have a capacity of one hundred tons of paper per day and shall turn out not less than seventy-five tons of paper per day.

Another likely development is the starting in Northern Ontario of a system of forest industries, employing trained men and operated upon lines that will mark a departure from the wasteful lumbering methods of the past. Negotiations are proceeding by which, it is expected, a large area in the north will be secured by private interests and devoted to the making of wood products that will utilize every inch of the trees from roots to top. With it will be carried on reforesting and the scientific culture of existing timber.

Mr. F. L. Barledt, a British capitalist who controls similar industries in Germany and Russia and is interested largely in a number of enterprises in England is behind the project. Mr. Barledt is in Toronto awaiting the outcome of the negotiations. Although a British citizen he is German born.

NEW PUMPS AT WELLAND, ONTARIO.

The pumps at the new pumping station at Welland, Ontario, have recently been put into service. The pumps were constructed by Messrs. Frank Pearn and Company, Limited, Manchester, England, and supplied by the Canadian Boving Company, Bay Street, Toronto. The water wheel is designed for the following:—Net head, 7 feet; normal output, 200 brake horse-power; maximum output, 250 brake horse-power; normal speed, 58 revolutions per minute.

THE CLEANING OF WATER MAINS.*

By F. W. W. Doane, City Engineer, Halifax.

The injunction from the secretary, limiting the extent of these discussions to one thousand words, makes it very difficult to deal fully with this important subject.

On the inside of all water supply pipe which has been in use for any length of time, there will be found an incrustation of oxide of iron more or less heavy. This coating presents a very rough surface compared with the original finish. It consists of tubercles or blisters shaped like a rivet head and varying in size, between which is an accumulation of sediment or ferruginous slime which greatly reduces the internal diameter and consequently the discharging power of the pipe. In some cases the discharging and carrying capacity of the pipe is reduced more than 50 per cent. and the thickness of the incrustation varies from ½ inch to 1¼ inches.

This incrustation has been removed annually from the pipes supplying the city of Halifax ever since 1880, by a mechanical scraper forced through the main by the pressure of water.

The scraper used there consists of two distinct portions, the front portion carrying the steel scrapers and the rear propelling the machine. There is a stout centre rod of wrought iron in two pieces, coupled together in such a manner as to allow a little play, so that the machine may pass round and bend or angle in the pipe line. There are eight arms of spring steel varying in width and thickness according to the diameter of the pipe, arranged in two sets of four each, the set behind breaking joint with that in front, so as to effectively scrape the entire inner circumference of the pipe. Each spring has a cutting edge tapered towards the centre of the pipe with the double object of cutting or splitting longitudinally any heavy incrustation of iron rust, and also of preventing the barbed knife from catching in any valve or defective or open joint in the pipes which would also cause a stoppage. A ferrule or similar obstruction striking the knife will cause the scraper to turn partially round and thus pass the obstruction without getting blocked, or the springs will yield sufficiently to enable it to pass.

The pistons or discs do all the work in propelling the machine forward. They are made double in order to insure steadiness, and they do not do any cutting work whatever. The discs are of iron, somewhat smaller in diameter than the the bore of the pipe, so that water may pass them to wash out the accumulated scrapings cut away. The iron [illegible] by radial cuts and stiffened at the back by lead plates, their construction giving them sufficient stiffness to withstand the pressure [illegible] backwards to pass any obstruction not removed by the cutters. In large sizes, small springs are attached to the back [illegible] exactly in the centre of the pipe. This is necessary with the large scrapers on account of their great weight. They also preserve the leather discs from being worn out too [illegible]

[illegible] in contact with the metallic iron through minute defects in [illegible] a knife after the tubercle is removed. The action of chemical salts and substances which form marsh land, and the salt water, corrode the iron rapidly from the outside and soften it in the same manner as the corrosive action referred to above, on the interior.

To prepare for cleaning, a section of pipe must be removed at each end of the main to be cleaned. The scraper is inserted, the section of pipe replaced, and the water turned on. The scraper starts off with a rumbling noise, by which it can be easily followed by men running along the pipe line. The rate of speed varies from ¼ of a mile an hour on the flat ground under a small head of water or going up a hill, to six miles an hour or faster, going down a hill. Where there are hydrants or blow-offs, they are left open and the approach of the scraper may be detected first by a current of air, followed by a rush of water which has accumulated in front of the machine. The water turns to a dirty brown color and as the scraper passes, the water becomes black. After the passage of the scraper, if the water is allowed to run from the hydrant, it gradually becomes clearer. It is out custom, however, to close the hydrants at once after the scraper passes, so that the pressure behind it may not be reduced.

In the city of Halifax the greatest length of pipe cleaned in one day is a supply main in two sizes, 15-in. and 20-in., and seven miles in length. It has been the custom to clean this main three times a year, while the other supply main is cleaned once a year only, and distribution mains when required. The first cost of cleaning the first twelve miles of mains over 30 years ago, averaged 3½ cents a foot for everything, including manholes, the lowest cost being 1⅔ cents and the highest 7 1/5 cents. The average cost, not including manholes was 2 8/10 cents.

Twenty-nine thousand five hundred feet of 15-in. main has been cleaned in 95 minutes, and the whole seven miles at a cost of $8.30, or 3/100 of a cent a foot. The lowest head operated under is 11 ft., but cleaning could not be done under such conditions except by an experienced man The heaviest incrustation removed is 1¼ in. from a pipe which had been laid between 30 and 40 years and was uncoated, while a 1-in. pipe has been closed in four years.

The cost for re-cleaning supply mains during 25 years was 1/16 of a cent per foot. On one occasion they were cleaned for 1/20 of a cent. Cleaning distribution mains is a little more expensive and varies from 1/10 of a cent to ½ cent a foot. The cost of cleaning by hand, before the mechanical scraper was used, was 14 2/10 cents per lineal foot.

Some of the immediate results were that the average pressure on 25 hydrants increased from 34.2 lbs. in February of one year, to 54.4 lbs. in February following, or 53 per cent. In another district there was a pressure of 19 lbs. after the cleaning, on hydrants where in the previous year there has been no water at all. In one cleaning an improvement of 400 per cent. was obtained, while at Louisville, Kentucky, they claim an improvement of 654 per cent. in one case.

The cleaning in Halifax has saved the city a large expenditure, the cost averaging about $3.25 a mile, while if it had not been possible to clean with a mechanical scraper, most of the mains would have been renewed long ago at a cost of many thousands of dollars.

◆

Contracts have just been let by the Montreal Transportation Company by which the Canadian canal trade will have the first electrically propelled merchant vessel ever built. The principle of propulsion for this vessel is identical with that of the "Gas Electric" railway car, of which an example was recently seen in Toronto on the line of the Canadian Northern.

---

*[illegible]

CANADIAN PACIFIC'S EXPANSION

The increase in the capital of the Canadian Pacific Railway, noted in last week's Monetary Times, and which will shortly be made, again draws attention to a railroad which has loomed large in the international investment eye. The increase will be from $200,000,000 to $260,000,000. There is little doubt as to the need of increased funds by the Canadian Pacific. It has a long programme of construction ahead, the most important part of which, perhaps, is the double tracking of the road to the Pacific Coast. Both passenger and freight traffic is rapidly increasing, and within a few years there will be work and constant use for a double track. Expansion of the company's hotel and steamship services, both of which have proved remunerative and in both of which there is room for expansion, will probably occur.

While it was not intended, the news of the new stock issue became public shortly after the publication of the company's preliminary statement for the year ended June 30th. It shows record earnings and constitutes a fairly good index to trade conditions in Canada to-day. The gross earnings by the railway and its allied steamship lines, with the working expenses, for 1911-12 and the six preceding years are given below:—

	Earnings.	Expenses.
1911-12	$123,319,541	$80,021,298
1910-11	104,167,808	67,467,977
1909-10	94,989,490	61,149,534
1908-09	76,313,320	53,357,748
1907-08	71,384,173	49,591,807
1906-07	72,217,527	40,914,218
1905-06	61,669,758	38,696,445

In six years the operating income of the railway and its properties has doubled, the operating expenses having rather more than doubled. This showing has been made during a period of increased competition, and in face of a tendency to reduce rates, for carrying both passengers and freight.

The company's dividends have been steadily maintained and the shareholder naturally has every confidence in their maintenance. It would be a disaster beyond modern foresight that would cause the passing of the Canadian Pacific Railway dividend. Invariably, too, the company has been able to report a large surplus after the payment of all dividends. Commenting on that fact, the London Statist reminds us that the company could stand a shrinkage in its traffic and gross earnings of something like 25 per cent. before the profit would cease to be sufficient to provide the 10 per cent. dividend. A shrinkage of 25 per cent. in traffic and in earnings is a very large sum, and that to have a margin of this kind indicates the conservative manner in which the company's financial policy is controlled.

There is an idea that a further increase of dividend to a still higher basis than 10 per cent. may take place, but those persons who expect an increase in distribution would do well to remember that it is wiser to pay a dividend which the company can maintain in good and bad years alike, than to distribute a dividend which would have to be seriously cut in a time of depression, or which could not be maintained in a period of increased competition.

◆

The interests representing the Labrador Pulp and Power Company have decided on a large pulp and paper enterprise, involving the increase of the capitalization of the company from three millions to fifteen millions of dollars, stated Mr. Robert H. Reid, of New York, vice-president of the company.

WILL THERE BE A CAR SHORTAGE?

That a car shortage is imminent is the opinion of Mr. J. E. Walsh, transportation manager of the Canadian Manufacturers' Association. An estimate based on railroad figures of the past four years tends to show that shippers will be confronted with a car shortage of sixty thousand this year on the smallest possible estimate, and as great a deficit as 180,000 cars should the proportion be as high as it was in October, 1909.

Vice-President Bury, of the Canadian Pacific Railway, said that so much has been done in preparation for handling the crop by concentrating rolling stock and motive power, together with the earliness of the season, it is improbable that there will be any blockade.

◆

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended August 7th:

	1911.	1912.	Increase or decrease.
C. P. R.	$2,272,000	$2,706,000	+ $434,000
G. T. R.	1,017,982	1,109,682	+ 91,700
C. N. R.	332,500	407,300	+ 74,800
T. & N. O.	35,274	30,905	— 4,369
Halifax Electric	5,641	5,646	+ 5

The following are the railroad earnings for the week ended August 14th:

	1911.	1912.	Increase or decrease.
C. P. R.	$2,205,000	$2,677,000	+ $472,000
G. T. R.	1,048,062	1,098,423	+ 50,361
C. N. R.	319,700	401,800	+ 82,100
T. & N. O.	36,830	29,838	— 6,992
Halifax Electric	5,714	6,486	+ 772

The accounts for the Grand Trunk Railway Company for the half-year to the 30th of June, 1912, show the following results:

Gross receipts		£3,834,300
Working expenses		2,793,300
Net receipts		£1,041,000
Deduct debit balance on account of rentals, outside operations and car mileage		33,500
Total net revenue		£1,007,500
Net revenue charges for the half-year, less credits		513,900
Balance		£493,600
Deduct Canada Atlantic deficiency for the half-year	£52,800	
Detroit, Grand Haven & Milwaukee deficiency for half-year	50,700	103,500
Surplus		£390,100

This surplus of £390,100 added to the balance of £6,800 from December, 1911, makes a total amount of £396,900 available for dividend, which will admit of the payment of the full dividend for the half-year on the four per cent. guaranteed stock, and first and second preference stocks, leaving a balance of about £8,500 to be carried forward.

The accounts of the Grand Trunk Western Company for the year ending 30th of June, 1912, after providing for all fixed charges, including the debit balance of £31,461, brought forward from the previous year, show a deficit of £16,144, which will be carried forward to the current year.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

Reference Book for Statical Calculations.—By Francis Ruff; published by Constable & Co., London. Cloth; 5 x 8 ins.; [illegible] illustrations; 136 pages; price $1.25.

This book is the translation of the German volume of the same name. It contains, in shape for rapid use, force diagrams for frame works, tables, instructions for statical calculations for all classes of building and engineering. The different application of statics to engineering design is presented in a comprehensive and clear manner. The use of the book should be conducive to carrying out any desired statical calculations with ease and rapidity. A compendium of tables at the end of the work includes tables for timber, weights of railway bridges and street bridges, weights of various materials, specific weights and loads used in building, etc. These tables will certainly spare the owner of the book a great deal of labor. The volume is intended as a reference book purely. It should be in the hands of every engineer and architect, for as a ready reference book on statics, it is the best we have seen.

Reinforced Concrete Construction.—By Geo. A. Hool; published by the McGraw-Hill Book Co., New York. Cloth; size 6¼ x 9½; first edition; 250 pages; price $2.50.

This is another volume of the Engineering Education Series, prepared in the extension division of the University of Wisconsin, for the use of their students in the correspondence courses. Vol. I. of Reinforced Concrete Construction deals with the fundamental principles of concrete construction and design and includes numerous tables and diagrams to facilitate the calculation and design of reinforced concrete structures. The book presupposes a knowledge of the elements of structures and is written to meet the needs of those who desire to take up the study of the subject by correspondence. There appears to be no reason, however, why it should not be employed for other purposes. The complete text for the course in reinforced concrete construction will be in three volumes, of which this is the first. The ground [illegible] design of retaining walls and building, but omits, however, the flat slab type of floor construction, which will be taken up in Vol. II. The treatise is most clearly written and the dis- [illegible] followed.

Concrete Workers Reference Books.—Published by the Norman W. Henley Publishing Co., 132 Nassau Street, New York. [illegible]

[illegible] constructor.

Diary of a Roundhouse Foreman.—By Mr. T. S. Reilly; published by the Norman W. Henley Publishing Co., 132 Nassau Street, New York. Cloth; 5 x 7; 158 pages; price $1.00.

This little volume is a compilation of a series of articles by the author which were published in the "Railway and Engineering Review." It contains many suggestions in connection with the duties of a roundhouse foreman, and much of the material for the book was obtained while the author occupied the position of machinist, roundhouse foreman and superintendent of motive power. It is a most interesting little volume and will be read by the railroad man with a good deal of pleasure.

Metropolitan Water Board: Eighth research report on the softening, purification and sterilization of water supplies. By Dr. A. C. Houston, director of water examination.

In his seventh report Dr. Houston mentioned that he had found that one part of quicklime added to 5,000 parts of raw river water was capable of killing B. coli in from five to twenty-four hours. The Water Board are in the position of being unable to purify all the water required in London by the method they prefer, viz., storage. Dr. Houston has set himself the task of finding out if his discovery with regard to the effect of quicklime will help the Board out of the difficulty, and tells his story in this his eighth report. To the treatment he gives the name of "Excess Lime Method," and briefly he finds that when one part of quicklime (about 75 per cent. CaO) is added to 5,000 parts of raw Thames water, about .007 per cent. free CaO is left in the mixture, and this excess is sufficient to kill B. coli in from five to twenty-four hours. To neutralize the excess, not less than 25 per cent. of store water must be subsequently added. The resulting fluid is water which has been purified ("placed beyond the pale of epidemiological criticism"), clarified and softened. On the question of softening Dr. Houston is led into a most interesting discussion as to the relative advantages of hard and soft waters. On health grounds he believes that there is absolutely no reason for objecting to hard water. On grounds of economy there are reasons, though they are, after all, not serious. The furring of boilers and pipes and consequent loss of heat is perhaps the most important, but the wastage of soap is largely a theoretical objection. For these reasons he does not believe that in the case of London water, at any rate, it is worth while incurring expense in providing plant, etc., and purchasing quicklime for softening purposes only. If in addition you can purify the water without the necessity of storing more than a fourth of all that is required, it is worth while. Quite satisfied with the method, Dr. Houston recommends it to the Water Board as a way out of their difficulties. Apart from mentioning that the quicklime [illegible] per pound, and that the London County Council [illegible] per annum at the sewage outfalls, got it for 13.75 shillings a ton in 1910, the financial side of the question is not entered into much. The [illegible] must be estimated by engineers, financiers, etc. The report itself, however, is, as is usually the case with Dr. Houston's reports, intensely practical and interesting, and the experiments are clearly described. The work marks a tremendous advance in our knowledge of water purification.

Pumping and Water Power.—By F. A. Bradley; published by E. F. Spon, 123 Liberty Street, New York; size 6 x 9; 120 pages; price $1.50.

The book was written by a consulting engineer, and although many works have been written embracing the subject of hydraulic work, pumping appliances, and the application of hydraulic power, they usually treat of some especial feature or branch of the subject, or of mechanical details of construction, or the book is too costly to be within the reach of mechanics, students, and others to whom a general explanation of the laws of hydraulics and their practical application would be serviceable. The present treatise will meet a necessity in this respect.

The work includes chapters on important laws of hydraulics, atmospheric pressure, pumping work, suction pipes, units of work, steam pumping, centrifugal pumps, hydraulic power machinery, hydraulic rams, waterwheels, turbines, pelton wheels, water pressure engines, and well boring.

And ten tables which includes areas of circles, square cubes, square roots and cube roots, loss of pressure by friction in pipes, weight of water at different temperatures, weight and quantity of water in one foot of pipe, average pressure of expanded steam, volume of steam at various pressures, theoretical velocity of water, downward flow turbines and pressure of water.

The book is well illustrated and a study of its contents should assist those engaged in erecting or using hydraulic machinery to lay out their work with confidence.

Webster's New International Dictionary.—Published by G. and C. Merriam & Company, Springfield, Mass. Leather; 9 x 12 ins.; 2,620 pages; profusely illustrated; price $12.

This new dictionary of the English language, which is based on the International Dictionary, of 1890 and 1900, is now completely revised in all departments. The new edition includes a dictionary of geography and biography. The first edition contained 70,000 words; this edition contains 400,000 defined words and phrases. Among the interesting features are the divided page, an up-to-date gazetteer and biographical dictionary, and 6,000 illustrations, many of them in color. This dictionary should be in the hands of every professional man.

PUBLICATIONS RECEIVED.

Proceedings of the Royal Military College Club of Canada. Editor, Lieut.-Col. Ernest F. Wurtele.

Commercial Creosotes. With special reference to wood from decay. By Carlisle P. Winslow. Being Circular 206 of the Forest Service, U.S. Department of Agriculture.

The Effects of Cold Weather upon Train Resistance and Tonnage Rating. By E. C. Schmidt and F. W. Marquis. Bulletin No. 59, University of Illinois, Engineering Experiment Station, Urbana, Ill. Price 20 cents.

American Road Builders' Association. Proceedings of the eighth annual convention, held at Rochester, N.Y., Nov. 14-17, 1911. Published by the association, 150 Nassau Street, New York. Price $1.00.

Forest Products of Canada, 1911—Pulpwood. Compiled by H. R. Macmillan, B.S.A. Bulletin No. 30, Forestry Branch, Department of the Interior.

Report on Mining Operations in the Province of Quebec During the Year 1911. The Mines Branch, Department of Colonization, Mines and Fisheries, Province of Quebec.

Seventh Report of the Bureau of Archives for the Province of Ontario. By Alex. Fraser, Provincial Archivist, Toronto, Ont.

Mica; Its Occurrance, Exploitation and Uses. Second edition, by Hugh S. de Schmidt. Mines Branch, Department of Mines, Ottawa.

Diamond Drilling at Point Mamainse, Province of Ontario. By Alfred C. Lane, Ph.D. Bulletin No. 6, Mines Branch, Department of Mines, Ottawa.

The Metropolitan Water Board. Eighth report of research work, by Dr. A. C. Houston, on the softening, purification and sterilization of water supply. Metropolitan Water Board, London, E.C.

Queen Victoria Niagara Falls Park. Twenty-sixth annual report of the commissioners. Copies may be secured from the superintendent, J. H. Jackson, Niagara Falls, Ont.

The Fifth Census of Canada, 1911. Vol. I., containing areas and population by provinces, districts and sub-districts. Department of Trade and Commerce, Ottawa.

Tenth Report of the Geographic Board of Canada for year ending June 30th, 1911. Being supplement to the annual report of the Department of Marine and Fisheries, Ottawa.

Third Annual Report, Commission of Conservation of Canada. The report of the third annual meeting held at Ottawa, January 16th, 1912. James White, secretary, Ottawa.

The Canada Year Book, 1911. Second series. Ottawa, Ont.

Ottawa Improvement Commission. The report and correspondence of the Ottawa Improvement Commission relating to the improvement and beautifying of Ottawa. Ottawa, Ont.

Telephone System. The Ontario Telephone Act. Municipal Ownership of Rural Telephone System, by Francis Dagger, Toronto, Ont.

Annual Report of the Minister of Mines, British Columbia, for the year ending 31st December, 1911. Being an account of mining operations for gold, coal, etc., in the province of British Columbia.

Preliminary Report on the Clay and Shale Deposits of the Western Province. By Heinrich Ries and Joseph Keele, being memoir No. 24 E Geological Survey Branch, Department of Mines, Ottawa.

Chain Belt. Paper, 6 x 9 ins., 8 pages. Chain Belt Co., Milwaukee, Wis. This is the August number of "Chain Belt," and it contains a descriptive article of the method adopted for roundhouse construction on the Lake Shore & Michigan Southern R.R. at Chicago, by means of the shooting system and movable steel towers 72 feet high.

CATALOGUES RECEIVED.

Wire Rope and Fittings. The B. Greening Wire Company, Limited, Hamilton, Ont., forward catalogue illustrating their wire rope and rope fittings.

Lead Wool. How to Use It. Pamphlet issued by the United Lead Company, 111 Broadway, New York, describing the use of lead wool.

Green's Fuel Economizer. Catalogue No. 142, forwarded by the Green Fuel Economizer Company, Matteawan, N.Y., describing different installations of the economizer.

Stokers. The American Stoker Company, 11 Broadway, New York, forward Bulletin B-I entitled "The Class 'E' Stoker," describing their new underfeed type of stoker.

Patent Steel Pipes. Stewart's and Lloyd's, Limited, Glasgow, forward catalogue describing the Stewart patent steel pipes.

Herringbone Gears. The Earle Gear and Machinery Co., Philadelphia, Pa., forward pamphlet describing their Herringbone gears.

Motor Trucks. The Canada Foundry Co., Limited, forward pamphlet illustrating the Knox-Ajax trucks for commercial use.

Industrial Railways. Catalogue No. 12-1, issued by the C. W. Hunt Company, West New Brighton, N.Y., illustrating Hunt industrial narrow gauge railways for handling raw and finished material.

Hayward Buckets and Digging Machinery. Being pamphlet No. [illegible] issued by the Hayward Company, 50 Church Street, New York, illustrating the use of their buckets and digging machinery.

Continuous Current Dynamos and Motors. Bruce Peebles and Co., Limited, Edinburgh, forward catalogue illustrating their medium size, self-contained continuous current dynamos and motors.

Gutta Percha India Rubber Covered Wires. The India Rubber Gutta Percha and Telegraph Works Co., Limited, London, E.C., forward price list of Gutta Percha India Rubber silk and cotton covered wires.

Mesta Machine Company forward 5 x 7-inch pamphlet, being a brief description and illustrations of their plant and products. Copies may be secured by addressing the Mesta Machine Company, 1245 Oliver Building, Pittsburg, Pa.

Glover's Cables. Descriptive catalogue and price list of cables for electric lighting, power and traction purposes. Manufactured by W. T. Glover & Co., Limited, Trafford Park, Manchester. Being List No. 4, Mains Section.

Westinghouse commutating pole direct current motors (Type QM) for compressors, blowers, pumps, and similar classes of service are fully illustrated and described in leaflet 2499, issued by the Westinghouse Electric Manufacturing Co.

Rules for the Selection of Machine Tool Motors, is the [illegible] by the Westinghouse Electric and Manufacturing Co. Quite a lot of valuable information is here condensed into a small space relative to the selection of a motor with the proper characteristics for the desired duty.

Faessler's Safety Sectional Expander with Quick-Acting [illegible] just published by the J. Faessler Manufacturing Co., Moberly, Mo. This bulletin illustrates and describes a new sectional expander which eliminates side blows on removal of the mandrel, [illegible] in time.

Circular 1516, attractively bound in an art cover, has [illegible]

Switchboard Meters [illegible] complete line of switchboard meters recently brought out by this company. In addition to describing and illustrating these meters, the circular contains reprints of papers by Mr. Paul McGahan on (1) Modern Tendencies in the Design of Switchboard Indicating Meters, and (2) Theory and Performance of Induction Instruments.

The Westinghouse Electric and Manufacturing Co. has just issued a series of descriptive leaflets (Nos. 2465 to 2473) illustrating the new line of switchboard seven and nine-inch indicating meters. In each leaflet is a full-sized facsimile of the meter dial, the purpose being to present a correct idea of the actual appearance of the meter when installed. By placing these leaflets on the wall an accurate idea of the readability of the meter may be gained from any distance and angle.

Descriptive Leaflet No. 2494 issued by the Westinghouse Electric and Mfg. Co., fully illustrates and describes the Westinghouse synchronous booster rotary converter. This machine consists of a standard converter in combination with a revolving armature alternating current generator mounted on the same shaft with and having the same number of poles, as the ammeter by means of which the direct current voltage delivered may be varied.

Sewage Distributors. Through the courtesy of Messrs. Laurie and Lamb, 211 Board of Trade, Montreal, we have received a copy of the new 140-page catalogue issued by Messrs. Tuke and Bell, Limited, of London, England, for which firm Messrs. Laurie and Lamb are sole agents for Canada. The catalogue which is bound in stiff covers, illustrates and describes various types of sewage sprinklers, distributors, ejectors, centrifugal pumps, penstocks, sewage screens, and many other pieces of apparatus of general interest to municipal engineers and of specific interest to those who have to do with the construction and maintenance of sewage disposal equipment. We would advise those interested to write Messrs. Laurie and Lamb for a copy of the catalogue.

◆

The following two letters are fair samples of many letters which reach our office almost daily.

Toronto, Ontario,
August 20, 1912.

The Canadian Engineer,
Toronto.

Gentlemen,—I have yours of August 15th re the.......... advertisement and subscription. I certainly would not or could not do without your paper, but you will have already received notice from the ....Head Office ordering the paper to be sent to me

Yours very truly,

....
Consulting, Designing and
Inspecting Engineer.

St. John, N.B.,
August 15th, 1912.

The Canadian Engineer,
Toronto.

Gentlemen,—Kindly send my copies of The Canadian Engineer [illegible] St. John, N.B., [illegible] weekly paper [illegible]

Yours truly,

Civil Engineer.

CANADIAN FAIRBANKS-MORSE TO BUILD TRACTOR FACTORY.

Messrs. T. Pringle and Son, Ltd., engineers and architects, Montreal and Toronto, have prepared designs for a large modern tractor factory to be erected on the south end of the property of the Canadian Fairbanks-Morse Company, Limited, Bloor Street, Toronto. The building will be 397 feet long by 100 feet wide, and will consist of concrete foundations with structural steel framework and brick walls. Steel sash will be used throughout for all windows. The forge shop will be 122 feet by 49 feet; testing room, 76 feet by 49 feet; erecting shop, 172 feet by 49 feet; structural steel shop, 318 feet by 49 feet, and the tin shop 397 feet by 49 feet. The structural steel shop will be served by two one-ton cranes and the erecting shop by a 12-ton crane. A very complete system of industrial railways will serve all portions of the plant. The paint shop is to occupy the end of the erecting shop, and it is from here that the tractors will be loaded directly into the cars on the siding. The factory will cost about a quarter of a millian dollars and will be, when completed, one of the finest equipped plants in the world for the manufacture of tractors.

◆

INCREASED WORK OF TORONTO'S NEW CIVIC LABORATORIES.

The laboratories of the Medical Health Department of this city were recently moved from very cramped quarters to spacious rooms and the results from the increased facilities is well shown by the following statistics.

In all, 2,385 specimens have been examined, as compared with 1,420 in July, 1911, as follows.—

	July, 1911.	July, 1912.
Diphtheria cultures	861	634
Tuberculosis sputum	46	106
Typhoid blood	49	39
Gonorrhœa	8	7
Water specimens	104	343
Milk for bacteria	152	284
Milk cans for bacteria	...	121
Milk for fat	200	423
Milk for dirt	...	428
	1,420	2,385

◆

PROGRAMME OF THE FIFTH ANNUAL MEETING OF THE CANADIAN GAS ASSOCIATION.

The fifth annual meeting for the transaction of business, reading of reports, etc., will be held as follows in the Engineers' Club, 94 King Street West, Toronto:—

Tuesday, September 3rd, 9 a.m.—Register at Engineers' Club; Business Meeting; Executive Committee's and Secretary-treasurer's reports; President's Address (Mr. Arthur Hewitt, Toronto); Nomination Committee's report.

Paper by Mr. Howard E. Mann, engineer Montreal Light, Heat and Power Company, Montreal, "Reconstruction of an Old Retort House."

Paper by Mr. H. E. G. Watson, Commercial Department, Consumers' Gas Company, Toronto, "Suggestions for Increasing the Industrial Use of Gas."

12.00 noon - Luncheon.

1 p.m.—The following papers by

Mr. J. J. Armstrong, accountant, Consumers' Gas Company, Toronto, "Consumers' Accounting and Records System."

Mr. C. H. Osler, superintendent of distribution, Montreal Light, Heat and Power Company, "Medium High Pressure Gas Distribution in Montreal."

Mr. C. W. Allman, Commercial Department, Consumers' Gas Company, Toronto, "Gas vs. Coal for Water-heating Appliances."

Mr. W. J. Fuller, Commercial Department, Consumers' Gas Company, Toronto, "Commercial Lighting in Toronto."

Wednesday, September 4th, 10 a.m.—Business meeting at Engineers' Club, announcements, etc.

10.30 a.m.—Sight-seeing trip around the city and a visit to the Canadian National Exhibition.

◆

PERSONAL.

MR. F. G. CLARK, of New York, has accepted a position as chief engineer of the Toronto Electric Light Company.

MR. S. P. PORTER has been appointed executive agent for the Grand Trunk Pacific Railway, with headquarters in Regina, Sask.

MR. GEO. OKXVIK, until recently with the Canadian Bridge Company, of Walkerville, Ont., is now with the city of Toronto in the Department of Railways and Bridges.

PROFESSOR C. C. SLICHTER, Ph.D., of Madison, Wis., U.S.A., has received a commission from the civic authorities of Winnipeg to make a full report on the water supply of that city.

MR. H. E. M. KENSIT, who during the past four years has been occupied in investigating and reporting on various undertakings and projects in Canada and the United States for Messrs. Smith, Kerry and Chace, of Toronto, has received an appointment with the water power branch of the Department of the Interior, Ottawa.

MR. LEROY A. KLING, who has been connected for some time past with two well-known crusher companies in Cedar Rapids, Iowa, has just accepted a position with the Wheeling Mold and Foundry Company, of Wheeling, W. Va., as sales manager of the road machinery department. This is the concern that has built so much of the important machinery for the Panama Canal. They will eventually manufacture a complete line of road building machinery, including a modern crusher, adjustable to crush to any size, pulverizers, rolls, screens, elevators, trucks and graders. Mr. Kling announces that his connection with these people begins at once.

MR. L. J. STREET, vice-president of the Canadian Inspection and Testing Laboratories, and district manager in Toronto for the past eight years, is severing his connection with that firm to go with the Dominion Iron and Steel Co., Sydney, C.B., as assistant to Mr. J. P. McNaughton, general sales manager. For several years Mr. Street was treasurer of the Engineers' Club of Toronto, and on its reorganization a year and a half ago, was elected chairman of its house committee. During his eight years' residence in Toronto Mr. Street has made many friends among the engineers and architects, and by his close application to work and expert attention to large inspection orders handled by him, has done much towards bringing the Canadian Inspection and Testing Laboratories to the high position it occupies in Canada at the present day. Mr. Street's knowledge of the iron and steel requirements of this country should make him a valuable addition to the staff of the Dominion Iron and Steel Co.

MR. JAMES MILNE, recently appointed mechanical and electrical engineer in the Works Department, city of Toronto, has entered upon his duties.

MR. E. M. PROCTOR, who has been with the Canada Foundry for the past two years, has accepted a position in the Department of Railways and Bridges for the city of Toronto. Mr. Proctor is a graduate of the class of '08 in civil engineering of the University of Toronto.

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer, John Keillor, Hamilton, Ont.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912 Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagara Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill: Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H Victor Brayley, N T Ry, Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh [illegible] 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill [illegible].

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—[illegible] Brydone [illegible] and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

[illegible] Hamilton, [illegible]

[illegible] MUNICIPALITIES.—[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer [illegible], Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. [illegible] Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, [illegible]

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, [illegible]; Secretary, H. [illegible] Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan [illegible]; Permanent Secretary, Norman S. Rankin, P.O. [illegible]

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, [illegible] Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-31	Trenching and Backfilling, Edmonton, Alta. (S.)	8-8

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page
Calgary, Alta., bridges	Aug. 31	Aug. 22.	67
Comaplix, B.C., wharf	Aug. 28	Aug. 22.	68
Dauphin, Man., superstructures of four bridges		Aug. 22.	80
Edmonton, Alta., purchase of material at Goose Island, Alta.	Sept. 4	Aug. 22.	67
Edmonton, Alta., lighting, Parliament Building	Aug. 31.	Aug. 8.	67
Edmonton, Alta., trenching	Aug. 31.	Aug. 8.	78
Fort William, Ont., water pipe	Aug. 28.	Aug. 8.	78
Longueuil, Que., dredging	Aug. 27.	Aug. 15.	68
Moncton, N.B., laying water mains	Sept. 1	Aug. 22.	67
Montreal, Que., moving Queen Victoria Monument	Aug. 29.	Aug. 22.	67
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
Ottawa, Ont., supply of coal	Aug. 28.	July 25.	67
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., Hudson Bay Railway	Sept. 12.	Aug. 22.	78
Ottawa, Ont., iron posts	Sept. 25.	Aug. 22.	78
Ottawa, Ont., twin screw steel steamer	Sept. 2.	Aug. 15.	68
Port Arthur, Ont., railway material	Sept. 2	Aug. 22.	80
Port Arthur, Ont., heating and plumbing, school	Sept. 1.	Aug. 22.	68
Point Tupper, C.B., station	Sept. 4.	Aug. 22.	68
Port Arthur, Ont., breakwater	Aug. 28.	Aug. 8.	80
Quarantine Station, St. John, N.B., Houses	Sept. 5.	Aug. 22.	68
Souris, P.E.I., breakwater	Sept. 11	Aug. 22.	68
Smith's Falls, Ont., wall	Sept. 14.	Aug. 22.	68
Tilsonburg, Ont., church	Aug. 31.	Aug. 15.	68
Toronto, Ont., sale of Normal School property	Sept. 30.	Aug. 15.	68
Toronto, Ont., pavements, curbs, walks and sewers	Aug. 27.	Aug. 22.	68
Upper Maugerville, N.B., wharf	Aug. 28	Aug. 22.	67
Victoria, B.C., breakwater, Victoria Harbor	Sept. 5.	Aug. 15.	80
Winnipeg, Man., 36-inch pipe	Aug. 28.	July 25.	68
Winnipeg, Man., lighting standards	Aug. 28.	Aug. 15.	68

TENDERS.

Craik, Sask.—Tenders will be received by Chas. R. Hainsworth, secretary-treasurer, town of Craik, Sask., until noon of September 9th, 1912, for the following buildings to be erected in Craik:—

(1) Town Hall (alternative tenders as per specifications).
(2) Skating and curling rink.

Plans and specifications may be seen at the offices of Messrs. Storey and Van Egmond, architects, Regina or Saskatoon, and at the office of the secretary-treasurer of the Town of Craik.

Creelman, Sask.—Tenders for building a two-roomed school building of solid brick with a concrete basement in the village of Creelman, Sask., according to plans and specifications which may be seen at the office of Geo. J. C. Jarrett, architect, Weyburn, Sask., or S. R. Carrothers, sec.-treas., Creelman, will be received until August 31st, 1912, at the office of the secretary-treasurer, S.D. 998, Creelman.

Dewdrop, Sask.—Tenders will be received at the office of Alex. Tibeau, secretary, Dewdrop, until Sept. 21, 1912, for the purpose of building a schoolhouse and barn. Plans may be obtained at the secretary's office.

Dunnville, Ont.—Tenders for the construction of a concrete pavement, together with curb and channel on Chestnut, Canal East and West, and Lock Streets, will be received until August 31st, 1912, at the office of Alan Mair Jackson, town engineer, at whose office plans and specifications may be seen. (See advt. in Canadian Engineer.)

Montreal, Que.—Tenders addressed to the Board of Commissioners, City Hall, will be received until noon of August 30th, 1912, for the construction of asphalt, block or asphaltic composition pavements, on eleven streets, full particulars of which may be obtained at the office of the Engineer, Superintendent of the Road Department. L. N. Senecal, secretary, Board of Commissioners, City Hall, Montreal.

Montreal, Que.—Sealed tenders for the supply and delivery of three city fire trucks, and one 800 U.S. gallon steam fire engine, addressed to the Board of Commissioners, City Hall, will be received until noon of September 5th, 1912. Specifications, etc., may be obtained from the Purchasing and Sales Agent, City Hall. L. N. Senecal, Secretary, Board of Commissioners' Office, City Hall, Montreal.

Ottawa, Ont.—The time for receiving tenders for the construction of the Victoria Harbour, B.C., Breakwater, is extended to Wednesday, September 18th, 1912. R. C. Desrochers, Secretary, Department of Public Works, Ottawa. (See advertisement in The Canadian Engineer).

Ottawa, Ont.—Tenders addressed to A. W. Campbell, Chairman Government Railways, Managing Board, Ottawa, will be received until September 12th, 1912, for the construction of an addition to the freight car repair shop at Moncton, N.B. Plans and specifications may be seen at the office of the Secretary of the Department of Railways and Canals, Ottawa, and at the Chief Engineer's Office, Moncton, N.B.

Ottawa, Ont.—The Department of Public Works, Ottawa, will receive tenders until September 12th, 1912, for the construction of an extension to the breakwater at North Head, Grand Manan, Charlotte County, N.B. Plans, etc., can be obtained at the Department, and at the offices of F. G. Goodspeed, Esq., District Engineer, St. John, N.B.; Geoffrey Stead, Esq., District Engineer, Chatham, N.B., and on application to the Postmaster at North Head, N.B.

Ottawa, Ont.—The Toronto General Trusts Corporation, 30 Elgin Street, Ottawa, will receive tenders up to the 20th day of December next for the purchase of several valuable timber limits. Maps, etc., may be seen at the offices of the above and at the offices of Messrs. Aylen & Duclos, barristers, Castle Building, Ottawa, or Messrs. Belcourt and Ritchie, barristers, Castle Building, Ottawa.

Ottawa, Ont.—Tenders will be received by R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until September 12th, 1912, for the supply of lumber and timber, etc., for one 3½ cubic yard dipper dredge, and for the supply of white oak, British Columbia fir and white pine, for four 95 cubic yard hopper scows. Specifications, etc., can be obtained at the offices of T. H. Schwitzer, Esq., Mechanical Superintendent, Birks Building, Ottawa, Ont.; J. G. Sing, Esq., District Engineer, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Merchants Bank Building, Montreal, Que., and at the office of the Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders addressed to P. E. Ryan, secretary, office of the Commissioners of the Transcontinental Railway, Ottawa, will be received until Sept. 10th, 1912, for furnishing and installing all piping systems, pipe tunnels, pipe coverings, and wiring ducts required in connection with the car shop plant of the Winnipeg shops, about six miles east of Winnipeg, Man. Plans, etc., at the office of Mr. W. J. Press, mechanical engineer, Ottawa, and at the office of Mr. H. H. Pinch, asst. engineer, Transcona, Man. (See advt. in Canadian Engineer.)

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, for the construction of a retaining wall in the town of Owen Sound, Ont., will be received until Sept. 28, 1912. Plans, etc., at this department and at the offices of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto; H. J. Lamb, Esq., district engineer, Windsor, Ont.; and on application to the Postmaster at Owen Sound, Ont.

Ottawa, Ont.—Tenders for the purchasing of the plant owned by the Department at the Timiskaming Dam, Timiskaming, County of Pontiac, P.Q., will be received until September 19, 1912. The list of plans and forms of tender can be seen and obtained at the Department of Public Works, Ottawa, and at the offices of C. R. Coutlee, Esq., Engineer in charge, Corry Building, Ottawa, Ont., and of H. H. Donnelly, Esq., Resident Engineer, Timiskaming, P.Q. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—R. C. Desrochers, Secretary, Department of Public Works, Ottawa, will receive tenders until September 11, 1912, for the erection of a residence for the Medical Superintendent of Lazaretto, Tracadie, N.B. Plans, etc., at this Department, and at the offices of Mr. D. H. Waterbury, Superintendent of Public Buildings, Public Works Department, St. John, N.B., and Dr. J. A. Langis, Medical Superintendent, Tracadie, N.B.

Ottawa, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until Sept. 17, 1912, for the construction of a wharf with stone approach at the village of Bell Ewart, county of Simcoe, Ont. Plans, etc., at the office of the secretary, and at the offices of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto, Ont.; H. J. Lamb, Esq., district engineer, Windsor, Ont.; and on application to the [illegible]

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, secretary, Department of Public Works, for the construction of a wharf [illegible] at Big Bay Point, in the township of Innisfail, county of Simcoe, Ont., will be [illegible]

Regina, Sask.—[illegible]

Toronto, Ont.—[illegible]

Victoria, B.C.—Plans for the two garbage stations at Spring Ridge and Fairfield are ready and tenders will be invited at an early date.

Victoria, B.C.—Tenders for the erection and completion of an industrial school for girls, will be received by the Hon. the Minister of Public Works, Victoria, until noon of September 9th, 1912. Plans, etc., may be seen at the offices of the Government Agents, Vancouver and New Westminster, and the Department of Public Works, Victoria. J. E. Griffith, Public Works Engineer.

Victoria, B.C.—Tenders for the erection of a schoolhouse at Quesnel will be received up to noon of Wednesday, September 4th.

Winnipeg, Man.—Tenders for the erection and completion of a twelve-room brick school building at Transcona, Man., will be received until Sept. 9, at the office of E. D. Tuttle, architect, 701 McArthur Bldg., Winnipeg.

◆

CONTRACTS AWARDED.

Belleville, Ont.—Messrs. Thomas Manley and Sons, contractors, have begun a $40,000 contract of building culverts for the Canadian Pacific Railway in Sidney Township, west of this city.

Camrose, Alta.—At a meeting of the council a resolution was passed accepting the tender made last year by the Western Paves, Limited, for the laying of cement sidewalks on the first two blocks of Main Street.

Galt, Ont.—Messrs. Thomas and Hancock have been awarded the contract for the concrete and brick work of the addition to be built to the Galt Robe Works.

Moose Jaw, Sask.—The contract has been awarded by the Moose Jaw Hardware Company for the erection of a $30,000 warehouse on the corner off Fairford Street and Seventh Avenue.

Moose Jaw, Sask.—The contract for the erection of the new Young Women's Christian Association has been awarded to the Western Improvement Company, Minot, North Dakota. The contract price is $56,383, which does not include lighting, heating or plumbing; these will be awarded later. L. T. Stromswold is president of this contracting firm.

North Toronto, Ont.—Mr. M. J. K. Allen, who was recently awarded certain paving contracts has been released from the obligation. The council then reconsidered other tenders with the result that Mr. E. G. Law was awarded the contract for Tarvia paving at a price of $1.58 per square yard and 40c. per lineal foot for curbing. This is an increas of $5,950 over Mr. Allen's offer.

Port Colborne, Ont.—A despatch from Montreal states that contracts have been let by the Montreal Transportation Company, by which the Canadian canal trade will have the first electrically-propelled merchant vessel ever built. The ship is being built by the Messrs. Swan, Hunter & Wigham Richardson firm.

Saskatoon, Sask.—Mr. G. N. Hughes is the contractor for the new apartment block to be erected by W. W. McKim at the corner of 23rd Street and 5th Avenue at a cost of $40,000.

Swan River, Man.—Messrs. J. W. Gunn and Sons, Winnipeg, are the contractors for building the concrete piers for the new $20,000 steel bridge which the Canadian Northern Railway is building over the Swan River.

Sydney, Cape Breton, N.S.—The contracts for the new [illegible] and McCurdy buildings have been awarded to Rhodes, Curry and Co. and Chappell Bros.

Toronto, Ont.—The contract for the erection and completion of a new bath house on St. David Street has been awarded to John [illegible], his price being $[illegible].

Toronto, Ont.—The Board of Control have made the awards for the work of supplying pipe for a 36" water main. The National Iron Works' tender of $[illegible] a length for [illegible] lengths, and the tender of the Canada Iron and Foundry Company for [illegible] lengths at $[illegible] per length, were accepted.

Barrett Specification Roofs

The Place to Break the Pen!

The building shall be covered with a Barrett Specification Roof or

IN writing your roofing specifications it is especially important not to add "or equal thereto."

You need precision in dealing with a roof more than with any other part of the structure for the reason that in laying a roof there are many opportunities for "skinning the job."

Further, you put the honest, reliable contractor at a great disadvantage when you ask him to bid on an indefinite or vague specification, and such specifications usually mean poor workmanship and cheap materials with subsequent leaks and trouble.

There are various ways of constructing gravel and slag roofs, but if The Barrett Specification is followed, there is no chance for mistakes or slipshod workmanship.

It describes in a practical way how to use Specification Felt and Specification Pitch to make a first-class roof—one that will always give maximum service.

The Barrett Specification embodies the best experience of the roofing industry and is designed for the benefit of architects, engineers and owners.

Incorporate it in full into your own building specification and you will be ordering a roof that has shown a lower cost per foot per year of service than any other type of roofing ever made.

We know that if all buildings were covered with Barrett Specification Roofs, roof troubles would be practically nil.

Copy of the Barrett Specification ready for incorporation into building specifications free on request.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If an abbreviated form is desired, however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Vancouver, B.C.—The contract for the erection of the substructures of eight steel bridges and trestles on the Canadian Northern Pacific Railway east of Yale, has been awarded to Messrs. Rigby & Marsden, of Vancouver. The total amount of money involved in the work is about $60,000, and the total of the eight completed bridges will be $300,000.

Vancouver, B.C.—Mr. Ambrose Adams has been awarded the contract to construct a six-story warehouse for Messrs. Stewart and Crombie at a cost of $61,000.

Vancouver, B.C.—Messrs. Phelan & Shirley, Palmer Brothers & Henning, of Vancouver; and J. Hogan, of Edmonton, have been awarded a contract for the construction of 60 miles (20 miles each) of track on the Northern Railway from Yellow Head Summit west and southward.

Victoria, B.C.—The contract for the construction of the big dam at Jordan River, for the B.C. Electric Railway Company, has been awarded to the Puget Sound Bridge and Dredging Company, of Seattle. The dam will be 800 feet long and 115 feet deep, and will be modelled after the Ambursen type of reinforced concrete structure.

Winnipeg, Man.—The contract for the supply of a quantity of water meters has been awarded to the National Meter Company, of Chicago, for $61,878.75.

Winnipeg, Man.—Tenders for the supply of materials for the extension of the fire service waterworks have been awarded as follows:—High pressure water pipe and specials, Canada Iron Corporation, Montreal, $64,211.71; valves, Rensselaer Valve Company, Troy, N.Y., $3,537.50; hydrants, Florence Iron Works, Philadelphia, Pa., $11,484.

◆

RAILWAYS—STEAM AND ELECTRIC.

Edmonton, Alta.—The commissioners have decided to purchase new fare boxes for the street railway cars. Mr. Woodroffe, superintendent of street railway.

Galt, Ont.—A report states that a portion of the lines of the Grand Valley Railway will soon be operating under the pressure of the hydro-electric system. The Galt, Preston and Hespeler Railway is operated from this source at present.

◆

LIGHT, HEAT AND POWER

Berlin, Ont.—The management of the Canadian Consolidated Rubber Company have made a request for an estimate [illegible] h.p. from the Berlin Light Commission. If the [illegible] to that now consumed in this municipal[illegible] the rates will be reduced.

Beauharnois, P.Q.—A group of Montreal financiers and business men have formed a company with the idea of erecting a power plant at this point. They have received the approval of the provincial government and will have powers in the city of Montreal, in the counties of Laval, Jacques Cartier, Hochelaga, Laprairie, Chateauguay, Beauharnois, Two Mountains, Argenteuil, Soulanges, Vandreuil, Terrebonne, L'Assomption, [illegible], Huntingdon, Napierville, St. Jean and Iberville.

Kingston, Ont.—The municipal council has decided to [illegible] the sum of $[illegible] for the enlargement of the present steam plant used for city light and power. Mr. P. Kelch, Montreal, P.Q., consulting engineer to the municipal council.

Nelson, B.C.—[illegible]

Port Dalhousie, Ont.—The ratepayers voted in favor of the installation of a hydro-electric lighting and power system for this municipality. Mr. [illegible] is Reeve of the place.

Victoria, B.C.—The Canadian Pacific Railway [illegible] that the provincial government and certain land owners will [illegible] of the municipal council, is [illegible] in the matter.

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—The ratepayers by a small vote defeated the proposed expenditure of $405,000 to construct a filtration plant and a new intake pipe.

Calgary, Alta.—City Engineer Childs is preparing plans and estimates for a sewage disposal plant to be erected in Ogden. This work will cost about $20,000.

East Toronto, Ont.—Sewers for the former town of East Toronto, at a cost of $327,500, are recommended by Works Commissioner Harris.

Guelph, Ont.—The municipal engineering department have reported that the Huskisson Street drain must be diverted. M. Ferguson, city engineer.

Kingston, Ont.—The Board of Health of this municipality has taken a definite action to secure the consent of the Civic Utilities Commission in the matter of supplying the filtration plant endorsed some time ago. R. J. McClelland, city engineer.

Kindersley, Sask.—Contracts have been let for the construction of a $90,000 waterworks system and electric light plant in this town.

Ottawa, Ont.—It is reported that Prof. Starkey, of McGill University, will be appointed as the representative of the Canadian section of the internal waterways commission to enquire into the question of the pollution of boundary waters.

Toronto, Ont.—The sum of $15,000 has been voted by the Board of Control to make a preliminary examination of the lake bed at Scarboro Bluffs in connection with the proposed duplicate waterworks system at that point. The New York firm of Smith and Travis will be engaged. Borings at the lake bed will be made, first along the shore, and then as far out as two miles, with 600-foot centres. The services of Prof. A. P. Coleman of the faculty of applied science of the University of Toronto will be secured by the city as adviser.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Calgary, Alta.—R. B. Bennett, K.C., has recently returned from a business trip to England, and made the announcement that he is interested in a large industrial undertaking that will mean much to Alberta and Calgary when the details are in such a condition as to be made public.

Calgary, Alta.—Pending the selection of a site the federal government are ready to construct an armoury in this city.

Edson, Alta.—Mr. M. Greenberg has started construction work on a 45-roomed hotel that will cost $40,000 before completion. It will be heated by steam and contain other modern appliances.

Fredericton, N.B.—Many important changes have been made in the plans of the new fire hall for this city. Tenders will be called in the course of a few days. Ald. Cruikshank is chairman of the committee dealing with this matter.

Galt, Ont.—Messrs. W. D. Sheldon, J. F. MacGregor and Allen Hills, all of this town, are interested in a new project of the Hare Engineering Company. $400,000 of capital stock in this company has been taken up in Great Britain and the company will now erect a plant to manufacture power equipment and pulp machinery. The plant to be erected in this town will cost about $150,000.

Kingston, Ont.—The management of the Canadian Locomotive Company are about to erect several residences for the mechanics employed by them. Fifteen double houses are to be built before the winter months.

Moose Jaw, Sask.—The Moose Jaw Steam Laundry have taken out a permit for the erection of an addition to their plant. There will be considerable machinery necessary for the work to be conducted in the new wing. The cost of the building will be about $10,000.

Montreal, P.Q.—A large glass factory will be erected in Montreal West near the Canadian Pacific Railway's new yards. There will be about 600 men employed when this industry commences operations.

48 in. CONTINUOUS STAVE LINE.

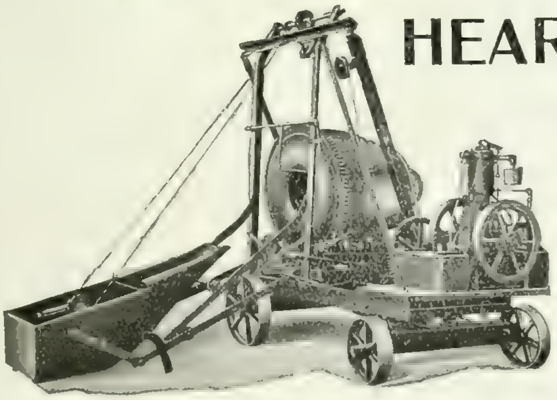
Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

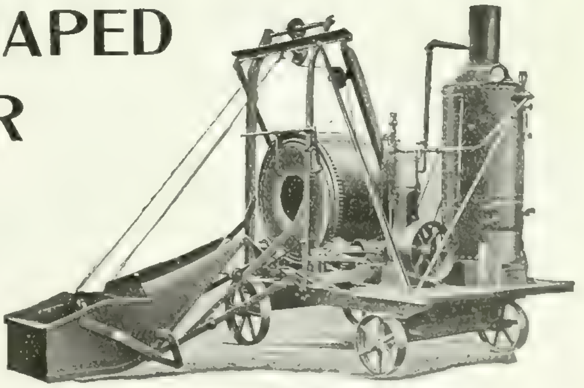
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER
HEART-SHAPED
MIXER



Write for 1912 Catalogues.



The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

A MIXER is not COMPLETE unless it is equipped with **AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES,** and built of **STEEL** and **SEMI-STEEL** as used in the entire construction of our mixers throughout.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH.
BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.,
316 Lagauchetiere St., W.,
Montreal, Que.

Northern Ontario.—It is the intention of the department of public works of the Dominion Government to begin shortly preparation of plans and estimates for the improvement of the French River, for which work $100,000 was appropriated at the last session of parliament. The river is the connecting link between Georgian Bay and Lake Nipissing, and as such is a part of the projected Georgian Bay canal.

Pelee Island, Ont.—Mr. H. Henderson, of this island, is at the head of a company which will build a passenger and freight steamer to run between this place and the main land. The cost of this work will be about $60,000.

Prince Rupert, B.C.—Plans are now being prepared in the department of public works, Victoria, for the new provincial buildings to be erected at Prince Rupert.

St. John, N.B.—The Grand Falls Power Company will establish at Grand Falls on the St. John River, a pulp and paper making plant at a cost of between $5,000,000 and $7,000,000. Eminent hydraulic engineers from the United States are now at work revising the plans for developing the power and erecting the plant.

St. Mary's, Ont.—The management of the St. Mary's Wood Specialty Company are making preparations for extension of their plant. They have taken an option on a flax mill and if the shareholders so decide, they will install such machinery and make such changes as may be necessary.

Toronto, Ont.—Mr. James O'Neill, proprietor of the St. Charles Hotel, is interested in a project calling for the erection of a 600-roomed hotel.

Toronto, Ont.—The management of the Northern Aluminium Company, local offices 1106 Traders Bank Building, Toronto, will erect a factory for the manufacture of their specialties on Sterling Road.

Toronto, Ont.—The municipal property commission have endorsed two sites selected for the erection of public lavatories at a cost of $8,000 each.

Vancouver, B.C.—The ratepayers will be asked to vote on the question of the erection of a proposed new school building on Pender Street East. The estimated cost of this work is $15,000.

Watrous, Sask.—The municipal council has closed an agreement with the Perfection Fanning Mill Company whereby the latter will erect a factory and start manufacturing their products in this town at an early date.

Welland, Ont.—An amalgamation of the Lake Shore Seed Company and the Dunkirk Seed Company, has been formed and will erect a brick factory, two-story, 450 x 100 feet, to be used for putting vegetable seeds into packets. Mr. J. H. F. Kaufman, of the Lake Shore Seed Company, has looked after [illegible] the Welland interests.

BRIDGES, ROADS AND PAVEMENTS.

Guelph, Ont.—Mr. M. Ferguson, city engineer, will prepare plans for a new bridge that the council have decided to erect over the River Speed in the place of the present Victoria Bridge.

Toronto, Ont.—The municipal Board of Control has recommended that the proposed Bloor Street Viaduct be made [illegible] as the present design calls for.

FIRES.

Western Lower Ontario.—Considerable damage was [illegible] and other [illegible]

CURRENT NEWS.

Eastern Canada.—[illegible]

Moose Jaw, Sask.—The Municipal Hospital Board held a meeting to consider a report prepared by Mr. Meyer J. Sperm, of Chicago, who has made an investigation of the conditions in Moose Jaw. He recommended that a building costing $300,000 be considered and erected on the unit basis.

New Westminster, B.C.—There is much dissatisfaction regarding the operation of the telephone system in this city and a movement has been started among the business men to petition the council with a view of granting a franchise to another company.

Niagara Falls, Ont.—It is reported that the large touring car, driven into the forebay of the Ontario Power Company, to extinguish a fire that had broken out while travelling along the river bank, has been washed over the falls. Divers have been at work for some time and nothing has been found excepting a door of the machine at the Maid of the Mist landing stage.

Ottawa, Ont.—The City Solicitor has engaged the services of two inspectors to crawl through the concrete aqueduct for the purpose of making a report on the condition of the concrete. This pipe has an internal diameter three feet six inches and is sixteen hundred feet in length.

Province of Manitoba.—In future all telephone extensions will be carried out by contract instead of day labor. It is expected that this will entail a saving of $80,000 per year to the Manitoba Government.

Regina, Sask.—The members of the Loyal Order of the Moose lodge of Regina recently issued a number of small celluloid bricks on which was printed "This entitles bearer to 25 cents worth of hospitality at the Moose Temple, Regina, Sask.," and from the sale of the same raised the sum of $15,000 toward the expense of erecting the new lodge rooms in this city.

Quebec, P.Q.—There is a large building boom coming across this city; ten permits were issued last week, which is the largest number in one week for many seasons.

Toronto, Ont.—The committee dealing with the proposed new technical school for this city have decided to ask for alternative tenders for brick and stone walls. If this is adopted the cost will be about 25% more than the present estimate. Messrs. Ross and McFarlane are the architects.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending August 8th, 1912:

A pottery firm in the Midlands desires to be put in touch with a Toronto firm wishing to represent English manufacturers of pottery, etc.

Inquiry is made on behalf of a Canadian firm of automobile and motor wagon manufacturers for the names of English manufacturers of auto parts and chassis willing to cooperate with them.

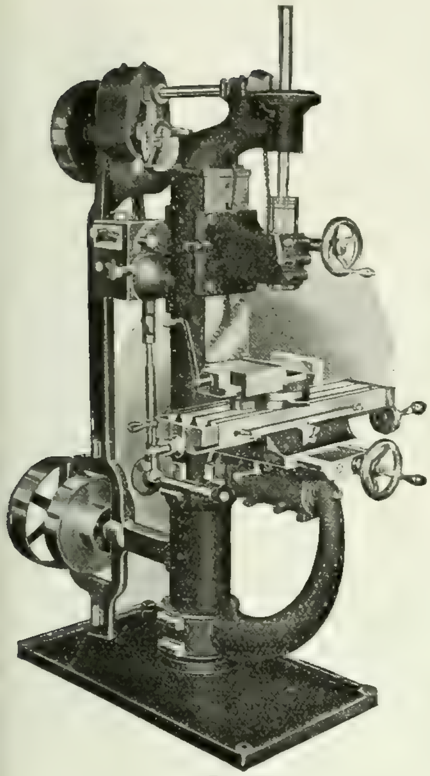
From the branch for city trade inquiries, 73 Basinghall Street, E.C.:

A Liverpool firm manufacturing a patented press for baling flax wish to arrange for their sale in Canada.

A London company manufacturing various kinds of soaps, toilet specialties and disinfectants, are looking for suitable Canadian resident agents, but require persons who have an expert knowledge of this trade and an established connection among buyers.

NITRATE MANUFACTURE IN SPAIN AND CANADA.

It is stated on apparently reliable authority that a Spanish consortium of financiers has recently inspected the nitrate works at Notodden with a view to the possibility of establishing a factory in Barcelona. It is proposed to transfer the Norwegian [illegible] method to a Spanish and a Canadian company. In the event of the latter proposition materializing, the works would be in the neighborhood of Montreal. It will be stipulated that the managers shall be Norwegians.



You Need a Machine Like This on a Dozen Different Jobs

It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows :—Spindle of crucible steel, ground bearings ; working surface of table, 29 × 8½ inches ; feed, longitudinal and transverse ; floor space, 60 × 68 inches ; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG.
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

MANITOBA'S FIRE LOSSES

"The fire losses on this continent from January 1, 1911, to July 1, 1912, are almost $135,000,000, which means that if, in the next six months, the same record is kept up, the fire losses for 1912 will show that the people have again recklessly destroyed $270,000,000 of property in the United States and Canada." Mr. Lindback, Manitoba's Fire Commissioner, makes this statement.

"Of these $135,000,000 losses," he adds, "in the first six months of the year Canada must be charged with about $15[illegible], of which Manitoba's share is one million, equal to a tax of $4 on every man, woman and child in the province—while in England the same tax is not over 40 cents per capita.

"While the United States escape with a per capita loss of $2.50, Canadians are taxing themselves $3.50 per capita, at the rate we have been burning created values during these six months. After an analysis of the causes, it will be plain how utterly indifferent we are in regard to fire prevention.

"On January 3rd the Excelsior Garage burned with a loss of some $115,000, caused through ignorance and carelessness. On the 22nd of the same month a cold storage, with a loss of $315,000, took fire at noon through carelessness.

"On March 9th a sash and door warehouse was destroyed, with a loss of seven lives and $24,000, first, because of non-conformity to the city by-law, second, because of non-inspection by the proper city authorities, and, finally, because the two or three barrels of gasoline used in the warehouse per week were handled under the name of naphtha, and therefore not considered dangerous. On March 5 a fire started in a building on Main Street while the people were still in the office; loss, $20,000; cause, carelessness with a lighted match.

"On April 23rd the Brown-Rutherford plant was destroyed by a spark from their smoke-stack falling in the sash and door warehouse during a very heavy wind, the fire getting beyond the fire department for want of sufficient water at the beginning of the blaze. Loss, $250,000.

"On May 3rd fire started on the platform of a warehouse located on the Canadian Pacific Railway track by a spark from an engine falling in some rubbish on the platform, notwithstanding the parties had been frequently warned about removing such rubbish. Loss from this fire was $34,000. To prove how little effect a lesson of this kind has, on June 20th another fire started under exactly similar conditions in what was left, but with less loss, because there was not so much to burn.

"On May 30th fire started in an unfurnished house on Home Street, causing a loss of $20,000. At the time I suggested the need of a watchman in such buildings under construction, but with no results. Loss here about $50,000.

"The province at large presents a similar record of indifference to fire prevention, although naturally a smaller money loss. But the fact to be deducted from the fire record is that while Canada and the continent generally have realized the need of prompt and drastic action where epidemics and diseases are in evidence, we are far behind in the work of fire prevention."

◆

NOTES ON MINERAL WASTE.

In the preface to Bulletin [illegible] "Notes on Mineral Waste," [illegible] of the Bureau of Mines, [illegible] Dr. Joseph A. Holmes, the director, [illegible]

Dr. Holmes says: [illegible] for the purpose of lessening the waste of essential resources—investigations on the same general lines as those looking to a reduction in the loss of life in the mining operations of the country and the far more extensive investigations looking to the more efficient production and use of agricultural products, both of which are being conducted by the Federal Government.

"In consideration of the possible activities of the individual, the State, and the Federal Government in behalf of a less wasteful use of our mineral resources certain facts and principles should be kept clearly in mind, namely:

"That the present generation has the power, and it will exercise the right, to use as much of the country's resources as it actually needs; there can and there will be no such thing as stinting the present generation by bottling up resources for the use of the future.

"That the nation's needs are not likely to be curtailed; these needs will increase with the extent and diversity of the nation's industries, and they will increase more rapidly than population increases, for the reason that the per capita consumption of mineral products is rapidly increasing; and

"That the men of this generation will not mine, extract or use these resources at continuous financial loss to themselves in order that something may be left for use of future generations; there can be no such thing as a mineral industry without profits.

"Furthermore, it should be clearly understood that the mineral resources of this country have required long ages for their accumulation and that of these resources the nation has but the one supply. There are no known substitutes available to meet the nation's further needs when that supply will be exhausted and, to the best of our present knowledge, this one supply must serve as a basis for both the needs of the present and the far greater needs of the future.

"In a higher way our mineral resources should be regarded as property to be used and to be held in trust with regard to both the present and the future needs of the country. It should be remembered that neither human labor nor any human agency has contributed to their origin or to their intrinsic value, and that whatever rights the individual may possess have been derived from the general Government and from the State as the original owner. The State does not surrender its right, and should not neglect its duty, to safeguard the welfare of its future citizens by preventing the wasteful use of these resources. Though the individual may claim the right to use the resources in proportion to his needs and the needs of the community, he certainly has no right to waste that which is not needed for present use but is certain to be needed hereafter.

"Those in charge of the investigations of the Bureau of Mines recognize the rights and duties of the Federal Government as being limited to the carrying on of inquiries and investigations with a view to determining the nature and extent of this waste of resources, the means by which it may be diminished, and the setting forth of the facts in the case.

"The present report embodies the results of certain preliminary inquiries as to the nature and extent of this waste. It will be followed by a more detailed report on the subject as soon as the necessary inquiries and investigations have been conducted and the results put in shape for publication.

"In the preliminary work along these lines, the representatives of the bureau have received the cordial co-operation of the engineers and chemists associated with the varied mineral industries of this country and also of the owners and the operators of the mines and the metallurgical plants."

Copies of this bulletin may be had by addressing the director of the Bureau of Mines, Washington, D.C.

◆

ANOTHER TRANSCONTINENTAL.

A new transcontinental line, with Fort Churchill on the east and Port [illegible] on the west as terminals, connecting Edmonton with Lac la Biche, Fort McMurray and Lake Athabasca, is projected. It is to be called the Northern Territorial Railway, and it is reported that it will commence a survey of its route from Edmonton northeasterly in the course of the next few days. The corporation has authorized capital of $[illegible] and under the charter which was granted by the Dominion Parliament at its last session has bonding power amounting to $[illegible] per mile. The length of the transcontinental from the coast will be 1,450 miles.

Volume 23. Toronto, Sept. 5, 1912 Contents of this issue on page 41

The Canadian Engineer
An Engineering Weekly

SOME NOTES ON THE OAKVILLE VIADUCT AND THE DYNAMITING OF THE CONDEMNED ARCH RIBS, AUGUST 12, 1912.

By C. H. CUNNINGHAM, B.A.Sc.

On Tuesday, August 13th, a rather interesting, and certainly unusual, event took place in Oakville when the big arch ribs forming the main span of the concrete viaduct under course of erection there, were dynamited. The arch span consisted of two ribs side by side, with vertical concrete posts carrying the slab and girders of the floor system.

These ribs had been completely concreted, but owing to several very serious faults in the construction, it was deemed advisable to destroy them and rebuild.

It was during the summer of 1911 that the county of Halton decided to call for tenders on a reinforced concrete viaduct over the 16-mile creek on the middle road between Oakville and the township of Trafalgar. Competitive designs in steel and reinforced concrete had already been prepared, calling for a clear roadway of eighteen feet. It was decided to adopt the concrete design and reduce the clear roadway to sixteen feet. Accordingly, these plans were prepared by Frank Barber, C.E., Toronto, as consulting engineer for Halton county, and on August 23rd the contract was awarded. Two schemes were submitted, one of which called for the floor to be 40 feet above ordinary water level, and the other at 50 feet. Owing to the better grades obtainable on the approaches the latter plan was the one adopted.

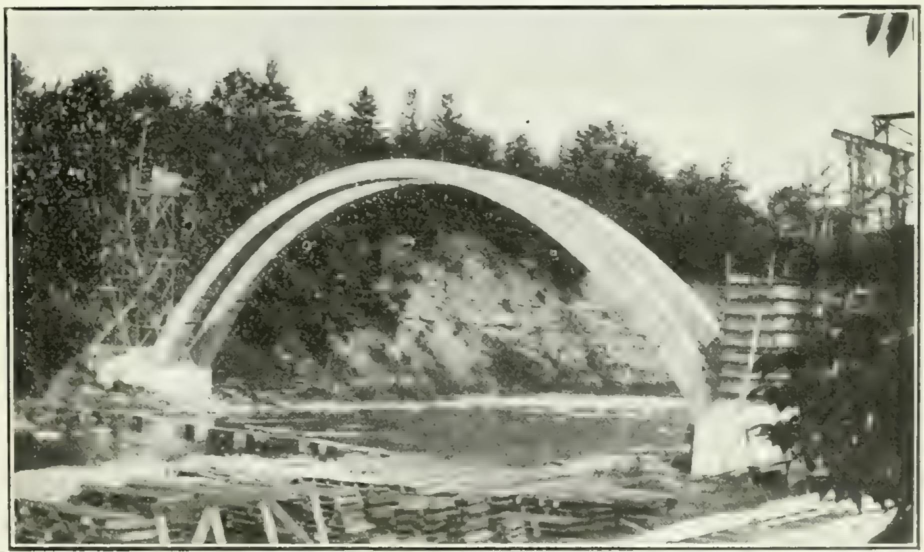


Fig. 1.—Showing the Arch Just Before the Blasts.
The notches where the rods were cut are plainly visible.

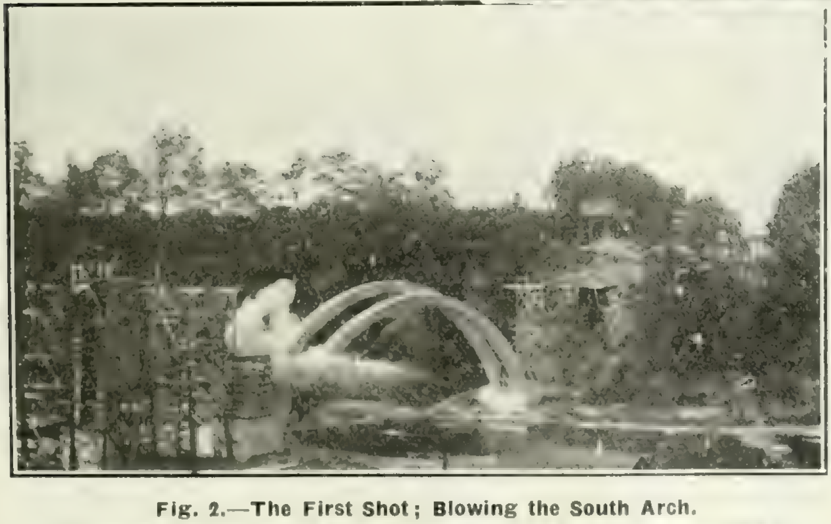


Fig. 2.—The First Shot; Blowing the South Arch.
The charge in the east haunch did not explode, leaving a long end as seen in Fig. 3.

The main features of the design are a cantilevered slab floor supported on two main girders of various spans at 9 feet centres, which frame into square posts supported on heavy concrete piers. The stream itself to be spanned by a double rib arch of 135 feet 0 inches clear span on which the floor is carried by vertical posts and small girders. The arch ribs are if uniform width throughout, being 3 feet 3 inches square at the crown and increase in depth to 5 feet 6 inches at the skewbacks. The floor slab has an average thickness of 12 inches, and is reinforced entirely with ¾ inch round rods, cantilevering about four feet on each side.

The girder spans, which form the viaduct approaches on each side of the arch are eight in number, six being on the west side; and range in lengths from 34 feet to 48 feet.

The parapets are also of concrete, and have practically no ornamentation. In fact, the whole structure is noticeably plain. Immediately that the contract was awarded work was begun, in order to get as much done as possible before frost set in. Concreting actually commenced on the footings on October 5th, and by the end of

November the arches were ready to concrete. It was at this point that the regrettable trouble ensued which culminated in the contractor going ahead contrary to the engineer's orders and concreting the arch ribs on centreing which was not sufficiently braced. An injunction and law suit followed, but meanwhile the arch ribs had been finished.

An investigation followed and showed up a considerable number of defects in the arches as erected. Also the weight of concrete was found to have been too great for the centreing, which had shifted and thrown the centre line of the ribs out of a vertical plane to the extent of about three inches at places. Probably no one of the faults in itself would have been sufficient to condemn the arches, but when all were summed up the engineers did not feel that they could stand behind the structure as it then was, and recommended rebuilding them.

An adjustment was finally arranged and the original contract cancelled. Work was not resumed till the spring, when another contractor undertook to complete the job for the county on a cost plus 10 per cent. basis. Work recommenced the end of June, since when good progress has been made.

The council finally decided to blow out the old arches, and accordingly all preparations were made. The concrete [illegible] was chipped away and the rods themselves cut at two places near each end haunch. There was but one connecting strut between the two ribs, situated at the crown. This was also severed and [illegible]

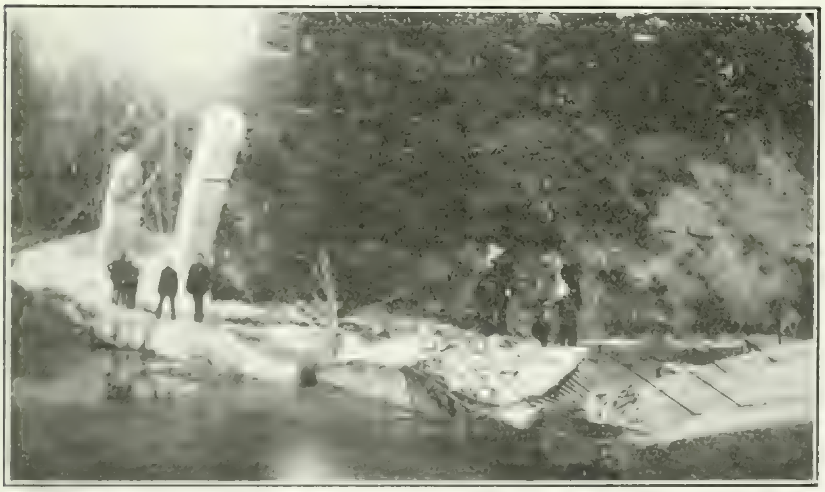


Fig. 3.—The Arches Blown Out and Lying in the Stream.

[illegible] at the break.

Charges were placed in the crowns and near each haunch. Dynamite was used and fired by the electric spark to ensure simultaneous explosions, although any one charge would have sufficed to destroy the arch.

The south rib was dynamited first, after which the [illegible] whatever, and the skewbacks on the main piers were left unharmed. The photographs here reproduced will show [illegible]

[illegible] from dust. Although these rods were simple rounds having [illegible]

From a military standpoint it might be interesting to note the ease with which such a structure as this could be destroyed by dynamite if so desired. One heavy charge, favorably placed, would be sufficient to preclude the passage of a stream that was not in itself readily fordable. However, it should be remembered that it took over a week for two men to cut the rods, in order that there should be as little damage done as possible to the skewbacks and piers.

ALUMINUM AND ELECTRO-METALLURGY IN FRANCE.

From a recent consular report we learn that the French manufacturers have formed themselves into a company called L'Aluminium francais, with a share and debenture capital amounting to 17,000,000 fr. ($3,400,000). The most interesting part of this combination lies in the fact that the new company has acquired the exclusive rights all over the world in the Serpeck process of aluminum manufacture, hitherto vested in the Nitride Company (Société des Nitrures), who had in 1910 bought up the rights and plant (at Mulhausen) of the Swiss holders of the patent, and had established experimental work in the valley of the Arc, near St. Jean de Maurienne. The Serpeck process, by which the production of nitrates forms part of the manufacture of aluminum, consists in the treatment of bauxite, the raw material of aluminum, in the electric furnace with air and coke, so as to fix the nitrogen, thus producing a nitride of aluminum. This product is then treated with a solution of caustic soda, which produces aluminate of soda and ammonia gas. From the aluminate of soda is extracted pure alumina, from which aluminum is obtained by the usual electrical process; while the ammonia gas is treated with sulphuric acid and produces sulphate of ammonia, largely used as artificial manure. The process is thus closely allied with that in use for the production of nitric acid and nitrates by the union of oxygen, nitrogen and steam in the electric furnace, dealt with under the heading of electro-chemical industries. Large works, utilizing 40,000 horse-power, are about to be established by the Aluminum Combine for the purpose of manufacturing under this process. The alumina thus obtained will be used by the various aluminum works grouped together in the new organization, and it is intended to carry on the production of the metal on a larger scale than ever, and to extend its use by all possible means. The company is also said to contemplate the erection of rolling and drawing works near Chambéry. It is calculated that, given sufficient water-power, the cost of the manufacture of alumina will be reduced, thanks to the valuable by-product of sulphate of ammonia, from 200 fr. to 50 fr. per ton, a net saving of 150 fr. per ton, or 300 fr. per ton of aluminum. The United States rights are stated to have been conceded to a subsidiary company with large financial resources, and licenses will probably be granted by the parent company for working the patent in other foreign countries.

The production of ferro-alloys and patent steels in the electric furnace grows apace in Savoy, there now being twelve factories engaged in this branch of the industry. The well-known works at Ugines (Savoie) for working the Paul Girod process of producing electric steel of great resistance have lately turned their attention to armaments, and have supplied [illegible] to the French and Russian [illegible]

EXTENSION OF AN OUTFALL SEWER.

A very interesting method for the extension seawards of an outfall sewer is described by Mr. John S. Brodie, M. Inst. C.E., borough engineer and surveyor of Blackpool, England, in a paper read recently at the conference of engineers and surveyors, held in connection with the annual congress of the Royal Sanitary Institute at York. The following abstracts are taken from the paper:

The old outfall at Gynn, Blackpool, was 1,304 feet in length, and consisted of cast-iron flanged pipes, 3 feet internal diameter, in 6-ft. lengths, bolted together and supported on timber piles and cradles. This outfall was laid in 1898, at the cost of £6,755, or at the rate of £15 10s. 9d. per linear yard. The work in 1898 was carried out by a contractor, and was never really completed to its intended length, which was 1,400 lin. ft., on the ground that the difficulties in connection with stormy seas and deepening water were so great that further extension was impracticable. Since then, sand banks have formed seaward of the old outlet, and it has been found necessary, in order to prevent the sewage from lodging on the foreshore, to extend the outfall across the recently formed sand banks into deep water, seaward of the same.

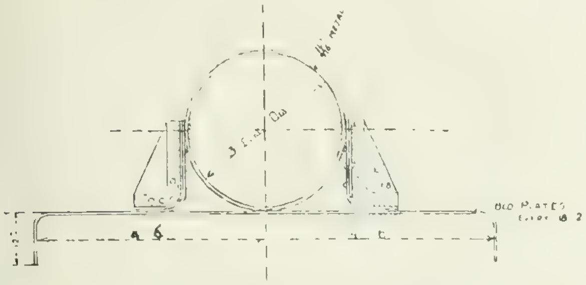


Fig. 1.—Cross Section Through Tube.

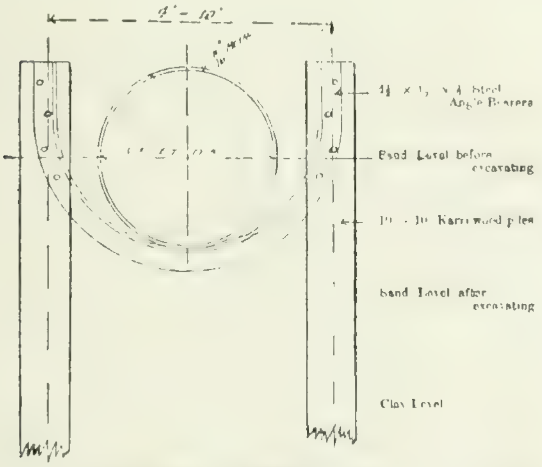


Fig. 2.—Cross Section Showing Piles and Cradling to Receive Connecting End of Tube.

The present extension has been made by means of a continuous steel tube, 3 ft. internal diameter, of solid welded pipes, in 18-ft. lengths, formed of open hearth steel, 11/16 in. thick, riveted together with cover straps 10 in. wide, 11/16 in. of thickness, with a double row of ⅞-in. rivets, spaced 3 in. centre to centre. The quality of the steel was such that the ultimate tensile breaking stress averaged 26 tons per square inch, with an ultimate elongation of 20 per cent. in 8 in. The whole of the tube, both inside and outside, has been heavily coated with an improved bituminous preservative. In order that the new tube should fit properly on to the flanged end of the old outfall, 10-in. square Karri wood piles were driven on each side of the trench at intervals of 6 ft. centre to centre, and connected by half-timber walings, to which close timbering, 3 in. thick, was secured, for a distance of 86 ft. seaward of the old outlet. The tube was built up for a total length of 600 ft., in the foreshore above highwater mark, at a distance of 3 miles along the coast line from its ultimate destination. In order that, when laid, the tube should not be subject to a rolling or rocking action on the sea bottom, caused by heavy on-shore gales, transverse steel bed-plates, 9 ft. long by 12 in. wide, and 11/16 in. in thickness, turned down at the ends for a length of 12 in., as shown in Fig. 1, were riveted to the tubes at 18 ft. centres, except for the 86 ft. length referred to above where the tube rests on the Karri wood and steel cradles.

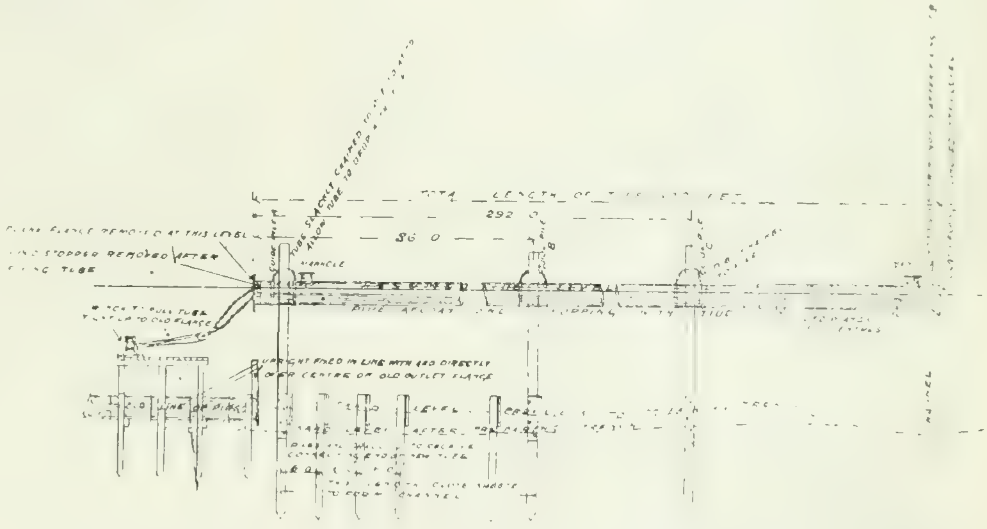


Fig. 3.—Longitudinal Section Showing Method of Dropping Tube in Position.

After being completed, the tube, which is provided with a 24-in. manhole and cover at each end, and also with blank flanges at the open ends, was filled with water and tested to a pressure of 50 lb. per square inch, at which pressure it was found to be perfectly tight. Timber watertight stoppers, easily removable, were then inserted at each end of the tube, close to the manholes above referred to, and caulked up watertight. The blank flanges were then securely fastened to the ends of the tube, and the manhole covers on the two manholes, one at each end, were also secured and made perfectly watertight. The tube was then launched from above high-water down the foreshore, to such a level between high and low water marks as would enable it to float with a 24-ft. spring tide. It was then floated into the sea, and towed by means of a steam tug for a distance of 3 miles, and was adjusted at high water over the trench, by means of guide piles, as shown in Fig. 3, where it was ultimately intended to lie. The blank flanges at both ends were then removed, the temporary stoppers maintaining the tube afloat. On the tide receding, the tube dropped down into its permanent position, the flow of sewage being held up temporarily by the shore penstock valves; the shoreward-end flange was then bolted up to the flange of the old cast-iron pipe, by means of 12 1⅛-in. steel bolts, and so secured in continuity of the old outfall. The manholes at both ends were then opened, the temporary timber stoppers were removed, the new outfall was then ready for the passage of the sewage.

The cost of the steel tube, which was constructed under contract by Messrs. Clayton, Son & Co., Limited, of Leeds, was £1,358, and the cost of launching, floating and laying was £592, a total cost of £1,950, or at the rate of £9 15s. per lineal yard.

Fig. 1 shows a plan and section of the new outfall tube sewer.

Fig. 2 shows the cross-section of the sewer as laid on the cradles for a length of 86 ft. seaward of the end of the old outlet.

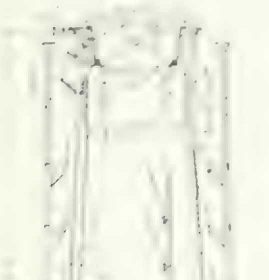
Fig. 3 shows the tube afloat, dropping down into its position on the receding tide.

The tube was manufactured and delivered on the foreshore at Blackpool by Messrs. Clayton, Son & Co., Limited, of Leeds, and the launching, floating and laying has been carried out departmentally under the author's assistant, Mr. H. Banks.

◆

A NEW THIN-LINED BLAST FURNACE.

The construction of a blast furnace of the new thin-lined water-cooled type, which has recently been put in operation, is described in the Cleveland Iron Trade Review. This furnace was built for the Eastern Steel Co.—formerly Warwich Iron & Steel Co.—at Pottstown, Penn., by F. C. Roberts & Co., of Philadelphia. It is the third of a group of furnaces owned by the company, and is arranged to be used with the stoves and power equipment of either No. 1 or No. 2 stacks.



Section Through Thin-Lined Blast Furnace.

The stack is 85 x 20 ft. The framework, including the columns, is of wrought steel. The top platform, charging apparatus, etc., are supported independently of the furnace shell by columns resting upon the main columns which support the furnace. Platforms are provided at various levels so that all parts of the furnace casing may be readily accessible. The lower portions of the furnace columns are enclosed in cast-iron casings filled with concrete. The in-wall is cooled by water carried and distributed by a spiral trough of the Roberts type. The waste water from the tuyeres and bosh-plates is delivered by different points in the spiral trough by an electrically driven pump. The trough is connected to the furnace shell by top bolts, which do not pass through the shell, thereby preventing the possibility of water entering the furnace around the bolts. A washer is provided around each bolt and between the trough and the shell. As a result, there is an opening between the bottom of the spiral trough and the shell which is continuous except for the thickness of the bolts.

At the lower end of the spiral trough the water is discharged into a horizontal trough which in turn is connected to the drainage system. The construction and operation of the spiral trough is such that while some of the water circulates around the spiral a large quantity passes through the openings at the bottom to the courses of the spiral trough below and continues its flow to the horizontal trough at the lower end of the spiral. In passing from one course of the spiral to that underneath, the water is in immediate contact with the furnace shell, thereby forming a thin film over all of the plates. The effect of a well-distributed spray is thereby secured with the additional advantages that the side of the spiral trough prevents the wind from interfering with the distribution of the water.

The bosh is enclosed entirely in a wrought steel casing having openings for the insertion of the bosh-plates. The construction is of the Farrell-Roberts type. The bosh-plates are held securely in position by angles on the inside and outside of the steel casing, the former angles being above and the latter below the bosh-plates. The steel casing enclosing the bosh extends downwards to a point below the top of the hearth jacket and is provided with openings for the tuyeres, cinder notch and the run of bosh-plates below the tuyeres. The hearth jacket is made of wrought steel plates which enclose a series of water-cooled cast-iron plates. Tht furnace mantel is simple in construction and a continuous wrought iron casing is provided which extends from the top of the hearth jacket to the top of the furnace. The hopper is supported by an annular ring, the construction being such that the leakage of gas around the furnace top is rendered impossible. The furnace is equipped with 10 tuyeres and two cinder notches.

The brickwork of the stock line is protected by Cook high-carbon steel plates. The downcomer is connected to the furnace top by four branches equally spaced around the furnace, each connection being provided with a vertical pipe extending 22 feet above the furnace platform and is equipped with a Roberts relief valve. In the event of a slip these valves permit the escape of gas, but prevent the discharge of ore, coke, etc. The furnace charging apparatus is of the Roberts skip hoist design connecting below with the stock transfer system, which supplies all the furnaces.

This stack has now been in operation about two months, with results entirely satisfactory.

◆

REPAIR OF FOUNDATIONS.

The underpinning of Winchester Cathedral, England, has been necessary on account of the serious settlement and displacement of some of the walls, cracking of masonry and distortion of arches. The original foundations have footings on timber grillages resting about 10 ft. below the surface on a 3 to 7-ft. stratum of peat underlaid by water-bearing gravel with pockets of silt between it and the peat in some places. Small pits were sunk outside the footings and from them drifts about 4½ ft. wide and 20 ft. long were tunneled diagonally under the wide footings. They were kept dry by centrifugal pumps down to a depth of about 18 in. above the silt when they were allowed to fill and the remainder of the excavation down to the gravel was dug by divers in water about 10 ft. deep. Bags of cement were carefully laid on the bottom under water and cut open. When set they formed a solid floor covering the bottom of the tunnel and enabling the latter to be pumped out and the work continued in the dry with mass concrete and concrete blocks built up to within 1 ft. of the overhead wall which was connected to the new footing with brick work.

THE TREATMENT OF WATER WITH CHLORINE.*

By Joseph Race, F.I.C. (Toronto's Filtration Plant.)

The use of chlorine as a disinfectant has developed entirely within the nineteenth century, and its general use followed directly in the wake of the commercial preparation of bleaching powder. This substance was often used in the early part of the century for the disinfection of sewage and water, and as early as 1854 its efficiency was so well recognized that an English Royal Commission recommended the use of this substance for deodorizing the sewage of London. In 1885 a special committee of the American Public Health Association stated that "taking cost into consideration, hypochlorites in general were the most efficient disinfectants available."

During the nineties many experiments with bleach and soda were made by Traube, Lode, Sickenberger, Kaufmann, and others, with the object of obtaining practically instantaneous sterilization of water for the use of travelers and troops in the field. Electrolytic processes were developed in 1889, when Webster in England and Woolf in America produced chlorine solutions from sea water, and used them for various purposes.

In 1897 bleach was used by Sims Woodhead for the sterilization of the water supply of Maidstone, England, subsequent to the outbreak of a typhoid epidemic. In 1904 and 1905, during the typhoid epidemic at Lincoln, a solution of sodium hypochlorite, commercially known as "Chloros," was used to the extent of approximately one part of available chlorine per million. This was carried out under the direction of Drs. Houston and McGowan, and was entirely satisfactory. A mawkish taste was, however, the subject of many complaints, and this was thought to be due to the action of the alkaline solution of chloros on the organic matter present.

Dr. Rideal has successfully used a form of electrolytic chlorine (oxychloride) at Guildford, England, for the treatment of water and sewage. Various combinations of chlorine were tried on the rivers Seine and Vanne in France, and at Meddlekerke and Ostend in Belgium. In North America Chlorine was first used on the commercial scale for water purification at Boonton, N.J., in 1908, and at Budby Creek, Chicago; since that date, the development of the process has been so rapid that over 200 cities are said to be using it at the present time.

In connection with sewage purification, the German experimental work at the Hamburg Hygienic Institute by Proskauer and Elsner in 1897, and later (1904-1905) the work of Dunbar and his associates, proved the practical possibilities of chlorine. In 1906 the Royal Testing Station at Berlin confirmed these results. In America, Phelps (1906), of the Massachusetts Institute of Technology, developed this branch of disinfection and carried out the first practical trial at Red Bank, N.J. Kellerman, Pratt, and Kimberley have also made experiments in this direction.

At the present time chlorine treatment of water or sewage is recognized in England and on this continent as a process capable of yielding excellent results at very low costs, but owing to certain disadvantages inherent to its use, it cannot be applied indiscriminately to all disinfection problems. It ought to be regarded mainly as an emergency measure, and secondarily as an adjunct to other forms of purification to provide an additional factor of safety. Each case in which the use of chlorine is suggested should be considered separately, as, except under strictly limited and peculiar local conditions, it cannot be regarded as a substitute for other purification processes. At the present time the problem is not how to use chlorine, although this phase cannot be considered finally solved, for the disinfection of water and sewage, but under what conditions it should be applied, how much it is desired to accomplish, and what amount of supervision is necessary. The views held by many German sanitarians are very different; they have not the high opinion of the process that prevails elsewhere, and generally regard it as inefficient. They severely criticize the bacteriological methods of the workers using gelatin plates for determining the efficiency, and give preference to enrichment methods. A study of their methods of applying chlorine to water shows that instead of using small quantities of disinfectant and allowing prolonged contact, they have employed as much as 40 parts per million of available chlorine with a ten minutes' contact, the excess being then removed by reducing agents, usually sulphites. Even with these large amounts, typhoid and cholera germs were not invariably destroyed, as in many cases the bacilli could be found after treatment, by means of enrichment in broth. Unless the view be taken that one single bacillus is sufficient to create infection in a susceptible individual, the criticisms of the German workers are not well founded, and their methods must be regarded as too stringent. The decreased typhoid death-rate in Toronto and other cities subsequent to the use of hypochlorite treatment is conclusive proof of the efficiency of the process, and refutes the theories of our German confrères.

The general principles regarding the action of hypochlorites are fairly well understood, but the details differ in every case and must be determined, as a full knowledge of them is essential to successful and efficient operation. The active constituent of hypochlorites for disinfecting purposes is chlorine, which liberates oxygen in a nascent condition when these substances are mixed with water. Nascent oxygen in small quantities inhibits the reproductive faculty of micro-organisms, and in large quantities kills them. It should be remembered that the results of chlorination are largely judged by the bacteriological results obtained, and, in these, the enumeration of the bacteria present plays an important part. The methods of counting the bacteria at present in use are dependent upon the ability of the organism to reproduce at such a rate as to form a visible colony within the period of incubation. Any substance which prevents the appearance of a colony during the period of incubation would be regarded as a disinfectant, but this does not imply that it kills bacteria. All substances known as disinfectant probably act at antiseptics in small quantities, and as germicides in larger ones, the line of division being imperfectly defined. The following tables show the action of chlorine on micro-organisms in water:—

City water is water drawn from the tap at the John Street pumping station and represents the main Toronto city supply approximately an hour after treatment by hypochlorite.

Control is water from the same original source as treated water, but not treated by hypochlorite. In order to make the bacterial counts in this water approximately comparable with the counts obtained in the treated water shortly after treatment, the original high count is reduced by dilution of the sample with water of the same kind sterilized by boiling.

Plating. In the column marked "Plating" are given the time intervals in days or hours between the time when the several Petri dishes were plated.

Count after—hours. In these columns are given the bacterial counts made on the several plates after the stated periods of incubation at 20 deg. C.

---

* Paper delivered to the Society of Chemical Industry on May 16th, 1912, and published in the journal of the society.

Ratio. In these columns are given the ratios between the bacterial counts on the same plates at the different periods of incubation, as indicated. These ratios indicate the relative increases under the different conditions.

Original sample, untreated, shows the bacterial count in the control sample, before dilution with sterile water, and corresponds also to the count before treatment in the Toronto city water or in the water used in the laboratory experiment.

Experiment No. 1

Toronto City Water

Treatment with available chlorine equals 0.25 part per million. City plant.

Plated		Count after					Ratio	
Time	Day	48 hours	72 hours	96 hours	120 hours	144 hours	2 : 6 days	[illegible] days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]

Control, lagoon.

Plated		Count after					Ratio	
Time	Day	48 hours	72 hours	96 hours	120 hours	144 hours	2 : 6 days	[illegible] days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1 : 1.6	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	540	1 : 1.7	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1 : 1.05
		[illegible]	[illegible]	[illegible]		[illegible]	—	

Original sample, untreated [illegible]

Experiment No. 2

Toronto City Water

Treatment with available chlorine equals 0.25 part per million. City plant.

Plated		Count after					Ratio	
Time	Day	48 hours	72 hours	96 hours	120 hours	144 hours	2 : 6 days	2 : 5 days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—		—	—

Control, lagoon.

Plated		Count after					Ratio	
Time	Day	48 hours	72 hours	96 hours	120 hours	144 hours	[illegible] days	[illegible] days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]
		[illegible]	[illegible]	[illegible]			—	

Original sample, untreated [illegible]

Experiment No. 3.

[illegible]

Plated		Count after						Ratio	
Time	Day	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] days	[illegible] days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] part per [illegible]

[illegible]		[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] days
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Available chlorine equals [illegible] part per million

[illegible]

Plated		Count after				
Time	Day	[illegible]	[illegible]	[illegible]	120 hours	144 hours
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—
[illegible]	[illegible]	[illegible]	[illegible]		—	[illegible]

It is evident that chlorine, in quantities smaller than 0.25 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the growth of bacteria [illegible] [illegible] [illegible] One part of available chlorine per million acts as a germicide, and there is no evidence of revivication. Since small quantities retard the growth when placed in such a suitable media as nutrient gelatin, it is probable that reproduction in water with a low organic content would be still further diminished. This is also indicated by the results.

From the results of these experiments and many others of a similar nature, it was decided to abandon the two-day incubation period recommended by the American Public Health Association and to count all plates on the third day. Three days is the period during which the formation of visible colonies proceeds most rapidly, and very little advantage can be gained by increasing it to four days. A three-day incubation period raises the standard of quality if numbers are given any consideration, and eliminates the anomalous results so often found when counts are made of chlorinated waters.

In this connection it is interesting to note the experience of Clark and De Gage, at Lawrence, Mass., during 1909. In the report of the Board of Health, page 319, 1910, they state: "It has frequently been observed that the numbers of bacteria determined at body temperature in the disinfected samples were much higher than the numbers determined at the usual room temperature. This phenomenon of reversed ratios between counts at the two temperatures has been occasionally observed with natural waters but a study of the records of many thousands of samples shows that the percentage of such samples is very small, not over 3 to 5 per cent. On the other hand 20 to 25 per cent. of samples treated with calcium hypochlorite show higher counts at body temperature than at room temperature. Similar counts have been noted elsewhere where waters are being treated with hypochlorites, but in many cases such results have been considered abnormal and have been omitted from the records. A phenomenon which has a frequency of 25 per cent., however, cannot under any circumstances be considered abnormal, and the omission of such counts from records is entirely unjustifiable. A careful study has been made of the conditions under which such reversed counts occur, and it appears that these counts are found in a considerable percentage of samples of water, sewage, etc., in which the room temperature counts have been reduced to less than 100 to 200 per c.c. by the use of hypochlorites, permanganates, and other oxidizing agents. A study of the types of bacteria remaining after disinfection shows that the proportion of spore-forming bacteria is practically the same after disinfection as it was in the untreated water, and the appearance of the reversed ratios apparently cannot be attributed entirely to the non-destruction of spores. The true significance of this phenomenon cannot be stated at the present time. It is evident, however, that, if the body temperature counts are [illegible] and reliance placed upon those at room temperature, a [illegible] and possibly a dangerous interpretation may be made [illegible] the quality of the water which has been treated with hypochlorites."

Available chlorine equals 4.0 parts per million. Treatment in laboratory.

Plated		Count after					Ratio.	
Time	Day	48 hours	72 hours	96 hours	120 hours	144 hours	2 : 6 days	[illegible] days
11	1	1	1	1	4		—	—
12	1	0	0	1	3	3	—	—
[illegible]	1	0	1	1	liquid	—	—	—
4	1	[illegible]	[illegible]	0	0	0	—	—
[illegible]	[illegible]	[illegible]	1	1	[illegible]	4	—	—
[illegible]		0	[illegible]	0	2	—	—	—
[illegible]	—	[illegible]	[illegible]	1	[illegible]	—	—	—
Original sample untreated								
[illegible]	1	[illegible]	[illegible]	[illegible]	3,6[illegible]	3,840	1 : 2·3	—

[illegible] [illegible] possibly [illegible] [illegible] [illegible] previously mentioned, and the phenomenon would probably disappear by increasing the period of incubation.

Chlorine Treatment of the Supply of the City of Toronto.—The city supply is obtained from Lake Ontario at a point approximately 2700 feet south of the south shore of Toronto Island. The water is conveyed by means of a six-foot steel conduit to the north shore of the island where it descends a shaft (100 feet deep) and is then conveyed under the Bay in a tunnel 8 feet in diameter to the main pumping station where it is pumped directly into the distributing mains.

Under normal conditions the treatment of the water with chlorine does not present serious difficulties. The turbidity is low, coloring matter absent, and the organic content comparatively low. Successful treatment depends upon two factors, viz., perfect admixture and sufficient period of contact. The early experiences with the city supply seemed to indicate that the second factor was the more important, and this point is clearly shown in the following tables:—

Bacteria per c. c. gelatin 3 days at 20° C.

Date	Sampling point	Count
April 27th, 1911.	Main Pumping Station	34,000
	9,000 feet from Pumping Station	8,400
	13,000 " "	4,520
	19,000 " "	3 810
	*14,000 " "	2,340
May 11th, 1911.	Main Pumping Station	5,800
	2,000 feet from Main Pumping Station	5,680
	8,000 " " "	2,380
	14,000 " " "	2,140
	20,000 " " "	2,260
	24,000 " " "	1,980
	Average of series of samples.	
Oct., 1911.	5,000 feet from Pumping Station	300
	6,000 " "	203
	7,000 " "	103
	12,000 " "	86
	14,000 " "	87

* This sample represents water which has been partially stored in a high pressure service reservoir.

The treatment takes place at the north end of the island, the bleach solution being added to the water as it descends the shaft to the Bay tunnel. The capacity of the tunnel is such that with a normal consumption of 43 million gallons per day, the period of contact before reaching the main pumping station is approximately 50 minutes.

In the spring of 1911, when the Health Department decided upon the treatment of the island supply, it was thought that owing to the water going directly into consumption after treatment with chlorine, insufficient time would be given to reap the full advantage of the process. It was, however, decided that chlorine treatment should be used, and a mechanical appliance was devised by the chief engineer of the Island pumping station by which a constant amount of disinfectant could be added and perfect admixture ensured. This apparatus consisted of a small plunge pump, the piston of which was connected with the piston of the main supply pump and was fed with bleach from one of two storage vessels. Check valves were placed on the inlet and outlet of the small pump. As each stroke of the large pump corresponded to a stroke of the small one, by determining the relative quantities delivered by each it was possible to fix the amount of chlorine added by varying the concentration of the bleach solution. Perfect admixture was obtained by injecting the bleach solution into the water by means of a perforated injector. The process worked very satisfactorily, combining a very high efficiency with a low cost.

Samples of water were taken at a point only a few yards distant from the pump, and although the time elapsing between treatment and examination never exceeded 15 minutes and was usually much less, almost sterile water was obtained throughout the whole season. The results were as follows:—

Island Results.

1911.	Available chlorine parts per million.	Bacteria per c.c.		Percentage of samples of treated water showing typical *B. coli* in		
		Raw water.	Treated water.	50 c.c.	10 c.c.	1 c.c.
July	0-20	864	27	Nil.	Nil.	Nil.
August	0-20	1,018	12	"	"	"
September	0-34	725	28	8.0	"	"
October	0 50	1,256	15	Nil.	"	
November.	0-50	6,098	4	"	"	.

Samples taken at various points in the distribution mains showed greater numbers of bacteria than were found immediately after treatment, and an increase in the amount of chlorine used had no appreciable effect on these increases. Blowing out the mains effected a slight reduction, but only of a temporary nature, and several hours' treatment with a strong solution of chlorine (4 parts per million) also gave but little relief. As B. coli was almost invariably unmoved, even when 100 c.c. were tested, the phenomenon must be ascribed to the growths in the mains and not to a revival of the original flora. The period of time required for the water to reach the points where increases were found was almost invariably less than one hour, and as revival could not take place in such a short time additional evidence is furnished in favor of the theory of contamination with secondary growths. Despite these increased counts, the process must be considered an excellent one and efficient admixture the essential feature for obtaining successful operation.

On Toronto Island, one million gallons per diem were treated during the summer season, and since it was first installed in May, 1911, the process has been put into operation at West Toronto and Sarnia, Ont., with equal success.

Chlorine-treatment in Conjunction with Filtration.—It is well known that turbidity reduces the efficiency of the chlorine-treatment, and since in the case of the Toronto supply an increase of turbidity is usually accompanied by increased pollution, the chlorine treatment of the raw lake water can only be regarded as a temporary expedient. Its use as such has been entirely justified as there is no doubt that the adoption of the process for the city supply has resulted in a decreased typhoid mortality rate. In 1910 the rate was 43, and in 1911, during the whole of which chlorine was in use, the rate was decreased to 20.

Date 1911	Chlorine parts per million	Bacteria per c.c. Gelatin 3 days at 20° C			Samples showing typical B. coli Raw water				Filtered water.			Chlorined water			Turbidity	
		Raw water	Filtered water	Chlorined water	50 c.c.	10 c.c.	1 c.c.	0.1 c.c.	50 c.c.	10 c.c.	1 c.c.	50 c.c.	10 c.c.	1 c.c.	Raw water	Filtered water
April	[illegible]	10,910	—	6,421	3	2	0	—	4		—	9	1	0	[illegible]	
May	[illegible]	4,81[illegible]	—	[illegible]	—	8	[illegible]					0	0	0	4	
June	0.26	16,8[illegible]	—	2,4[illegible]	17	1	[illegible]					0	[illegible]	[illegible]	[illegible]	
July	0.28	864		310	22	14	0						1	0		
August	0.31	1,018	—	74	19	[illegible]	—	—				[illegible]	0	0	4	
September	[illegible]	725		104	[illegible]	10	0					[illegible]	0	[illegible]	1	
October	[illegible]	1,256	—	81	18	17						0	[illegible]	0	[illegible]	[illegible]
November	0.38	7,150	—	[illegible]	22	9	1					0	0	[illegible]	5	
December	[illegible]	11,999		84	14	[illegible]	9					[illegible]	4	[illegible]	1	
1912																
January	0.33	[illegible]	47	21	16	9	0	[illegible]	15	0	1	4	1	[illegible]		[illegible]
February	0.31	[illegible]	2,228	14	20	11		2	16	[illegible]	1	[illegible]	[illegible]	0	10	1
March	0.28	[illegible]	[illegible]	41	[illegible]	17	4	0	[illegible]	9	1	1	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	81	[illegible]	24	17	10	3	9	11		[illegible]	0	[illegible]	11	[illegible]

Until the system of slow sand filters recently put into operation had demonstrated its ability to sufficiently purify the water supply it was deemed advisable to continue the treatment with chlorine, and the effect of the reduction in turbidity and organic content is easily observable in the table given below. The filtration plant was first operated on January 4, 1912, so that the beds have not yet matured. It will be noticed that the efficiency is rapidly increasing despite the high rate of filtration (5.3 million gallons per acre per day).

As a result of prolonged incubation of city tap water after filtration and chlorine treatment, the following numbers of bacteria per c.c. at 20 deg. C. (average of 12 samples) were counted:—After 2 days, nil; after 3 days, 0.75; 4 days, 3.0; 5 days, 7.0; 6 days, 10.0.

Chlorine treatment of the city supply was commenced in May, 1910, but no results are given until April, 1911, as gelatin counts were not made until this latter date. From this date onwards there has been a steady progressive increase in efficiency, and the reason for this can only be attributed to a gradual removal of organic growths in the large distributing mains. No evidence of revival has been found within the period of time the water remains in the system, as the count decreases with increased period of contact, the best water being invariably found at the points farthest removed from the pumping station.

That is the reverse of the experience at Cincinnati with chlorine treatment of filter effluents. Elms (Eng. Record, Vol. 63, p. 472) finds that although the water at the reservoir appeared practically sterile, very much larger counts were obtained from city tap samples, and he attributes this to disturbances of the bacterial flora and secondary growths. The difference between the Toronto and Cincinnati results may be due to the presence of a larger amount of easily oxidized organic matter in the latter supply. Elms (loc. cit.) has shown that the efficiency of the process is inversely proportional to the amount of easily oxidizable matter present and that large increases of bacteria are common in such samples following a temporary reduction.

The point of application of chlorine used in conjunction with filtration systems varies in different countries, English practice being to apply it to effluents only, and American usually to treat the raw water. In mechanical plants where coagulants are used it is convenient and economical to add the bleach prior to sedimentation, but the full advantage of the bleach is not developed in this method as the chlorine is acted upon by the full organic content of the water. Furthermore, the Lawrence, Mass., experiments have shown that when small quantities of chlorine are used (less than 3 parts per million) in conjunction with coagulants the action is soon complete and that subsequent storage increased the bacterial count from 100 per cent. to 670 per cent. There is an increase when chlorine is not used, but not nearly so marked as these figures indicate. These factors detract from the efficiency of the plant and better results can undoubtedly be obtained by treatment of the filtrates. This is proved by the Cincinnati results.

Any excess of chlorine added to water is considered by many to be removed by filtration, but of this there is no proof. Chlorine after addition to water exists in various forms—as free chlorine, hypochlorous acid, and in combination with organic matter. The two former can only be removed by special methods, such as the "Dechlor" and "Ferrochlor" processes, and although a portion of the latter is undoubtedly removed by sand filters, filtrates are obtained [illegible]

Experience with slow sand filters shows that chlorine [illegible] formation of the "blanket" layer, and retarding the bio- [illegible] During the chlorine treatment of the prefiltered water at Lincoln, [illegible] there is almost invariably an increase in the bacteria grow- [illegible] in contact beds.

Some experiments on sand treatment, made in the filtration plant laboratories, indicate a similar action, and two typical examples are shown in the following tables:—

Experiment 1.

Available chlorine in liquid parts per million.	Bacteria per gram of sand after		
	3 hours.	24 hours.	48 hours.
Nil.	70,000	—	—
0·1	7,200	20,400	12,800
0·3	5,240	6,400	11,200
0·5	5,120	4,700	10,800
1·0	1,000	8,800	20 400

Experiment 2.

Available chlorine in liquid	Bacteria per gram of sand after		Typical B. coli after 24 hours				Free chlorine after 24 hours.	
	3 hours	24 hours	100 gr	10 gr	1 gr	0·1 gr	Without acidification	After acidification
Nil.	[illegible]	[illegible]	+	+	+	—	—	+
[illegible]	[illegible]	[illegible]	—	—	—	—	—	+
[illegible]	[illegible]	[illegible]	—	—		—	—	+
[illegible]	[illegible]	[illegible]	—	—	—	—	—	+
[illegible]	[illegible]	[illegible]	—	—	—	—	—	+

The relative weights of water and sand were as 1 : 2.

It is observable that the effect of large doses of chlorine is first to reduce the bacterial count, but the reduction is not maintained and the subsequent increase is abnormally rapid. The conditions were evidently unsuitable for the reproduction of B. coli, and it remained inert.

From a consideration of all the available data there is no doubt that if chlorine is to be employed to full advantage, it must be added to the filter effluents. The turbidity, color, and organic impurities of a raw water are not apparently reduced by chlorine, but they are acted upon with consequent loss of available disinfectant.

The disadvantages of the addition of chlorine to prefiltered water may be summarized thus:

Mechanical filters: Reduced efficiency of chlorine.

Slow sand filters: Reduced efficiency of chlorine and reduced purification by filters per se.

Aesthetic Considerations.—Any compound of chlorine which liberates the free element on addition to water has a tendency to impart a distinct taste and odor to it, and when present in amounts exceeding 1 part per million of available chlorine it can generally be detected by the senses. This is the result of many experiments with Lake Ontario water, and although in some cases quantities smaller than 1.0 part per million could be occasionally detected, many blanks were also said to contain chlorine so that many of the positive results were due to auto-suggestion.

The taste of chlorine is sharp and acid, and the odor pungent, but these should not be confounded with the sensory characteristics of natural untreated waters. Many organisms such as Uroglena, Volvox, and Eudorina, impart a distinctly fishy taste and odor to the water in which they grow, and this is especially noticeable when the water is warmed. Uroglena probably effects this by the rupture of the oil sacs which it contains, and as the products of decomposition pass into solution they cannot be removed by the usual forms of purification. The majority of complaints regarding water supplies which are treated with small quantities of chlorine are due to these natural and uncontrollable causes, and although samples are often said to taste of chlorine it will generally be found that chemical tests give a negative result. As the reaction with potassium iodide and starch in acidified solutions is at least five times as [illegible] complaints must generally be [illegible] In these cases the number of complaints will be found to bear no relation to the amount of [illegible] Typical examples of this [illegible] during the summer [illegible] in 1911. Many complaints were received during the early part of the season when the rate was only 0.20 part per million of chlorine, and these entirely ceased during the latter half of the season when the rate was increased 150 per cent. The nature of the complaint has been the same as in other places where chlorine is in use, that it caused colic and other human ailments, that cattle and other animals refused to drink it, that it injured plants, fish, and birds, and extracted abnormal amounts of tannin from tea. No reliable evidence was ever produced in support of these statements, and they ought, therefore, to be treated as myths.

Corrosion.—There is no doubt that chlorine tends to increase the corrosive properties of water, but when the amount present is very small, the increased effect is so minute as to be inappreciable. Chlorine accelerates the action on iron by increasing the number of hydrogen ions, which are, according to the electrolytic theory of corrosion, mainly responsible for the deleterious effects produced. No injury has been noticed in the pumps at the main pumping station where chlorine-treated water has been pumped continuously for over two years, but it must be remembered that actual "free" chlorine is generally removed by absorption during the 50 minutes' contact in the tunnel under the Bay. If chlorine were added to a water in excess of the carbonates present, it is easy to conceive that an electrolytic action would ensue in a pump constructed of different metals or alloys of metals. The water becomes an electrolyte, and corrosion would take place. If a contact period sufficient for the assimilation of the free chlorine cannot be obtained previous to pumping, it is a good policy to inject the chlorine into the discharge pipe of the pump. In the case of plunge pumps this can be done as previously described, whilst with centrifugal pumps, the plunger of the small bleach pumps could be operated by a water-wheel connected in the discharge pipe. Dr. Houston in the 5th Report of the Royal Commission on Sewage Disposal gives some results of experiments on the action of chlorine-treated waters on lead piping. These show that chlorine (as "chloros"), in amounts varying from one to ten parts per million, does not appreciably increase the plumbo-solvent action of either unfiltered or filtered river water. Some experiments have been made within the last few days with the Toronto supply. Raw lake water, filtered water, and water treated with 0.25 and 0.50 part per million of chlorine all dissolved the same quantity of lead in 24 hours. The amount is, of course, so small that it cannot detract from the hygienic safety of the supply.

In conclusion, I wish to acknowledge the assistance I have received from the many valuable suggestions that have emanated from Mr. F. F. Longley, the resident engineer at the filtration plant.

◆

WATER PURIFICATION AS ENDORSED BY THE ONTARIO BOARD OF HEALTH.

The following is an extract from a circular being distributed by the agents of the Ontario Board of Health at the Canadian National Exhibition at Toronto.

A level teaspoonful of chloride of lime should be rubbed into a teacup of water. This solution should be diluted with three cupfuls of water and a teaspoonful of the whole quantity should be added to each two gallon pail of drinking water. This will give .4 or .5 parts of free chlorine to a million parts of water and will in ten minutes destroy all typhoid and colon bacilli or other dysentery-producing organisms in the water. Moreover, all traces of the chlorine will rapidly disappear.

This method should be very valuable for miners, prospectors, campers, and those living in summer resorts where the condition of the waters might not be above suspicion

CENTRAL STATION ELECTRIC POWER FOR RAILWAY OPERATION.*

By Frederick Darlington.

Every engineering operation seeks to accomplish some practical result, which is measured by its financial worth or capacity to earn money by saving labor in doing something useful. There are no exceptions to this, but for railroad work, which will be the subject to-night, we often have to look further and deeper for the full measure of worth, than is usual in any other matters with which I am familiar.

In the manufacture of cloth, for instance, the problem is simple, that is, make cloth of a desirable quality, at a minimum cost; likewise in making steel rails or bricks or paper, or any article of merchandise, there is a definite result to be obtained and the final test of different methods is the cost and value of the product, which in such instances is readily determined. There is no such simple way to judge the merits of transportation work for it is far more complex than manufacturing or other lines of production. This is seen in the great diversity of rates and classifications under which railroad accommodations are sold. In freight business, for example, there are different rates for long hauls and for short hauls, for car loads and for part car loads, and various classifications almost without limit. This diversity has not, as many people suppose, resulted primarily from a desire on the part of railroads to "charge what the traffic will bear," but rather from necessity caused by differences in transportation costs, combined with differences in the value of services rendered. It is not necessary to enlarge upon this for we all know it would be fatal to the interests of both buyers and sellers of transportation on a ton-mile basis, or on a uniform basis of distance hauled, or on any direct measure of transportation. An equitable rate for carrying a ton of wheat from Chicago to New York City has very little relation to an equitable rate for carrying a ton of wheat twenty miles from a farm to a grain elevator; likewise, there is very little relation between the cost per ton of transporting a car load of wheat and the cost on a single ton in a part car load lot, and short hauls and part car load lots may be quite as important in the aggregate as long hauls. What I want to bring out is not the value of the work done by the railroads, immense and necessary as it is, but rather to point out the need for still more and different railroad facilities, and to show that the use of electric power from central station plants will benefit railroads and at the same time benefit all other operations requiring power.

There is a wide field for improvement in railroad service that can be best accomplished with electric power, especially for local transportation. The statement has been made that the money expended in wagon hauling freight to and from freight depots of one of the largest railroad systems in New England, is greater than the gross receipts of the railroad from its freight business, and I am inclined to believe that this will apply to other American railroads. It is certain that the cost of wagon hauling freight to and from railroads, is a heavy part of freight transportation. Also in passenger service the collection and distribution of passengers to and from railroad depots, is a matter of large cost and has an important bearing on travel. This is evidenced by the work of electric interurban trolley roads, the favorite field of which is in the territory tributary to steam railroads, where they have in many places greatly facilitated the local collection and distribution of traffic. I will not enlarge upon this for it is well understood.

---

* A paper presented to the American Institute of Electrical Engineers, January 18, 1912.

In comparing steam and electric power for railroads, the comparison should not be based on the relative cost of operating certain trains by steam and by electric motive power, but the comparison should be made between the best use of steam power considering the cost and value of the service rendered, compared with the best use of electric power, considering the cost and value of electric service. It follows from the wide difference in the nature of the two kinds of power, that the train weights, schedules, etc., and even the locations that are best for railroads employing steam power, will not always be best for electric power.

As far as distribution of power is concerned, independent of whether it is for railroads or for other purposes, it is demonstrated that wherever a large number of small powers are to be supplied in a limited territory it is more economical to distribute it by electricity than by any other known method. An example is seen in the case of textile mills, where power from steam engines or water powers was formerly generated at each mill and conveyed to various rooms and machines by series of shafts and belts. This plan has been widely superseded with electric drive whereby electricity is generated in a central plant supplying numerous mills and is used to operate motors for driving small groups of machines in each mill, or even for driving a separate motor for each machine. Likewise, in railroad work, electric motive power enables a profitable service to be rendered, with greatly subdivided motive power suitable for light and frequent trains that if operated by steam power would be too costly to be profitable in such small units. So it has been in every field where electric power has been extensively applied. The most important result has not been a cheapening of work that was previously accomplished by other means, but more and better work has been accomplished, and so it will be with the use of electricity on railroads and this betterment will not be confined to railroading, because there is an interdependence in electric power operations, whereby any extension of electric lines and increased use of electric power for any purposes, leads to development of more and better electric power for all other purposes. How this must always result can be predicted by using a little justifiable imagination to clear the point of view of natural bias in favor of present conditions and methods that have gradually become unfavorable for present needs.

Custom and habit often leads to the continued use of apparatus and methods for work that could be better met by new means. To appreciate this, imagine that a wholly new country, that is destined by natural resources to become rich and prosperous is to be opened up, settled and developed, and that some empire builder with a master hand and complete foresight could furnish the transportation and power facilities of the country. By means of electricity and the railroads, he could direct the development of the country. First of all by building railroads with electric motive power, he would at once provide the means of transportation that is always adopted where the population is sufficiently dense.

[illegible] transportation and [illegible] centres and settlements will naturally locate on the railroads with transmission lines along the roads, these various centres are tied together, forming the [illegible] power system. If a country is to have a [illegible] of [illegible] and prosperity, [illegible] would pay for transportation by electric power then the railroads should unquestionably be provided with transmission lines connecting the [illegible] lines carrying electric power along the railroads make the most economical means for distributing power for every purpose, and all the street cars, house lighting circuits, shops and factories along the railroad, would naturally derive their power from these lines, and towns and manufacturing centres are always attracted by convenient power, as well as by good transportation conveniences. Then again, a diversified and extended use of electric power within any area, increases the size of the power plants employed therein and accordingly reduces the cost of each unit of power generated.

A manager acting for a central power plant desiring to sell power to a city electric railroad system, recently put the matter as follows: To the banker president of the railroad, who has a reputation of being difficult to convince in any such matters as sacrificing or setting aside part of his property, the manager said, "Do you want to make a dollar?" To which, after the way of bankers, he answered, "Yes." Then the manager asked him if he "Would share the dollar with someone else who helped make it," to which he answered, "Yes, if he could not make it all himself." Then said the manager, "I will sell you power for your railroad at less than it costs you to make, and even so, I can make a profit on it, for you are making it in 2000-kw. units and I am making it in 6000-kw. units, and, therefore, at less cost than you are; but besides making it in larger quantities than you are, I am serving a great variety of companies and secure a more even and steady load than you do since you are making power for only one kind of service, namely, to operate an electric railroad; but in addition to these reasons, I want your business, because with your load added to my present load I can generate power in 8000-kw. units, and still further reduce my kilowatt-hour cost."

It is not a matter of opinion but of accomplishment that available central station power is a valuable asset to every prosperous settlement, just as are railroads and telegraph and telephone systems. As power machinery and methods of work that are not now adapted to the electric plant, are becoming obsolete or wearing out they are being supplanted by electric machinery and electricity is being installed in new works where foresight is exercised to realize the maximum benefit by centralization and unification of power.

Much that was sought by railroads long before electric motive power was available for their needs is now accomplished with electricity. Years ago Wellington in his standard book entitled "Railroad Location"—a book, by the way, that deserves a much more comprehensive title—pointed out that "In the sale of transportation the price that the consumer is able and willing to pay, is greatly affected by trifling differences of convenience." He emphasizes the importance of convenient local transportation facilities and says that "The loss to the railroad due to not supplying the best facilities might be borne if it meant simply a reduction of transportation tax upon the traveler or the shipper of freight." (In other words, less money paid to the railroad), but he asks, "How stands it with the traveler or shipper? They save indeed the two or three cents per mile, which the railway loses, but they have to pay the entire cost of cartage on their freight and pay for their own conveyance, besides suffering the annoyance and inconvenience, which they estimate at a good round sum." He says, "From poor transportation facilities, the loss is threefold: The cost to the public is greater. The receipts to the railroad are less. The traffic is decreased in volume." To quote still from Wellington, "This means from the point of view of political economy, and as a plain statement of fact, which would appear in census statistics, that the capital of the country and the world is less than it otherwise would be."

We can now add to Wellington's list of losses and state that poor transportation, when resulting from failure of railroads to employ electric power under conditions favorable to its use, will cause a fourfold loss, including the three losses enumerated and adding a fourth represented by the added cost of power, both for railroad working and for industrial uses, and in the fourth instance, as in the three enumerated by Wellington, this means, from the point of view of political economy, a loss to all—to the railroads and to the public alike.

While it has been one of the works of electric railroads to produce added values with better transportation facilities, it is not my intention to reiterate arguments for better local service with electric power as a means of increasing values. It is rather the purpose to accept the evidence of interurban railroads that electric power is disadvantageous for light and frequent train service, and from this premise to examine the conditions for its further application.

The general statements thus far made concerning central power supply and railroad operation, are all capable of verification by examining specific conditions, but, as I indicated at the commencement of this paper, a complete analysis to apply to all conditions is most complex. It will be possible for me to give here only a few results based on actual operations which may be used by those interested as a basis to compute what economy centralization and unification of power supply will secure at other places.

	Total cost per year	Cost per year per kw. of plant capacity	Per kw-hr.
Operating labor	$52,500	$2.10	0.100
Operating materials (exclusive of fuel)	15,000	0.60	0.025
Labor for maintenance of plant	15,000	0.60	0.025
Material for maintenance of plant	17,500	0.70	0.030
Total cost of power plant operation and maintenance, exclusive of coal per yr.	$100,000	$4.00	0.150
Add the cost of coal at $1 per ton for coal of 13,500 B.t.u. per pound	82,500	3.30	0.15
Note.—The fuel cost will increase as the cost per ton increases or the quality falls off			
Other expenses pertaining to power plant operation, such as administration, legal and general expenses	10,500	0.42	0.02
	$193,000	$7.72	0.35
Add for fixed charges on the cost of power plant	225,000	9.00	0.41
Total cost of power per yr. with coal at $1 per ton and a load factor 25 per cent	$418,000	$16.72	0.76

The figures given below are for the cost of producing electric power in steam plants carrying railroad loads under conditions that are widely prevailing in the United States. These figures are not exact costs taken from any particular power plant, but are average costs worked out from actual results in several steam plants on heavy railroad and other work, so shown as to permit easy analysis for varying conditions of load and for different fuel costs, etc.

The figures given are the cost, including fixed charges, of producing power in a 25,000-kw. steam turbine plant, containing five main units of 5000-kw. nominal capacity each, but capable of carrying 50 per cent. overload or more in emergencies.

The yearly production of power is assumed at 55,000,000 kw.-hr. or a load factor of 25 per cent. on a maximum load of 25,000 kw., which is the total nominal capacity of the five generators. It is equivalent to an average operation of all of the generators for 2,200 hours per year at their rated capacity.

Such is the cost of electric power generation by steam for heavy railroad operation and general central station service.

There are two factors in the foregoing costs which are liable to maximum variations, viz., the cost of fuel and the average load on the plant, as it is called, the load factor. The assumed maximum load of 25,000 kw. could easily be carried on four ordinary 5000-kw. nominal capacity steam turbine generators, and leave one square unit in a five-unit station. A 25 per cent. load factor is assumed above (25,000 kw. maximum load and 55,000,000 kw.-hr. per year), the result in thermal efficiency would be about 8.4 per cent. It is difficult to determine from actual results just what the thermal efficiency would be at other load factors, but as it is sometimes necessary to know this as a basis for arriving at the fuel costs under varying load conditions, the following approximate figures are given for these variations. The coal is assumed to contain 13,500 B.t.u. per lb.

It would be difficult to demonstrate in detail the economies that can be derived from combination of mixed power service from the above plant compared with power for only one industry like railroads, and an attempt at it would lead back to the same generalities that I have already stated, but analysis of the schedules of costs and thermal efficiencies for a 25,000-kw. plant, working at 25 per cent. load factor, proves the broad assertion that in power generation large stations carrying mixed loads afford the maximum economies. Take, for example, the cost of general expenses and of fixed charges and of power station labor and material, exclusive of coal. These things are little affected by the load factor, but even in so large a station as 25,000 kw. they amount to $13.42 per kilowatt per year, out of a total cost of power of $16.72 per kilowatt per year, with good coal at $1.00 per ton, or $20.02 with coal at $2 per ton, etc. Furthermore, even the fuel cost per unit of power generated will ordinarily be less in mixed service plants than on plants for railroad work only, since the former generally work at better load factors than the latter. The better load factor comes from serving a diversity of operations. Also with more operations the plant will be larger and for this reason as well it naturally has a better load factor and all unit costs are correspondingly less.

Yearly load factor (ratio of maximum load to average output)	Average operation per yr. hours	Thermal efficiency of plant	Cost of coal per kw-hr. at $1.00 per short ton
10 per cent	876	6.5 per cent.	0.20 cent
20 " "	1752	7.8 " "	0.16 "
25 " "	2190	8.4 " "	0.15 "
30 " "	2628	9 " "	0.14 "
40 " "	3500	9.8 " "	0.13 "
45 " "	3940	10.1 " "	0.125 "

There are other important advantages from centralization of power in large power plants, which will have important bearing on the future of central station business, for industrial and for railroad power. One of these has to do with obsolescence and its importance in this connection does not always receive the attention that it deserves. Another is the utilization of off-peak or secondary power, which so far has been very little realized, but which will increase in importance.

Obsolescence has long been the bugbear of electric companies that are striving to earn dividends, and centralization of power seems to be their best means of salvation. We all know that electric companies that were started fifteen or more years ago, whether they were for lighting or for railroads, or for whatever purpose, have found a large part of the cost of conducting their business has been due to the failure of apparatus to meet growing demands not so much because it was worn out as because it became obsolete, when increasing business required larger powers and improved machinery.

Good serviceable power plants became obsolete because they could not do the increasing work of later years, and were discarded because the use of power increased. Centralized power plants meet changing conditions because they are built for larger service and constructed on a unit plan that can be economically extended to meet growing demands.

The utilization of off-peak power will be promoted by the concentration at central points of large amounts of off-peak power, which can be more readily utilized as second class power than the same amount of off-peak power if scattered through a number of small generating plants.

There are several very promising methods in prospect for utilizing off-peak or secondary power when it is concentrated in large blocks, but it is not within the scope of this paper to go into a discussion of them.

Next, turn to the power transmission side of the problem. In this the results in favor of large mixed operations are even more striking than in power generation. It is a difficult subject to generalize on, but briefly, suppose that a central plant is located at a favorable point at a coal mine or a water power, and it is desired to transmit power from the plant. It often pays to run 100 miles of transmission line to pick up a large load, whereas for a small load, the cost of 10 miles of transmission may easily be too great. It follows that if the aggregate amount of power surrounding the power centre is not large, it will not pay to go far for it, and the economical distribution area may be restricted to a radius of 10 miles or less. But, on the other hand, if the aggregate is large, long distance transmission will pay and the combination of large amounts of power per mile of transmission on long transmission lines, covering large areas, gives a big connected central station load. In this lies one of the great advantages in favor of including railroad roads on central plants, viz., where the amount of power and lighting scattered through a territory for manufacturing and similar purposes is not sufficient to make it economical to install electric transmission for this alone and where the railroad business is not sufficient to pay to transmit for railroad power alone, transmission for the combined loads will often be highly profitable.

There is a well-known power transmission company that affords an excellent example of the advantage of combining as much power as possible in a given territory. Its business aggregates something like 60,000 h.p., connected on several hundred miles of transmission lines, and the yearly cost of transmission including all fixed charges and operation and maintenance of the transmission system, amounts to about $12 per h.p. per year, based on its peak load of 50,000 h.p. Its load is industrial power and lighting with a few street railways. In the same territory there is a total consumption of power exclusive of steam railroads approximately 225,000 h.p. which if all served for a single central power plant would produce a maximum load of probably 150,000 to 175,000 h.p., but for various reasons, one of which is the use of exhaust steam for heating buildings, factories, etc., [illegible] that it would be [illegible] to serve from [illegible] would [illegible] peaks of only about [illegible] to [illegible] h.p. [illegible] of steam railroad operation. The yearly cost of power transmission including all fixed charges for transmission [illegible] for serving [illegible] h.p. in this territory [illegible] h.p. [illegible] as now [illegible] at [illegible] per h.p. per year [illegible] with $12 per h.p. which is the cost of power transmission and distribution for 50,000 h.p. only.

[illegible] of the [illegible] railroad [illegible] in the same territory [illegible] that if all of the railroads used electric motive power exclusively, the railroad load would require a [illegible] of between [illegible] and [illegible] h.p., and if only the railroad lines carrying heavy traffic and frequent train service were electrified in the territory, the maximum load, if served from a central station, would be somewhere between 150,000 and 200,000 h.p., and that the yearly load factor of this railroad load, including freight and switching and passenger service, would be between 40 and 50 per cent. It is clear that if this load were added to the industrial and lighting load, it would greatly facilitate and cheapen the unit cost of distributing power from the central station.

In conclusion, I want to review briefly what the substitution of electric motive power for steam on existing railroads should include. It is not enough to say that it would require the construction of central station generating plants, of transmission and distribution lines, generally following the railroads and of electric locomotives to replace steam. These would all have to be provided, of course, but that is not nearly all that should be done. Unless we look beyond such facts we cannot even appreciate the problem before us, much less solve it. When the railroads are paralleled by transmission lines over which central stations supply electric power for their operations, then the country traversed by the railroads will be in electric power zones, where power for any purpose may be taken from the lines along each railroad right of way and these lines will connect large central stations together, so that transmission lines will network the country as railroads now do and will connect important centres for power, as railroads do for transportation. Into this network of transmission circuits central electric plants will pump energy that can be drawn off in just the right amount to supply the needs of each point included in the network.

When this is carried out, the distribution of power, which is the greatest problem in the way of almost universal use of central station electric power, will be overcome with the resulting economy in generation as well as in distribution, since the most economical conditions for both generation and distribution are where large amounts of power are supplied at the best load factor attainable, which results when the largest number of operations are supplied from a single system. Thus there are many places where railroad electrification will be profitable as outlined, where it would not pay to build transmission lines for the railroad load alone or for the industrial power and lighting without the railroad load.

* * *

THE OVERHEAD PLANT OF A MODERN TELEPHONE SYSTEM.*

By Sergius P. Grace.

(Continued from last issue.)

On a breakdown test, the insulation stood 15,000 volts, alternating, for 15 seconds before breaking down. The voltage was gradually raised to the above figure.

For a ten-year-old wire this is very remarkable, and if we could be assured that all the rubber wire that we have purchased would give the same results the drop wire part of the plant would prove very economical to maintain.

During recent years, with the many manufacturers in the field to supply the large demand, and the introduction of many kinds of rubber substitutes to just meet the specifications, I am afraid that our drop wires are going to cost us more than they would if the old quality of wire had been maintained.

---

* Paper read before the Philadelphia Telephone Society and published in the Telephone News.

The invention of the paper telephone cable and the use of the lead press to form the cover has been described so often that I will not weary you by repeating the details. One point I wish to bring out clearly is that originally lead cable was designed for use underground, for which purpose it is splendidly adapted.

Lead is a metal which should be used only under quiescent conditions, because of the readiness with which it crystallizes and cracks under repeated bending. I do not know the name of the genius who first found that lead cables could be successfully used overhead. He is to be congratulated that so unsuitable a material as lead has proved so successful for the purpose.

Let us consider what an unmated couple we have when we hang a lead cable on a steel rope. Lead has a temperature coefficient of expansion of .0000160 and that of a hard steel rope is .0000064. In other words, for any given change in temperature, a lead bar or cable sheath will expand two and a half times as much as a steel bar or messenger rope. In a 110-foot span, with a rise in temperature of 100 degrees Fahrenheit, a lead cable would increase in length 2.13 inches, while the steel rope would increase only .84 inch, leaving a surplus of 1,29 inches of lead which obviously must be stowed away somewhere.

The lead cable, by reason of its excess expansion, is forced into taking care of itself by moving into the pole dips or other bends or kinks along the cable. If the cable were free to move throughout its entire length and were placed on frictionless rollers, it would expand in a straight line and not into the dips and bends along the length of the cable. These dips or bends may be called nodes of least resistance into which the cable moves back and forth with every temperature variation.

These daily excursions of the cable into the dips and bends will, in a few months or seasons, cause deterioration in the cable and finally result in crystallization and cracking.

In the older forms of cable construction it was generally the practice to band the cables closely to the steel strands and leave at each pole a dip of four to six inches.

Realizing that there is a difference in expansion rates between the lead cable and the steel supporting wire, the only rational method of suspension is one that will permit the cable to take care of its expansion and contraction in long, sinuous waves, so that at no point will the stress in the lead go beyond its elastic limit. This can be done by long hangers, large rings or big pole clips.

I wish now to refer to the prevalent evil of tight messenger wires. There is a difference of opinion as to whether this makes a better looking job than loose messengers with uniform, slightly sags, but, as I will point out later, tight messengers have a most destructive effect on pole line construction and increase the difficulties from expansion and contraction troubles, which are the main cause of repairs and excessive depreciation.

A wire of uniform weight per foot, when suspended between two supports, will describe a catenary curve, the fundamental equation of which is

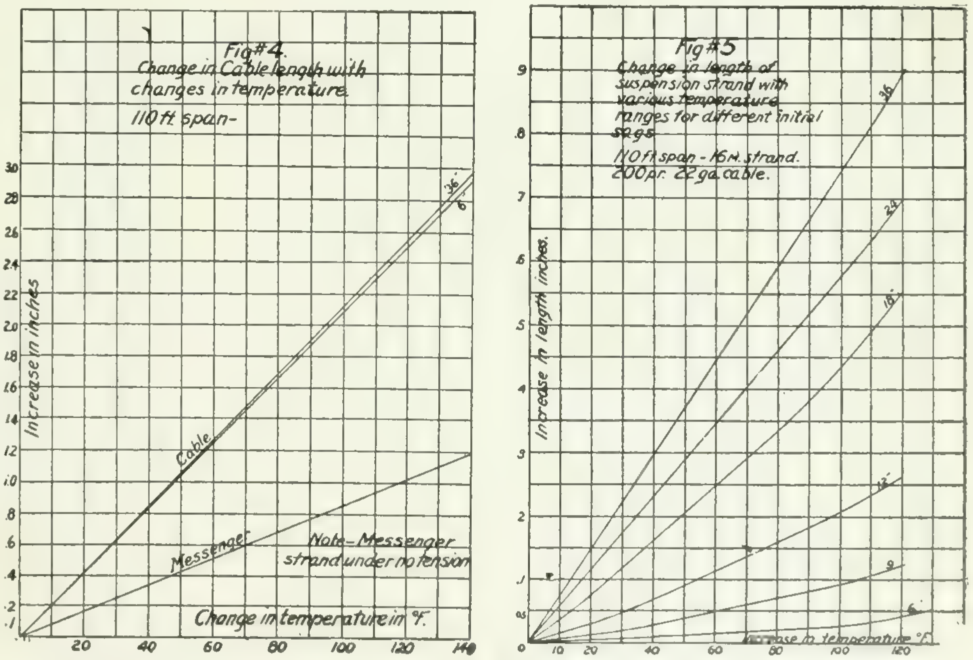
$$y = \tfrac{1}{2} a \left(\frac{x}{Ea} + \frac{—}{E} \, \frac{x}{a} \right) \qquad (1)$$

in which E is the base of the Naperian system of logarithms, x and y, coördinates, and a, the distance from the bottom of the curve to the horizontal axis. For catenaries of small deflection, the curve is practically that of a parabola, and we may write for the horizontal tension in the centre of the span the formula—

$$T = \frac{WX^2}{2d} + \frac{d}{6} \qquad (2)$$

in which W = weight per foot of wire and cable. X = ½ span in feet, d = sag at centre of span in feet. From this equation the curves in Fig. 3 were plotted

By referring to these curves, it will be noted how rapidly the stress in the messenger wire increases for a small decrease in the dip of sag of the span. For example, with a dip of 4.32 inches, the stress in the messenger wire supporting a 100-pair 19-gauge cable would be 27,500 pounds, and for a 50-pair cable 17,500 pounds. If, instead of a 4-inch dip, an 18-inch dip had been given these messenger wires and cables, the stresses would be 6,000 and 4,000 pounds, respectively.



Curves Nos. 4 and 5.—Showing Changes in Cable and Messenger Wire Lengths With Temperature Changes.

The standard sags which were worked out for our company are as follows:—

Span in feet.	Minimum sag in feet.
100	2
115	2½
130	3
150	4

These sags were determined with a view to producing the least strains in the overhead construction consistent with clearance and a reasonably good looking job.

Under these conditions, a 400-pair 22-gauge cable suspended with the standard sag will produce a stress in the messenger wire of only 4,203 pounds, or with a 16,000-pound messenger wire, a factor of safety of 4.

In addition to the great strain tight messenger wires place upon overhead construction, another peculiar effect is produced. A steel messenger wire is elastic, and, under a state of tension, will elongate to an extent dependent upon the modulus of elasticity of the material. When the stress is removed, the steel cable will come back to its original length, provided that we have not carried the stretching far enough to exceed the elastic limit of the material.

A tightly stretched messenger wire will be elongated nearly an inch in a 110-foot span, and its cross section will also be proportionately reduced. Now, under these conditions, if the temperature should increase, the sag will of course tend to increase an amount dependent upon the temperature coefficient of the material, but the increasing of the sag or length also has a tendency to reduce the tension in the wire and thus reduce the elongation which is dependent upon the modulus of elasticity.

Consequently, in a tightly stretched messenger wire, a condition of equilibrium will be reached in which it will be found that the length of the messenger wire will be increased but very little. Therefore, under these conditions, it is not a case of taking care of the difference in expansion between the lead and the steel, but, instead, almost the entire expansion of the lead will have to be taken care of and stowed away in some place. Obviously the movement which may be concentrated in a bend or pole dip, is very much greater than would have been the case if the cable had been placed on a messenger wire with a reasonable amount of sag and consequent small tension.

The formula which shows the relation between temperature changes and sags for an elastic wire is as follows:

$$a = \frac{1}{\text{[illegible]}}(d^2_1 - d^2_0) + \frac{\text{[illegible]}}{\text{[illegible]}}\left(\frac{1}{d_0} - \frac{1}{d_1}\right) \qquad (3)$$

when sag is expressed in inches and span in feet. In this formula.

a = temperature variation for small change in sag.

t_0 = initial temperature.

[illegible]

[illegible]

d_1 = sag at temperature t_1.

c = coefficient linear expansion per degree Fahr.

e = modulus of elasticity. A term expressing the relation of amount of extension or compression of material under stress, to the load producing that stress or deformation. It is load per unit of section divided by the extension per unit length.

[illegible]

s = cross section of wire in square inches.

By assuming small changes in the sag, successive values of "a" may be found from which curves showing variation [illegible]

[illegible]

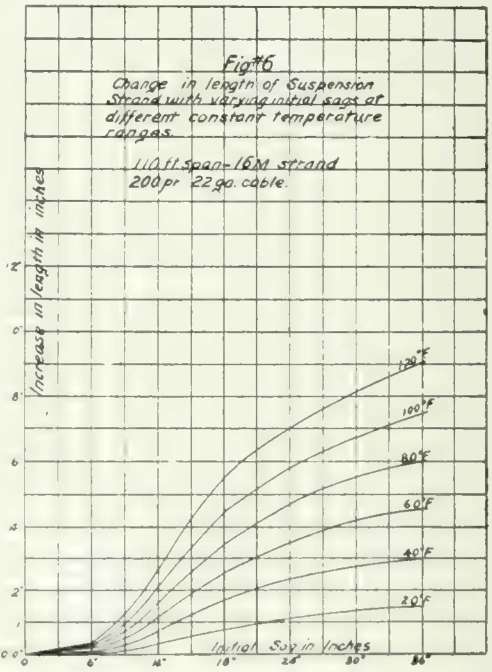
$$l_1 = l\,(1 + \frac{8d^2}{3l^2}) \qquad (4)$$

[illegible]

[illegible] For example, the increase in length for an initial sag of 6 inches for 100 degrees rise in temperature is only .025 inch, practically negligible, while under the same conditions with an initial sag of 30 inches, the increase in length would have been .7 inch, or 28 times as great. Curve No. 6 shows these relations in a different way, as the initial sags are plotted horizontally, and increases in length vertically for a series of varying temperatures.

It is clear from these curves how little variation is produced in the length of a tightly stretched messenger even with wide temperature variations.

In our standard practice, we specify a 30-inch sag for a 110-foot span. It may be assumed with safety that the daily variations in temperature will not exceed an average of 40 degrees, and a reference to curve No. 6 will show that above 30 inches initial sag, no material increase in length will be obtained for this temperature change. Consequently it appears that the standard 30-inch sag for this span is correct. In other words, with a 30-inch sag and average temperature changes, we realize 87 per cent. of the increase there would have been under a state of no tension in the messenger.



Curve No. 6.—Temperature Variation Effects on Messenger.

In case cables have been erected in the hot summer days, the reverse of the above expansion movements will take place. If dips have been left at the poles, cold winter weather will contract the lead cables and take most or all the slack out of the dips. On the other hand, if no dips have been left and the cable has itself been pulled up until no slack is left, the cold weather will have an extremely bad effect. This is because the cable will contract more than the messenger wire, and particularly so if it be a tightly stretched and elongated messenger, which will have the effect of taking the load off the messenger and throwing the major portion of the strain in the cable itself. Since a lead cable is easily stretched and deformed beyond its natural length by small stresses under the above conditions, the lead sheath will be permanently elongated and perhaps injured in many places. When the hot weather returns, this elongated lead sheathing will again expand at a higher rate than the messenger wire and show the familiar surplus of cable. The tighter the messenger is strung, the more aggravated will be these troubles.

Previous to the year of 1902, the practice in our company was to stretch the messenger wires very tightly and attach the cables closely to the messenger by means of marlin bands. This unfortunate method of cable erection marred what was, in most all other respects, an admirably designed and constructed aerial cable system of distribution. In the course of a few seasons, hundreds of breaks occurred, and when I came with the company, in 1902, it was one of the first problems passed to me for a solution.

It might interest you to know of some of the experiments we made at that time to determine the cause of the trouble. The general opinion was that the cracks were caused by the vibration of the poles and messenger wires, but both Mr. Snyder and myself felt sure that the principal trouble was due to expansion and contraction by temperature changes.

We placed a lead cable 67 feet long through rings on the roof of the telephone building. The cable has a 4-inch dip at one end, was fastened at both ends, but free to move along its length and expand into the dip. Around the cable we wrapped a resistance wire protected with a heat-insulating material. By passing current through the wire, we could raise the temperature of the cable to any desired degree. It was clearly shown that the cable was moved with temperature changes and that the coefficient of expansion was practically that of the lead sheath and not of the wires inside.

In order to determine the number of movements necessary to break the cable sheath in the average dip, a number of pieces of various size cables were bent with a dip of four inches and subjected mechanically to a movement of one inch along the cable. When the movements were made by a fast arm motion, it was found that 50 to 100 movements were required to break the sheath of the cable. When the movements were very slowly executed by the arm, it took from 200 to 300 movements to crack the sheath.

The cables with large diameters broke first, which was to be expected, since the angular opening at the surface of the sheath for a given movement would be larger because of the increased value of the radii. To make sure that the same results were occurring in practice, metal gauges were placed on existing cables to measure the increase in the dip and the movement of the cable along the span.

On many cables we were able to observe a daily longitudinal movement of the cable of one-half to three-quarters of an inch. All these experiments and tests prove very conclusively that our lead cables are constantly moving on the messenger wires because of temperature changes. We may, without exaggeration, imagine them to be alive and writhing and twisting about the supporting wires with the unceasing variations of heat and cold.

Unquestionably, because of these movements, aerial lead cables start to deteriorate from the day of their erection, and microphotographs of the molecular arrangement taken yearly would plainly show the changes in the molecular structure of the lead.

Another interesting phenomenon in overhead cables, is the effect produced by the difference in expansion rates of the entrained air in the cable and the lead sheath. Air has a greater coefficient of expansion than lead, and, therefore, when a cable is heated on a warm summer day, the air inside is compressed. If there be an opening anywhere in the lead sheath, the air will escape because of its compression; then, if a summer shower takes place, the cable is very suddenly cooled and the air inside will be rarified into a partial vacuum. This causes air to rush into the cable from the outside, and, as under these conditions there is usually water present on the surface of the cable, the water will be driven into the interior of the cable very rapidly and cause a serious case of trouble, which will take some time to locate and remedy.

In some of the older construction work, it was the practice to fill each joint with paraffin. In a few seasons it was noticed that nearly all these paraffin joints had a collapsed appearance. I believe this can be ascribed to the melting of the paraffin in very hot weather and its being driven each way into the cable by expansion. Then, if the cable was suddenly cooled by a shower, the paraffin would solidify and leave voids or vacuum pockets inside the lead sleeves. The outside air pressure would then force in and crumple up the lead sleeving.

A crystallization and cracking effect similar to expansion cracks is sometimes caused by the repeated blows of tree limbs.

Electric light and trolley crosses also play havoc with lead cables, and when a heavy arc is drawn, the lead will run in streams like so much water.

Lightning, as a rule, entering a cable does not burn large holes in the lead sheath, but the puncture is more like the hole made with a brad-awl or punch.

From time to time we have heard curious stories of various kinds of bugs and beetles devouring the lead sheath of telephone cables in California, Australia, and other parts of the world. There seems to be no doubt that there are several species of beetles which, for some strange reason, have aspirations to build a home inside the sheath of telephone cables. I understand that in California they have actually caught the bug in the act, and the state entomologist is now engaged in looking up his pedigree and ancestors.

Lead cables placed in boxes over vibrating bridges have also been a frequent source of trouble. This trouble would naturally be expected on account of the susceptibility of lead to crystallization and cracking, due to repeated blows, which they would receive in such a position.

Many times, in looking over aerial cable construction, it will be noticed, particularly if the messenger wires have been tightly pulled, that some of the cables will have expanded so much as to force themselves above the messenger wires. It is puzzling to account for this large amount of excess cable unless we remember the elongation of the messenger wire that takes place under tightly stretched conditions. It has been shown previously that a messenger wire stretched very tightly did not materially increase in length for large temperature changes. The same effect will be produced in a tightly stretched messenger wire if some of the corners give way or the anchors loosen up slightly.

If the messenger wire had not been elongated, this giving way of the corner or anchor would produce no change in its length, but since the messenger wire is tightly stretched, when the corner gives way, the tension will be decreased and the messenger wire will increase in cross section. Its length will actually be decreased.

Since the cable was not elongated, it is apparent that, with the shortened messenger wire, we will have a surplus of cable which can only take care of itself by pushing around and above the stand. This phenomenon will also be observed when a splice is made in the middle of a section and the splicer's carriage and guy rope has stretched the messenger wire beyond its normal elongation. When the weight of the splicer and carriage is removed, the messenger wire will shorten and produce an apparent increase in the length of the cable.

In conclusion, when we stop to consider that the lead telephone cable was originally designed for use underground, where the lead could be quiescent, it is a marvel that our engineers, construction and maintenance men have been so successful in keeping operative the many thousands of miles of aerial plumbing throughout the Bell system.

I venture to say, however, that our present form of lead aerial cable is not the final answer to the solution of aerial distribution, but that in the years to come, we will have a much more flexible cable with a sheath capable of withstanding the mechanical shocks and temperature changes of overhead construction.

Finally, at the risk of tiresome repetition, I am again going to say that one of our most important duties is so to design and construct the overhead plant that while it serves its proper purpose in the giving of efficient and economical service it will in appearance give the least offense to the public taste that every day is demanding more and more on the æsthetic side of the city beautiful.

NEW APPLIANCES FOR TESTING STONE PAVING BLOCKS.

Tests of paving materials as regards crushing strength and resistance to frictional wear have been conducted for the city of Paris, France, by its municipal laboratory for about 40 years. The equipment of this laboratory has been supplemented recently by the reconstruction and improvement of old appliances and the installation of new ones. This new equipment is described by Mr. Pierre Labordere, engineer of the Roads and Bridges Department, and Mr. Frederick Austett, Chief of the Paris Municipal Laboratory for Testing Materials, in a paper prepared for presentation at the 6th Congress of the International Association for Testing Materials at New York City, Sept. 3-7. An abstract of the paper follows:

Preparation of Test Pieces.—The preparation of the test pieces comprises two operations: Cutting to shape and finishing. The first operation is accomplished by means of a helicoidal wire, composed of three steel wires 2 mm. in diameter, each forming an endless band 30 metres long, running in vertical plane with a velocity of 7 metres per second. It is maintained in uniform tension by a counterweight and rests on the specimen to be cut. This latter is firmly secured on a plate, situated in the centre of a frame carrying the the pulleys which serve to guide the wire. The wire carries with it an abrasive material consisting of powdered sandstone and granulated steel, continuously moistened by a jet of water. The rate of cutting is 5 centimetres per hour in [illegible]

The operation of sawing with wire leaves irregularities on the surface of the specimens, which irregularities must be eliminated; and, moreover, the specimens to be tested must have perfectly flat and strictly parallel faces. In order to bring about this result a polishing machine consisting of [illegible]

Testing the Specimens.—[illegible]

[illegible]

[illegible]

The head of the tup is provided with a brake, which is set in operation by the effect of the impact and stops the mass instantly after the rebound, thus preventing the secondary impact due to successive rebounds.

The test specimen (a cube of 5 mm. side) is fixed in a box which, in turn, is bolted to the anvil base. This box is provided on all four sides with spring pushes exerting a uniform pressure of 6 kilos on the specimen it contains, through interposed steel plates. The cube projects from the box for a distance of 1 centimetre.

To prevent the tup from striking the cube slantwise in the event of the contact surfaces of the two being not exactly parallel, or of the upper face of the cube not being perfectly true, the cube is covered with a kind of cap of tempered steel, the perfectly flat inner face of which is applied to the upper face of the cube by means of lateral springs, so as to insure complete contact. The upper portion of the cap is spherical; and by this means each blow of the tup is transmitted integrally to the entire surface of the test cube. A note is taken of the number of blows required to produce the first crack; and then of the total disintegration.

The authors have been impressed by the imperfections of the machines for the test for resistance to attrition (wear under friction) typified by the Dorry machine used in France and consisting of a cast iron disc mounted horizontally and rotating in its own plane, the specimens of stone to be tested being placed in contact with the disc.

The test pieces being of rectangular section, whereas the different points of the disc in contact with same have a trajectory of concentric circumferences, the wear set up by is irregular, both as regards the disc itself and the test pieces. It is therefore somewhat difficult to measure the attrition produced; and the tests made with discs that exhibit irregular wear are difficult of comparison with one another.

A new machine which has proved thoroughly satisfactory has been designed and constructed for the resistance to attrition test.

It consists of a cast iron drum rotating about a horizontal axis. The blocks to be tested are placed in pivoted boxes sliding vertically in recesses, and are brought into contact with a generating line at the top of the drum. Powdered sandstone and a jet of water are delivered from a couple of calibrated funnels onto a point a little in front of the plane of contact with each test piece.

The drum has a diameter of 60 cm., in order that the arc on which the specimens rest may have a very slight curvature. A few turns of the apparatus are then sufficient to impart to the lower face of the specimens a curvature corresponding exactly to that of the drum surface. When this is achieved, the height of the test piece is measured, the measurement being repeated at the conclusion of the test.

To prevent the formation of grooves on the surface of the drum the following plan has been adopted: Each test piece, 6.5 cm. wide, is separated from the adjacent test piece by a distance of exactly the same width as the pieces themselves, namely 6.5 cm.

After every 1,000 revolutions, the cylinder is displaced on its shaft by a distance of 6.5 cm., the shaft being provided for this purpose, with two stops situated at each end and limiting the displacement of the drum in either direction.

In this way a very considerable number of tests can be performed with the apparatus without any sensible abrasion of the drum, and above all without the formation of grooves thereon. The apparatus is constructed to take 6 test pieces at once, the drum being [illegible] cm. long

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

—Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 5, 1912. No. 10

CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Commission Form of Government 419
The Toronto City Architect's Department 420

Leading Articles:

Some Notes on Oakville Viaduct and the Dynamiting of the Condemned Arch Ribs, August 12th, 1912 403
Aluminum and Electro-Metallurgy in France 404
Extension of an Outfall Sewer 405
A New Thin-Lined Blast Furnace 406
The Treatment of Water With Chlorine 407
Central Station Electric Power for Railway Operation 411
The Overhead Plant of a Modern Telephone System 414
New Appliances for Testing Stone Paving Blocks.. 418
Municipal Telephone Ownership 421
Pressing Concrete With a Movable Steel Tower.... 422
Methods of Road Construction and the Problem of Dust Suppression 424
Concerning Web Stiffeners 427
The Attitude of the Railways Toward Forest Fires.. 428
Method and Cost of Applying Stucco With the Cement Gum 431
Personals 433
Coming Meetings 434
Engineering Societies 434
Market Conditions 24-26
Construction News 67
Railway Orders 74

THE COMMISSION FORM OF GOVERNMENT.

The problem of city government has been a difficult one to solve. Many forms of municipal government have been tried in the past thirty years in the United States, and, while some of these have shown distinct advance over preceding methods, still not one could be called an unqualified success. Mr. Oswald Ryan, of Harvard University, in a recent analysis of the real problem of Commission government, makes some interesting commentaries on this form of city government which has proved unusually efficient in the Western United States and in some of the Western cities of Canada.

The municipal needs of the present day are stronger than ever in their demand for a system which will ensure administration by experts. The increasing social and economic complexity of modern urban life has entailed burdens and obligations hitherto unknown to local government, and if the work of meeting these needs is not carried on with the assistance of permanent experts the cities must fail in their obligations. At the same time it is plain that government by experts alone is undesirable and out of harmony with American political ideas. A staff of permanent officials which is out of touch with the electorate tends to develop into a professional bureaucracy, tied up with red tape and unresponsive to the popular will and needs. It is, therefore, necessary that the expert should be under the constant supervision of the layman, who will thus form a connecting link between the professional staff and the people. In this way the permanent official will be brought into contact with the needs of the people, and the people, through their elected supervisors, will possess the means of controlling the permanent official.

It is precisely this adjustment between the professional and lay elements in the government which has been responsible for the marked success of the English borough governments. As in the commission plan, the legislative and administrative powers of the English borough are vested in the council, which is the sole governing authority. The actual work of administration is carried on by a permanent staff of experts acting under the supervision and control of standing committees of the council.

The principle underlying the organization of the commission system of city government is clearly in harmony with what American and English experience has shown to be the most effective working principle that may be applied to the government of cities in a democracy. The commissioner, being an elective official, can not be expected to be an expert official. Indeed, experts will never accept an office of such uncertain tenure as that subject to the fluctuating influence of politics. The commissioner may be an efficient unprofessional, supervisory official, however, acting in the same capacity as the English council committee: and in such a capacity he will reach his maximum efficiency. Under this clearly defined distribution of functions between the elective and the permanent official each official will exercise that kind of function for which he is best fitted. This proposition, clearly understood, settles the crucial point in the problem of commission government.

If the commissioner's function is defined as supervisory with respect to his relation to the administrative service, the question may arise: Will it not now become necessary to have a permanent expert department head working under the supervising commissioner? This question must be decided with reference to the character of the commissioner's duties. In the small city, where the affairs of the different divisions of the department are left to the charge of the subordinate officials, these duties would be comparatively light, and only the general direction of the activities should rest with the commissioner. Under such circumstances the commissioner would be able to direct the work without the aid of a permanent head. It is probable, on the other hand, that the work of directing one of the great departments of the very large city would be too onerous and too complex for the layman to discharge without the aid of a permanent administrative head, in which case it would be found necessary to institute the permanent official.

With the development of the commission plan into a more distinctly supervisory character, the people will have worked out a system of city government which does not differ in essential principles from that with which they started out, the council plan. The machinery of the commission government is more centralized and more responsive, but the relation between the elective official and the permanent administrative staff is common to both systems. It is upon these principles that the permanent efficiency of the commission government must rest, just as it was contempt for these principles that caused the failure of the reform municipal systems of the past thirty years. If the commission plan conforms strictly to these principles, there is reason to believe that it will not become the subject of a tale "full of sound and fury, signifying nothing."

THE TORONTO CITY ARCHITECT'S DEPARTMENT.

The inquest at the time of the Neilson building collapse brought to light considerable evidence which showed the necessity for reorganization of the Toronto City Architect's department. While there have been many rumblings since in the City Council as yet no action has been taken. We hope that the City Council and the Board of Control will seize the opportunity to get a strong man to take charge of this department of the city's work. The City Architect's department is in some respects the most important section of municipal activity. It is perfectly clear to all that some drastic action must be taken with regard to the present organization of the department. The protection of the public demands the appointment of a man at the head who is not only capable of handling the executive end of the work, but also a man who is well versed in the technical details. The ideal head for this department is a man well versed in the strength of materials, one who has made a special study of it, in fact. The various equations in the different handbooks it should be possible [illegible] If any improvement is to be made in the department, such a man [illegible] ability.

The [illegible] the Assistant City Architect did in the Neilson investigation ought not to be entrusted with this important work. Under a competent City Architect, however, he [illegible] versed in modern building materials and their strengths to put them in proper shape. All of the above facts demand that the Board of Control and the City Council appoint a man who possesses qualifications which fit him for the position. The history of civic appointments in Toronto has not been above criticism. The necessities of public safety, however, demand that all question of political expediency and personal pull be eliminated. *The Canadian Engineer* is interested, because it is not the artistic, but the scientific or engineering side of architecture which is at stake.

EDITORIAL COMMENT.

In recent comments on the new Canadian Pacific Railway building in Toronto, one of the Toronto daily papers speaks very favorably on the style of architecture and the general pleasing appearance of the building. While it is true that it is "a design peculiar to our age and country," we believe that the corner of King and Yonge Streets is no place for a sixteen-story building. It may be "satisfactory" and "satisfying" to certain members of the daily press, but it certainly will not be spoken of in such terms by the man living in its shadow. It is time that the City Council passed the ten-story limit amendment to the building by-law.

* * * *

Attention has been called to the fact that the British School of Architecture at Rome is inaugurating a scholarship in architecture open to all British students under thirty years of age. The scholarship is worth $1,000 per year, and is tenable for three years. The expectation is that a number of Canadian students of architecture will try for the scholarship, full details of which can be secured from the Department of State.

CHANGES DUE TO THE NEW WELLAND CANAL.

The construction of the new Welland Canal will necessitate a number of changes along the course of the first section of the old canal. It is understood that the government has under consideration the changing of the aqueduct under the Welland Canal necessitated by the crossing of the Welland River. Enlargement of this aqueduct would be extremely difficult. As an alternative it is suggested that the aqueduct be [illegible] and that lock gates be installed in the river at Port Robinson, raising the level of the water in the river to that of the canal. This would mean a raised elevation of [illegible] feet. Levees would then be built along the shores of the river to prevent flooding. A harb r and turning basin would be built at the intersection of the river and the canal. It is also reported that the government will construct a large [illegible] Lake Erie to provide a water supply for the [illegible] supplied from the canal.

LARGEST FLOATING DOCK.

The largest floating dock in the world was launched [illegible] at Birkenhead. It has been constructed for the British Admiralty. The dock is capable of lifting battle ships having a displacement of 32,-[illegible] accommodation for the [illegible] officers and crew.

MUNICIPAL TELEPHONE OWNERSHIP.

Some figures on the cost of telephone systems in Ontario are given in a recent report of the Ontario Provincial Government by Francis Dagger. This report gives the operation of the systems now operating under the Local Municipal Telephone Act of 1908.

The Act provides means whereby a municipality can furnish the necessary capital to construct a telephone system upon a petition from any number of ratepayers. This capital is repaid by the subscribers in ten annual instalments of principal and interest, the cost of operation and maintenance being also a charge upon the ratepayers who are telephone users. In this way the ratepayers who take a telephone obtain service at actual cost, while those who do not, are exempt from all liability in connection with the cost of constructing, extending, operating or maintaining the system.

The following table includes the most important farmers' telephone systems at present being operated under this Act, with the latest available figures, showing the number of subscribers to each system:

	Subscribers.
Brussels	700
Tuckersmith	505
Chinguacousy	412
Maidstone	247
Rochester	240
Sandwich South	210
Gosfield North	206
Blyth	203
North Easthope	200
Colchester, North	173
McKillop	167
St. Vincent	144
Colborne	125
Goderich	105
Laird	101
Tay	100
Oliver	53
Paipoonge	44
Total	3,804

In order to convey an adequate idea of the benefits resulting to the communities in which these systems are in operation, it may be stated that in answer to the question, "How many farm telephones were there in your district before you started?" the townships of Colborne, Maidstone and Sandwich South replied "None." These three municipalities are now furnishing telephone service to 591 subscribers. In reply to the same question, the township of Colchester North replied, "One"; Gosfield, North, "Four"; Tuckersmith, "Five," and Chinguacousy, "Thirty." In these four townships there are at this date 1,296 farmers who have telephones in their homes as a result of municipal ownership under the Act referred to. It would be safe to say that similar conditions obtained in the other municipalities, although definite figures are not available.

As these figures will doubtless encourage the ratepayers in other rural municipalities to devote some thought to the important question of obtaining telephone service at cost, the writer has obtained authentic data in regard to the cost of construction and operation of these systems, of which the following is a summary:

Original Cost of System, Per Subscriber.

Brussels	$88
Tuckersmith	66
Chinguacousy	73
Maidstone	44
Rochester	41
Sandwich, South	65
Gosfield, North	43
Blyth	93
North Easthope	65
Colchester, North	40
McKillop	66
St. Vincent	57
Colborne	44
Goderich	48
Laird	38
Tay	59

It will be noticed that there is a considerable difference between the cost of constructing the various systems named. In explanation it may be stated that this is due to several causes. The Blyth system, which shows the highest cost, provided central office equipment and built pole lines to serve many more subscribers than are at present connected. The cost of connecting additional subscribers using the same switchboard and poles will be much less per telephone than $93, and in this way as the system is filled in the average cost per subscriber over the whole system will be reduced. Again, the cost of the Brussels system includes a central office building and an expensive modern central switchboard equipment; while the Tuckersmith municipality does not own any central equipment, its lines terminating upon the "Bell" switchboard at Seaforth. Chinguacousy, also, only provides a central office equipment for half its subscribers, the lines of the remainder terminating in the "Bell" exchange at Brampton. The lower cost given are mostly accounted for either by the fact that smaller poles are used, or that there are more subscribers connected on each mile of pole line. For example, in Maidstone there are five subscribers to each mile of pole line, while in Sandwich, South, there are only seven telephones for each two miles. Some systems also economize by buying lower-priced equipment, and by the farmers providing much of the labor at cost, while other municipalities purchase more expensive, because of a higher grade equipment, and had the plant constructed by qualified contractors who, of course, require a profit over and above the actual cost of labor.

Annual assessment to subscribers for ten years in repayment of cost of system, with interest at five per cent:

Brussels	$11.30
Tuckersmith	8.37
Chinguacousy	9.00
Maidstone	5.85
Rochester	5.44
Sandwich, South	8.42
Gosfield, North	5.83
Blyth	*12.00
North Easthope	*10.50
Colchester, North	5.72
McKillop	9.72
St. Vincent	7.95
Colborne	†8.00
Goderich	[illegible]
Laird	[illegible]
Tay	9.80

* Includes cost of operation.

† For five years, plus cash payment of $15.00.

Reconstruction and Renewals.—It may be pointed out that the above payments cease at the end of ten years, the original debt being wiped out. It must not, however, be understood that at the termination of this period subscribers will obtain service at the figures given in this article under the heading of "Annual Payment by Subscribers for Cost of Operation," as provision will then have to be made for such reconstruction and renewals of plant as may from time to time be rendered necessary by depreciation and obsolescence. The cost of this provision will have to be assessed against the subscribers, in addition to the amounts now paid for operation and ordinary maintenance. What the actual amount of such an assessment would be depends very much upon the quality of the equipment and the manner of its construction when the system was first built. For this reason it is important that municipal systems be well constructed and only the best equipment adopted in the first place, as a badly-constructed system, with inferior, because cheap, equipment, may require almost total replacement at the end of ten years, which would necessitate the continuance of an assessment nearly approaching the figures named above.

With a properly engineered and well built system, using high-grade equipment, a yearly amount not exceeding half the original assessment should be ample to take care of all necessary repairs and reconstruction. Assuming this to be so, in a system such as Chinguacousy, the subscribers of which now pay $9 in payment of principal and interest, plus $3 cost of operation, would at the end of ten years pay $4.50 plus $3, or $7.50 per annum, instead of $12 as at present. In considering this matter there is, however, another element to be considered, which is that the Act provides for additional subscribers paying the same assessment as the original subscribers who shared the cost of building the main pole leads and of equipping a central office to accommodate many more telephones than were installed at the start. It will be apparent that the cost of connecting additional subscribers using the same central office equipment and pole leads which have already been paid for by the original subscribers, is very much less than the amount paid by these original subscribers. This difference is set aside by the municipality as a reserve fund to be expended on maintenance, reconstruction and extensions, and it is within the range of possibility that by the end of ten years this fund may have reached a proportion which would considerably reduce the amount to be assessed against subscribers on account of depreciation or obsolescence.

Annual Payment by Subscribers for Cost of Operation.

*Tecumseth	$3.50
Chinguacousy	3.00
[illegible]	1.00
[illegible]	1.00
Caledon, North	[illegible]
[illegible], South	2.00
*[illegible], South	3.00
*[illegible]	3.50
[illegible]	7.00

*[illegible] and pay Bell Company [illegible].

[illegible]

Reasons for Low Maintenance Charges.—The above [illegible] however, comparatively new and under ordinary conditions [illegible]

[illegible]

municipality absolutely subject to the control of another organization. It is parallel to buying a house and giving the key to another party, with the right to control your entrance and exit according to his pleasure or goodwill towards you. It has already been argued in the law courts that a telephone system which does not own and control its central switchboard is not a system at all, but a mere collection of lines having no terminals and powerless to furnish even its own subscribers with service without the consent of another party, which it cannot control.

◆

PLACING CONCRETE WITH A MOVABLE STEEL TOWER.

An interesting method of placing concrete for a locomotive roundhouse is being used by the Lake Shore and Southern Railway in Chicago.

The chief difficulty in this particular job is the fact that concrete has to be distributed over such large area, the roundhouse being 405 feet in diameter. Also the pit walls are so high above grade that distributing by wheelbarrows is impossible and the cost of a series of wooden towers is found to be prohibitive, three towers costing nearly $2,200.

W. B. Louer, Chicago representative of Chain Belt Co., was consulted and he suggested a steel tower and from this developed the portable steel tower which has been found to be most satisfactory and economical, as the total cost set in place was less than $1,000. The material for this article has been furnished by the Chain Belt Company, of Milwaukee, Wis., while the contractor's costs have been taken from an article published recently in Engineering and Contracting.

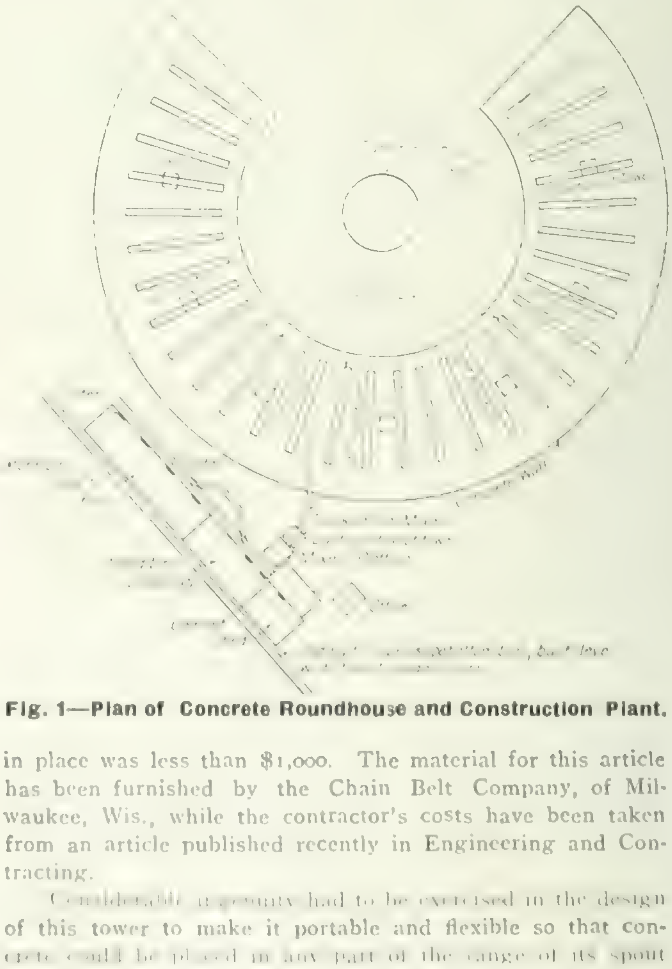


Fig. 1—Plan of Concrete Roundhouse and Construction Plant.

Considerable ingenuity had to be exercised in the design of this tower to make it portable and flexible so that concrete could be placed in any part of the range of its spout which is 60 feet long, with an additional loose vertical spout 30 feet long. This enables placing concrete 95 feet away from base of tower.

Fig. 1 shows a plan of the concrete roundhouse and the layout of the construction plant.

Fig. 2 shows the construction of the tower which is 72 feet high. The steel work is carried on wooden skids which lie across two railway rails forming a truck. On the bottoms of the skids where they rest on the rails are steel plate shoes which are fitted with clamp buts for anchoring the tower to the rails. The tower is also guyed, the guys running through blocks at the deadmen.

The horizontal spouting is made of heavy galvanized iron 10 in. by 10 in., open at the top, and is set on a light frame steel truss. The steel truss and spouts are all supported by a 40-foot boom which is rigged from top of tower and held in place by steel blocks and cable running to a winch. The winch is secured to side of tower so that the boom spout and loose leg may be raised or lowered or swung in a semi-circle, giving a wide range of work and placing coucrete anywhere within a radius of 95 feet.

The steel tower is made up of 6-foot sections, sections being composed of steel angles and channels. The tower rests on heavy wooden skids that have steel liners, which rest on railroad rails, making the whole rigging easy to move.

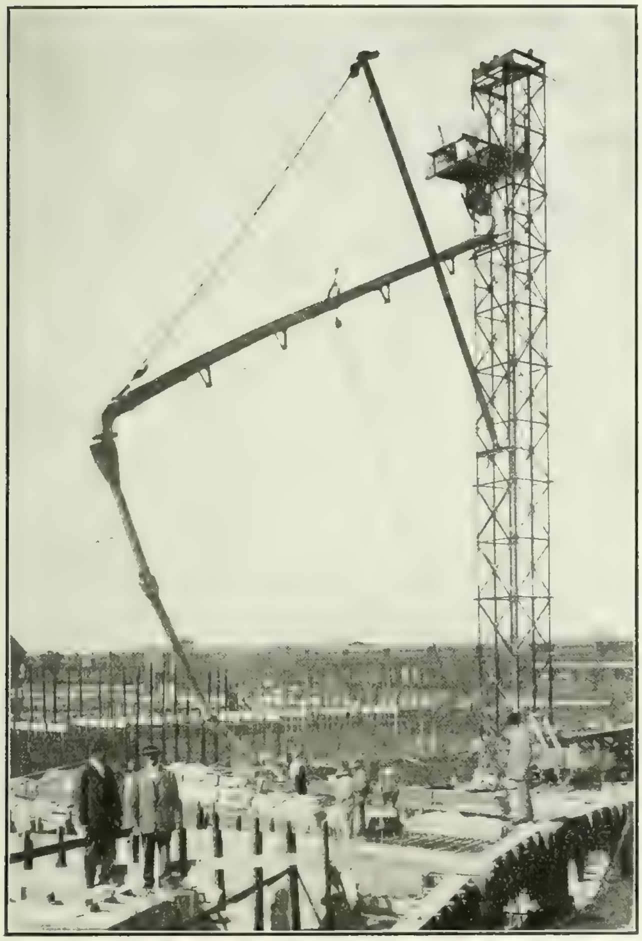


Fig. 2.—View of Steel Tower, Showing Concrete Chute in Position.

After the concrete has been placed in one section the tower is drawn back along the rails by means of the hoisting engine of the tower. This operation is accomplished by loosening the guy wires and a change of 60 feet can be made in about four hours time. Then they are ready to distribute again.

The concrete is mixed by a concrete mixer which is situated about 600 feet away from the tower on account of having the mixer near the storage bins which are on a railroad siding. The mixer discharges into cars which are conveyed to the tower, and the concrete is dumped in the bucket of the elevator and hoisted to the top of the tower where it is automatically dumped into the receiving hopper. This receiving hopper has a gate which is operated by a man standing on a platform at the top, and he regulates the flow of the concrete through the spouts.

The roundhouse is being built on a piece of ground which was formerly swampy, and the new floor will be some 5 or 6 feet above the former level of the ground. The footings for the foundations of the walls and engine pits were carried 22 feet below track grade. This work was done by hand in trenches. The work was in sand and close sheeting was necessary as was also the use of several small pumps. After the concrete was carried to ground level forms for the walls of the engine pits and for the outside walls were built. These forms carried the work several feet above the general level and the distance over which the work was spread, made the use of wheelbarrows or carts impracticable, so the chuting system was adopted. The roundhouse is about 800 feet long, measuring along the circumference. The steel tower was erected on a track running through the centre of the house and at a point within 95 feet of one end. After all the concrete up to the floor level had been placed the tower was moved back 95 feet and another set of forms was poured so that after three moves had been made, half of the concrete was poured. The tower was then "snaked" down to within 95 feet of the other end of the roundhouse and proceeded to pour the concrete there, being "snaked" backward toward the centre as the work progressed. Before the tower was moved to the last half of the work it was necessary to turn it around so that the spout would run in the opposite direction. Turning the tower about, was accomplished as follows: A pit was dug in the sand just ahead of the tower and cribbing was placed in it, with a platform and track on top so that the tower could be pulled onto it. A 40-ton hydraulic jack was arranged on the cribbing underneath so that it would operate against the platform and raise the tower about half an inch. Supported on the hydraulic jack the tower was turned around by means of a crowbar, short distances at a time, while three men at each guy line shifted them to new positions until the tower was reversed. Three men were required to a guy line as the cable and tackle block were quite heavy, and as the weight of the tower with its boom and spout is considerably unbalanced caution was exercised in shifting the guys.

The number of men required to run the plant consists of 1 foreman, 17 laborers and 2 engineers. The number may vary but this is an average crew. They are divided as follows:—

1 foreman at $4.00	$ 4.00
5 men unloading cars	16.00
3 men hauling sand and stone	9.60
1 man on cement	3.20
1 mixer engineer	6.00
1 man charging and dumping mixer	3.20
2 men on concrete car	6.40
1 man at top of tower	3.20
1 tower engineer	6.00
3 men handling spout	9.60
Total per day	$67.20

A portion of this daily cost will be eliminated for the last portion of the work when the tower will be located at the mixer. The average day's run of concrete may be taken at about 120 cu. yds. The maximum has been 147 cu. yds., but the minimum full day's run has been about 100 cu. yds. The work has been arranged so that 400 cu. yds. is run for every move of the tower. The moving of the tower requires about 4 hours, but the necessary track relaying, and the building of a new incline for carrying the concrete car high enough to dump into the hoist, requires about a day.

It may be said, then, that 400 cu. yds. is run about every 4½ days. The labor cost for this is, therefore, 4½ × $67.20 = $302.40, or 76 cents per cubic yard.

The use of the movable tower is the main feature of the concrete work, and this has no doubt saved considerable money to the contractor over the cost of handling the work by any other method.

METHODS OF ROAD CONSTRUCTION AND THE PROBLEM OF DUST SUPPRESSION.*

By Frank B. Earl.†

To the average citizen the condition of the streets seems to have been of little interest, but with the advent of motor-driven vehicles and the increased importance of highway traffic, we have come to realize that our highways are our arteries of travel and that when congestion exists the whole body of politic is made to suffer. From the moral standpoint, we have begun to recognize that, in providing a smoother path for the feet of men and by improving their method and means of communication with each other, we are making this world a better place to live in.

In conversation with the mayor of a certain city, the speaker outlined to him the general conditions of the streets as they were, suggested certain improvements, told him how the same would increase the value of the abutting property, emphasized the fact that there was no improvement possible by which the community would have both large and quick returns, that home-seekers would be attracted, rentals increased, etc. As a result the Mayor expressed a desire that the [illegible] as well as the community at large, with the [illegible] result that a public meeting was held and a general outline of the above suggested benefits given to the public. This is a long step in the right direction, as it is the taxpayer who is most vitally interested in these questions, because he is the one who foots the bill.

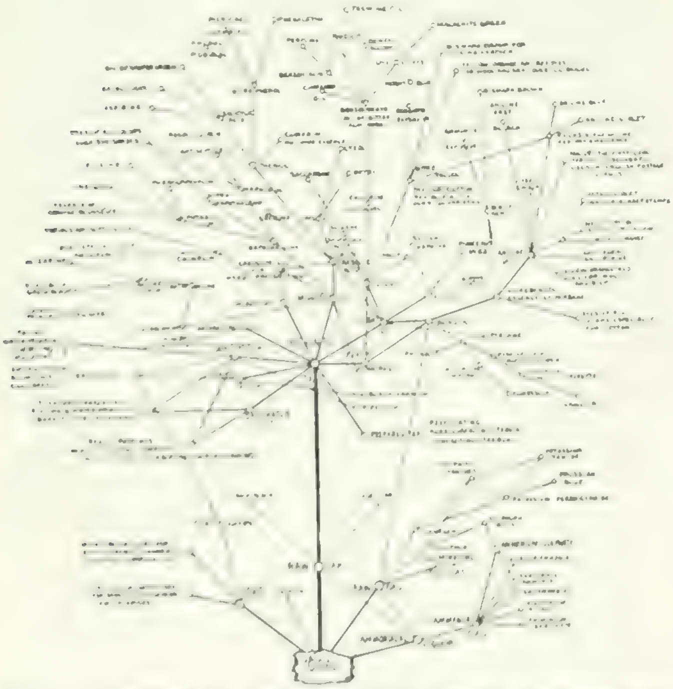


Fig. 1.—Products of Coal Tar, with Special Reference to American Conditions.

[illegible]

There was spent on the roads in the United States last year $142,000,000 and I presume that nearly twice that amount will be spent during this coming year. New York State is bonding for $50,000,000; Ohio is likewise bonding for $50,000,000, and Pennsylvania for the same amount; New Jersey $10,000,000, and thus it is being done all over the country.

In Montclair, N.J., they are considering the advisability of issuing bonds to the amount of $400,000 to make it "The Town Beautiful." Essex County, N.J., has increased its appropriation for repairs $30,000. The city of Newark, N.J., is spending nearly $1,000,000 more this year than it has ever expended before.

This gives some idea of the amount of money appropriated, and shows why the attention of legitimate business has been attracted, and it also provides a reason for the large number of questionable enterprises which come and, fortunately, go with the season. Some of the difficulties arising from these conditions are startling, and at times contracts seem to have been let, because of the low prices offered, to irresponsible bidders who, of necessity, were compelled to resort to dishonest practice or lose money on the job. The speaker believes the time has come when contractors will form some sort of combination themselves and seek to classify business interests—a step which would doubtless result in multiplied benefits to all concerned, and which is, he believes, within the scope of this society.

The speaker considers it a privilege to talk with the members of this society regarding come of the problems of road construction which we all meet every day, and about which little or nothing new has been advanced within the last year. For that reason it is a subject about which he always feels a sense of embarrassment when asked to speak. He does not know that he has anything new to present, but such as he has he will gladly share with you.

The ordinary water-bound macadam roadway when subjected to automobile traffic rapidly goes to ruin and for some years past many experiments have been made to replace this type of construction by substituting some more effective binder, both on new work and the resurfacing of old roads; the two chief binding materials experimented with being asphaltic and tar compounds.

Both asphalt and tar are used in new construction and in dust prevention—there being many grades of each, varying in density and viscosity, the lighter grades being used for dust prevention and the heavier in resurfacing and new construction.

Naturally, the speaker is best acquainted with Tarvia, because he deals in this material exclusively in the construction of roads and for the prevention of dust. In his experiences with various municipalities over a part of two States and in driving constantly over the roads, he comes in contact with every form of material that is on the market and has opportunity to note the method, results and machinery, and to draw definite and intelligent conclusions, which he will endeavor to state briefly to you without any disposition to criticize one way or the other.

In order to present the pedigree, so to speak, of the tar binder, he is forced to start at the real beginning of affairs—for you all know that tar is a derivative of the distillation of coal and that coal itself was formed in the Carboniferous Age by the accumulation of masses of vegetation and trees.

Very little is at present known about coal. Some writer has aptly called it "buried sunshine." Not a misnomer, as it suggests the source of light and heat which is driven off from the coal and also the diversified colors which we get from the coal tar products. During this formative period of coal these forests were the habitation and feeding place of the Brontosaurus and other Saurians that have been extinct for ages, but the skeletons of which have been found in the rocks of that period by modern scientists, carefully chipped out, and assembled into the complete skeleton. The larger museums contain specimens of these animals—the American Museum of Natural History in New York City being especially favored in that respect.

---

* Abstract of paper presented at meeting of the American Society of Engineering Contractors, May 8th, 1912.

† Assistant manager and salesman, "Tarvia" Department, Barrett Mfg. Co., 17 Battery Place, New York City.

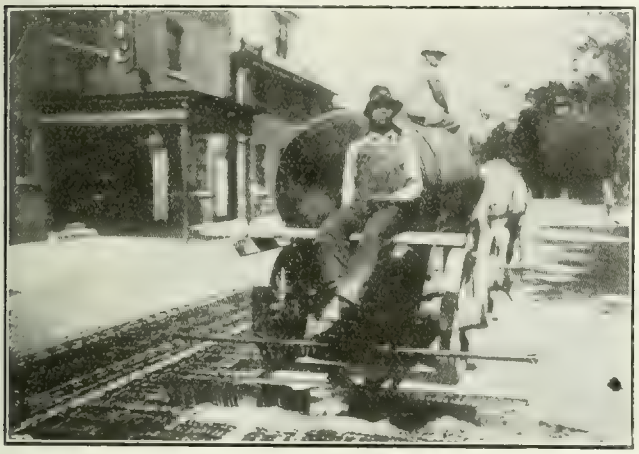


Fig. 2.—Distributing Tarvia "B" by Means of an Ordinary Watering Cart Fitted with a Distributing Device.

The family relation existing between coal and tar and the derivatives is graphically shown in the coal tar tree. (Fig. 1). The main stem of this represents the raw tar. Off to the left coke is designated, which is a residue from the fractional distillation of coal. The drawing also shows the production of gas and ammoniacal liquors, refined tars which are used in the saturation of felt for roofing and waterproofing purposes, and those which are manufactured into Tarvia for use in road construction. You will also notice that the various branches of this tree represent the drugs, chemicals, disinfectants, germicides, insecticides, and almost innumerable by-products. Finally, it is of interest to note that by synthetic chemistry we have a class of coloring dyes, etc., which are important in the commercial world.

The making of coke and the separation of the distillates was formerly accomplished by the Bee-hive oven, patented in England in the year 1620. The coal is fed into the oven through the opening at the top and leveled off with a hand rake. The face of the oven is then bricked up to within a few inches of the top, and the heat, which has been retained in the brick from a previous operation or from a preliminary heating, is reflected from the dome of the oven, thereby causing the coal to disintegrate. The gases pass out through the opening at the top, leaving a residue which hardens upon cooling. This is of a light silvery color, and is known as "Coke." In this type of oven all of the by-products are lost, and because of the smoke and disagreeable odors of escaping gas it was impossible to operate it in the near vicinity of dwellings. For these reasons the Bee-hive oven is rapidly becoming replaced by the more modern coal gas retort. In this the operation is substantially the same, except that the distillation of the bituminous coal is done under the exclusion of air. By this method the gases are carried off in pipes, recondensed and scrubbed, thus relieving them of their deposit of tar and ammonia.

The modern gas retort is a more efficient type of oven, which, being built in series, is capable of handling a much larger quantity of coal, and as it is mechanically operated, is much more economical. In the treatment of the gases for the recovery of the tar and ammoniacal liquors, the gas is forced through a series of baffling plates which are perforated with tiny holes. The plates are placed one back of the other, but in such a way that the unperforated surface of one plate is opposite the perforation in the other plate. The gas is then drawn through these plates and the tar, which exists in minute globules, adheres to the unperforated surface of the plate and is thus recovered. For the recovery of ammonia the gas is passed through a cylinder containing revolving wooden paddles which are constantly kept wet, and the gas coming in contact with the wetted wood is relieved of its ammoniacal deposit.

As it has been shown, in a general way, how tar is produced, it might be interesting to explain the manner of its distribution to consumers. It is sent in tank cars, which are fitted with steam coils to heat the material before transferring it to the distributing wagon. It is also shipped in barrels by rail or boat and by tank steamers, the hold of which is partitioned off fore and aft for the transportation of tar in bulk.

There are three grades of Tarvia on the market—"A," "X," and "B"—the "A" and "X" grades being used in new construction and resurfacing, while the "B" grade in light resurfacing, and as a dust preventative. For example, Tarvia "B" was successfully applied to the surface of a water-bound macadam street in Phillipsburg, N.J.

In this instance an ordinary watering cart was used, fitted with a distributing device, as seen in Fig. 2, at a cost of about $10. The surface of the street was first carefully swept, then from one-third to one-half gallon of Tarvia "B" was evenly distributed over the surface and broomed out with hand brooms where necessary. After an exposure of several hours this surface was lightly covered with a drifting of sharp, clean sand and the street thrown open to traffic. The initial cost of this treatment was 3 7/10 cents per square yard. The traffic there is more than ordinarily heavy, the street being the outlet for several foundries. Notwithstanding this, the street has been maintained for two years without other maintenance than the annual application of Tarvia "B."

Fig. 3.—Rolling a Tarviated Macadam Road Constructed by the Mixing Method.

In new construction there are two distinct methods of application—the penetration method and the mixing method. In the former the tar binder is applied by hand or machine to the stone in place on the road, while in the latter the stone and binder are mixed together, like concrete, and then the mass deposited and the road rolled. (See Fig. 3).

Early Street, Morristown, N.J., is an example of the penetration method of construction of a 6-inch tarviated macadam in which Tarvia "X" was used as a binder. The method employed in the construction of this street was as follows: First, the road bed was carefully prepared, and, after being brought to grade, thoroughly rolled. Four inches of crushed stone of the 1½-inch size was then placed upon the road and likewise rolled until there was no perceptible movement beneath the roller. Over this was placed two inches more of the same size stone, and these again rolled. Tarvia "X" to the amount of one and one-half gallon to the square yard, heated to a temperature of 250 degrees Fahr., was then poured by hand from suitable sprinkling cans upon this prepared surface, after which clean screenings were drifted over the surface of the road in sufficient quantity to fill the voids without leaving any excess material. The road was then again thoroughly rolled and the second coat of Tarvia "X," from one-half to three-quarters of a gallon per square yard, poured over the surface. Over this finally was placed another coating of screenings and the road thoroughly rolled to a finish.

The entire cost of laying this pavement, including all the gradings, was 78 cents per square yard. Early Street was paved two years ago and is at present in good condition.

In passing it may be of interest to note that the cost of removing Tarvia from the package and heating it to the required temperature is about one and three-fourth cents per gallon less than the cost of the same operation with asphalt binders.

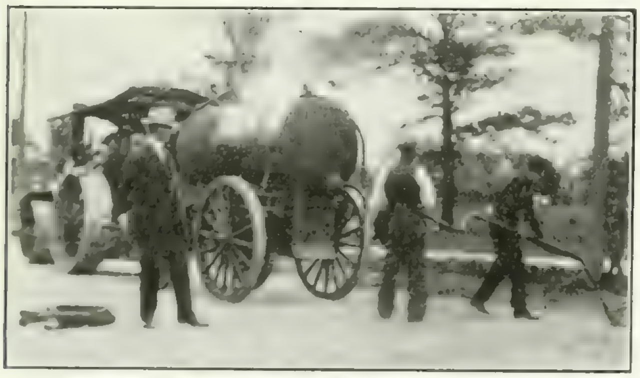


Fig. 4.—Tarvia "X" Being Distributed from a Tank Wagon Fitted with a Fire Box and Hose Attachment.

Tarvia "X" can be quite readily transferred from the barrel when one head is removed, and if reasonable care is exercised it is not necessary to destroy the barrel.

The distribution of Tarvia "X" from a tank wagon fitted with a fire box by means of a hose attachment is shown in Fig. 4. In this operation the Tarvia is heated in the tank car, drawn off into the tank wagon, which has a capacity of [illegible] gallons, attached to the steam roller and drawn to the point of operation. Steam connection is made between the roller and the tank wagon and the Tarvia forced from the tank through the hose under a pressure of about 15 pounds. This method is recommended as being more efficient and economical than the use of hand distributors.

The mixing method [illegible] is favored by many [illegible] than the penetration method. The materials are either mixed together by hand or by machine. In the case of hand-mixing, Tarvia "X" heated to 250 degrees Fahr., using from [illegible] gallons to the cubic yard of stone, is thoroughly mixed by hand upon a mixing board and placed upon the prepared road bed to the required thickness. The mixture is then leveled off with hand rakes, the voids filled with screenings, and the whole thoroughly rolled. Over this again is poured, as in the previous operation, the required amount of Tarvia. The second coat of screenings is then applied and the road rolled to a finish.

The method employed in machine-mixing was used recently in the construction of Park Avenue, Newark, N.J., which was built by the Essex County Park Commission. Crushed stone is loaded into the hopper, which is then lifted to an elevated position and its contents delivered into the drum of the mixer, where it is heated. After the stone is thoroughly dried and heated to the desired temperature, Tarvia "X," which has been previously heated in an ordinary heating tank, is also mechanically lifted and deposited upon the stone in the mixer. The stone is then thoroughly coated with the Tarvia, after which it is dumped into wheel-barrows and carried to its destination. The evidences are that this is destined to become a very popular method for the construction of bituminous macadam roads, and the experiences of those who are familiar with this machine would lead us to believe that it is well adapted to this work.

The asphalt bound macadam is built by using these same methods of construction (with the exception that heavy asphalt is used instead of tar as a binder). Many types of new roads have been experimented with during the last few years—with the view of solving the problem of an automobile-proof road without going to the heavy expense of a permanent pavement. One of the latest additions to the list is known as "Dolarway Pavement." This consists of a carefully laid concrete base, usually six inches thick, of not less than 1:3:5 mix, with expansion joints approximately every 25 feet. Upon this prepared concrete base there is placed a thin coat of Dolarway bitumen which is broomed out with a horse sweeper. This method of construction has been thoroughly tried for several years, and the evidences are that in the near future it will become very popular. This pavement is low in the first cost, dustless, resilient, economical to maintain, and, in fact, has all of the virtues of the best types of permanent pavements in use to-day without any of their disadvantages.

◆

TESTS OF CROSS-ARMS.

The Department of Agriculture, Forest Service, has recently been conducting some strength tests of cross-arms and results are embodied in Circular 204, just issued by the department. The material tested includes practically twelve cross-arms of each of the following seven groups: Douglas fir, shortleaf pine, longleaf pine, graded by the manufacturers as 50 per cent. heart; longleaf pine, 75 per cent. heart; longleaf pine, 100 per cent. heart; Southern white cedar, and shortleaf pine, creosoted. Each of these cross-arms was tested in a 200,000-lb. Richle universal testing machine. The comparative strength was as follows:

	Average Maximum Load.
Longleaf pine, "75 per cent. heart"	10,180
Longleaf pine, "100 per cent. heart"	9,780
Shortleaf pine	9,260
Longleaf pine, "50 per cent. heart"	8,080
Shortleaf pine, creosoted	7,650
Douglas fir	7,500
White cedar	5,200

A summary in the report concludes with the statement that, all things considered, cross-arms of the species and dimensions tested are strong enough for ordinary use; with longer arms the strength is relatively of much more importance. With the standard cross-arm, however, the question of strength need not enter into calculations of line construction, except in the rare case of abrupt change in grade. The ability of the timber to resist decay and methods of preventing decay are considerations of greater importance.

CONCERNING WEB STIFFENERS.

It is easy to say that the function of a stiffener is to prevent buckling of a plate girder web, and that it must be designed to accomplish this purpose. But when one attempts to summarize one's ideas as to how this shall be done one finds that the fund of accurate information concerning stiffeners is meagre. The actual design is accompanied by so many assumptions as to make one who inclines to theory rather than experiment somewhat sceptical of the results obtained. Notwithstanding the indeterminate character of the action of stiffeners of loaded plate girders, it is satisfying to know that failures of web stiffeners are very rare, and that those that have been known to occur are of such a nature as to cause no other serious consequence than slight inconvenience and expense of repairs. But many tons of steel are used annually in stiffeners, and the subject is therefore one that merits more study than has been given it, says the "Engineering Record."

Web stiffeners are used at concentrated loads for the double purpose of transferring these loads from the flanges into the web and to prevent the web from buckling under the compression, and they are also used at intermediate points between concentrated loads solely to prevent buckling of the web. The sizes of these intermediate stiffeners are nearly always assumed, but their spacing—that is, the horizontal distance from one set to the next—is now quite generally determined by a formula based upon compression in the web. resulting from the shearing forces acting upon it. Some important specifications still use the arbitrary method of spacing intermediate stiffeners at horizontal distances not exceeding the depth of the girder, even though this rule has practically no reason for its existence. Since the tendency of a web to buckle must be due to the compression acting within it, and since this compression is a direct function of the shearing force on the web, it seems perfectly clear that the method used for spacing intermediate stiffeners should bear some relation to that shear; that, other things remaining the same, the greater the shear the closer together should be the stiffeners.

There seems to be a deep-seated conviction that intermediate stiffeners must be fitted accurately at both top and bottom flanges, for by being so arranged they add strength to the girder in some mysterious way. It is readily seen that if fitted to a compression flange, stiffeners might act to a limited extent as braces to this flange, and hence the expense of fitting them might be justifiable; but when one looks for a reason for fitting them to a tension flange it is not forthcoming, except it be in the desire to secure a tight fit for the sake of appearance, or to eliminate small openings wherein painting is difficult. Of course, it is perfectly right to insist on close fitting at flanges for either of these two reasons, but let us not deceive ourselves into thinking that intermediate stiffeners must be fitted to both flanges to add strength in some unknown manner.

Stiffeners at such concentrated loads as bearings and columns should be, and usually are, designed as columns, and sufficient rivets should be placed in them to transmit the proper forces between stiffeners and webs. Determining the cross-sectional area of a set of stiffeners under a column load or over an end bearing by applying the ordinary column formula is on the side of safety, for this process assumes the stiffeners to have their maximum compression throughout their entire length, whereas the stress diminishes from the maximum at one end to zero at the other. In this respect, therefore, the ordinary stiffener at a concentrated load differs from a column, because in the latter the loads are applied at the ends, and column formulæ as generally used apply to this case only.

Consider the stiffeners under a column which rests upon the top flange of a plate girder. The entire column load is transmitted first to the top flange, then to the outstanding legs of the stiffeners under the column. The outstanding legs must be carefully fitted, and must be of sufficient area to give proper bearing against the horizontal legs of the top flange angles. The stiffener legs lying against the web transmit very little or no stress from the top flange, because they are sheared or ground to fit the curved fillet of the flange angles, and should be neglected in determining the required area for bearing at the top flange, and it is for this reason that only the outstanding legs of stiffeners should be relied upon to transmit the column load from the inside of the top flange angles. When the stress has thus entered the outstanding legs, these legs are thrown into compression, and until a portion of this stress is transferred to the legs lying against the web, the comparatively thin projecting legs must be able to sustain this comparative stress without buckling.

It is just here that a link in the chain is usually overlooked, for this buckling tendency is ordinarily not considered, even though the bearing against the flange may be carefully provided for. As the stress becomes distributed over both legs of the angle stiffener, column action is approached, and for this reason a column formula is applied to determine the gross cross-sectional area of the two legs of the stiffener. In the case here supposed—that is, the case of a stiffener under a column,—the maximum stress exists only for a short distance down from the top, for the uppermost rivet in the stiffener transmits its quota of stress from the stiffener into the web, and each succeeding rivet further diminishes the stress until at the bottom the stiffener has no stress at all. Consequently, when stiffeners are designed as columns having the full stress through a length equal to the girder depth, they are on the side of safety.

It is apparent, then, that if the bearing of the outstanding legs be sufficient to transfer the column load from the top flange, that if the cross-sectional area of the stiffener angles be large enough to satisfy the column formula, and that if the rivets be the correct number, there still may be a weak link in the design if the buckling of the outstanding leg at the top be overlooked. An interesting case of this buckling occurred a few years ago at the Union Street drawbridge in Salem, Mass., U.S.A., This was a deck plate girder highway swing bridge, with a centre bearing having the entire revolving weight suspended from the centre casting by means of a series of round rods which were attached at their ends to the top of the centre casting. The rods passed through holes in the distributing girder flanges, and their lower ends engaged in nuts bearing against the bottom flanges of the distributing girders. This arrangement resulted in a series of large concentrated upward forces on these flanges, and a set of angle stiffeners were used for reinforcement at each rod. The outstanding legs of these stiffeners were too thin. and they buckled, the buckling being confined to the lower 8in. of each stiffener. As a consequence of the failure of these stiffeners, the drawbridge settled vertically to such an extent that its operation was almost impossible because of frictional resistances at the abutments. The Salem case made an everlasting impression on the engineers who had anything to do with it, for local column action of the outstanding legs had been manifestly overlooked in the design.

The brief analysis here given indicates that the designers should investigate four things in connection with stiffeners at a concentrated load:—

First, the bearing area of the outstanding legs should be sufficient to transmit the column load from the flange.

Second, the thickness of the outstanding leg should be sufficient to prevent buckling of this leg.

Third, the entire cross-sectional area of the angle or angles should be sufficient to carry the load as a column having a length equal to the depth of girder.

Fourth, enough rivets must be placed in these stiffeners to transmit their stress into the web.

The action of stiffeners over an end bearing of a girder is similar to the case here considered, unless there be on top of the girder a column load. In the latter case the stiffeners must not only transmit the shear from the web into the end bearing, but they must also carry the column load from the top flange of the girder to the bearing. While the principles involved in the two examples are the same, their application is slightly different.

* * *

A NEW AUSTRALIAN DAM.

The cabled announcement of the formal opening of the Burrinjuck Dam in New South Wales, and the irrigation scheme for which it is to supply the water, is a more than ordinarily interesting event in Australia's domestic history. Burrinjuck is not as large as Assuan Dam, but it is the second largest dam in the world, and it certainly rivals the great Egyptian work in picturesqueness. It is set in between two steep granite hills that rise from oposite sides of the Murrumbidgee River. These mountains are about 2,500 feet high and form the gateway to the long and winding gorge, rugged and rocky, through which the upper Murrumbidgee flows for about 200 miles.

The dam, set in the neck of the gorge, will ultimately rise to a height of 240 feet from the foundation level—ultimately, for the engineers have decided that the irrigation scheme can be started with the dam at only about half the height it will have reached when the entire area is ready to be watered. The areas immediately adjacent to the Yanco diversion channel can easily be served with the dam at a height of only 120 feet, and this land is the portion now formally opened. The dam is expected to reach its full height some time next year. The retaining wall will then be 240 feet high, 784 feet long (curved in plan to a radius of 1,200 feet), with a breadth of 170 feet at the base and 18 feet at the crest. It will back up the waters of the Murrumbidgee for 45 miles in the long gorge, and create an inland sea among the mountains of 20 square miles in area and over 33,000 million cubic feet in content—nearly half as big again, say the mathematicians, as Sydney Harbor. It is calculated that on the average flow the Murrumbidgee will take a year to fill the Burrinjuck reservoir.

From Burrinjuck the water is, under regulation, allowed [illegible] to Berembed Weir, near the town of Narrandera. From Berembed the diversion canals reach out. The Berembed Weir and lock have [illegible] a main diversion canal, now nearly completed to its full length, runs out straight in a north-westerly direction for 132 miles to [illegible] rivers and the canal is to receive particular attention from the irrigationists, but subsidiary channels stretch out to the east [illegible] and, finally, when the northern irrigation scheme is in full [illegible]

THE ATTITUDE OF THE RAILWAYS TOWARD FOREST FIRES.*

E. A. Sterling, F.E., Forester, Pennsylvania Railroad Company.

"Railroads" and "unknown origin" are the two headings under which the causes of a large majority of our forest fires are listed. Even after allowing for inaccuracies in the records, the number of fires resulting from railroad locomotives is unquestionably large. The attitude of the railroads towards the forest fire evil, and the possibilities of reducing this particular source of danger, are therefore questions of interest and importance.

While the railroads for many years have, perhaps, shown too little interest in forest protection, it must be remembered that indifference has characterized most of the other interests, from the Government down to the smallest woodlot owner. The railroads could hardly be expected to worry about forest fires when the States through which they ran had neither laws nor organization to prevent or fight fires. So many of the developments tending toward the solution of forest problems have not taken place until recently, that criticism of any particular interest reflects discredit on all. Practically all of the definite accomplishments in forestry, both in Canada and the United States, have taken place in the last ten years, and the greatest achievements are less than five years old.

Under the latter, the beginning of effective fire protection stands out prominently. Our forests are still far from safe, but Federal, State, and private activity has paved the way, and another decade should remove the fire menace from our remaining forests. In this work, which must be co-operative to succeed, the railroads are doing their full share.

Certain basic causes must underlie any given set of conditions. If the railroads have been the too frequent cause of forest fires, there are various reasons why this has been true. First of all, no spark arresters have been designed which will eliminate flying sparks under all conditions, and at the same time give the locomotive free draft. While the various devices in general use greatly reduce the danger from this source, the fact must be accepted that there are certain mechanical difficulties which have not been entirely overcome.

If it is recognized that sparks capable of starting fire reach the ground, the next logical step would be the removal of inflammable material from the right-of-way. It is easy to advise this, or even to legislate to this end; but to the comparatively new roads which have pushed into the forest regions, the expense of a fireproof right-of-way is a very serious consideration. Most of the main trunk lines now clear their right-of-way twice a year, but this is by no means a guarantee against fires from locomotive sparks. The strip of property owned by the railroads is too narrow for a safe fire belt. Adjoining property offers quite as great a menace, so that, even if the railroads kept a right-of-way of fresh mineral soil, live sparks might easily start fires in the slashings and accumulated litter on adjoining property over which they have no control.

A[illegible] other consideration it may be mentioned that [illegible] the railroads shared in common with the public the attitude of calm indifference as to what happened to our forests. Corporations occasionally lead in developing public sentiment; more frequently they are guided by it. The man [illegible] is hardly awake to the importance of forest protection, [illegible] the railroads are taking the matter [illegible] in advance of public sentiment.

---

*Paper read before Canadian Forestry Association, February [illegible]th and [illegible]th, [illegible]

The fair analysis of the situation reveals several reasons why the railroads have been either the primary or the indirect cause of many forest fires. No reasons can be found, however, for the railroads deliberately,permitting or desiring to start fires, although such is often the popular conception of the matter. From many standpoints the railroads are the heaviest losers when a forest area burns. It takes away tonnage, both present and future; reduces summer tourist travel; and, unless the region is developed for agriculture, merely furnishes ground on which to run tracks between more productive points. Damage claims follow every fire, and alone are enough to bring about any protective measures within reason.

The past gives us little of which to be proud, so it is best to forget, save as a lesson, the semi-annual pall of smoke which has marked our forest fire losses. If we date our history some two or three years back, we can find basis for a future of greater promise. In the United States, no one factor in forest fire prevention can be mentioned without including others. The Forest Service set the pace in the systematized fire work on the national forests; while the States, the timberland owners, through their forest protective associations, and the railroads followed. To-day all are working together in closer co-operation than was ever believed possible, and the results from only two years of combined efforts are most encouraging.

To tell specifically what the railroads are doing would occupy too much time. Briefly, the measures which are proving most effective are the removal of combustible material from the right-of-way, systematic reporting of all fires which start, and prompt action in extinguishing them, regular patrol during dry seasons, use of oil-burning engines in forest regions, wherever practicable, and the keeping of spark arresters and ashpans in good condition. The clearing of land adjacent to the right-of-way is a very important development, which is permitted in Massachusetts and required by New Jersey, the latter providing for a 200-foot strip between the outer rail and a 10-foot fire-break. About 235 miles of such fire-breaks have been constructed during the past two years, with the result that the number of fires has been very greatly decreased. Where the Northern Pacific and Great Northern Railroads traverse National Forest land, 200-foot strips are cleared and maintained under a co-operative agreement between the railroads and the Forest Service.

The systematic patrol of the railroads, particularly under the direction of the State forest officials, is proving a valuable fire preventive measure. Minnesota provides for this in the new forest law; New York has required the patrol of railroads in the Adirondack region; while the Maine Central has provided a voluntary patrol. In the West, the Forest Service co-operated with the railroads in patrol work, most of the patrolmen being on the Government rolls, because of the protection afforded adjacent forest land.

The use of oil-burning engines is required by law in New York State from April to November on all roads traversing the Adirondack forests. This, however, puts a heavy burden on the railroads, and is hardly a fair or practical measure in regions remote from sources of crude oil supply. Two transcontinental roads, after extensive experiments, have voluntarily installed oil-burning engines on divisions traversing the National Forests.

The Pennsylvania Railroad and other roads operating in the more thickly populated Eastern States have to contend mainly with small fires started in woodlots, stubble fields and second-growth woodlands. These fires rarely assume serious proportions, and are guarded against by the trackmen and other employees, all of whom are under definite instructions to report fires and promptly extinguish those which start. Only one fire was reported by the State fire wardens as having been caused by the Pennsylvania Railroad during 1911, and this, upon investigation, was found to have occurred beyond the possible range of live sparks.

A striking summary of the railroad forest fire problem and most excellent recommendations for fire control were passed as resolutions at the Forest Fire Conference in Portland, Oregon, in December, 1911. It would be impossible to do better than close by quoting these resolutions:—

Whereas, The protection of the timber resources means: The stumpage value to the timber owner of approximately $2 per M. feet B.M., employment and remuneration to the wage earner of approximately $8, tonnage to the railroads both in supplies, equipment, and forest products approximately $6 to $8 per thousand, benefits to the farmer and merchant through the use of supplies, an insurance of community prosperity and the general public welfare; and,

Whereas, It is recognized that the railroads operating in forested regions are a source of fire danger menacing the preservation of this resource for use; and,

Whereas, The danger from forest fires is common to all and co-operation is necessary to meet this danger; now, therefore,

Be it resolved, That in order to secure the best results this co-operation be systematized along the following lines:—

1. Clearing up rights-of-way of railroads of all combustible material on ground; not necessary to take down trees or take out stumps unless punky, rotten or hollow.
2. Establishing efficient patrol of tracks during dry seasons, both night and day.
3. Increase efficiency of spark arresters and transforming of all engines being operated through timbered districts to oil-burners as far as practicable.
4. More strict enforcements of orders that steam be turned on all ashes dumped from engines. Stringent enforcement of orders that no ash-pans be dumped while train is in motion.
5. That orders be given expediting the furnishing of men from road gangs and section crews.
6. Reports of all fires by all train crews at first telegraph or telephone station.
7. Sharing expense of patrol by railroads.
8. That association, Federal and State organizations furnish their regular employees within their respective territories to assist in fire patrol.
9. That authentic information of the condition of railroad rights-of-way, the methods used under different conditions, and of all fires originating on or adjacent to the right-of-way be obtained by Federal, State, and private organizations in order to present definite data to effect improvement in methods.
10. That this situation be kept before the railroads, the organizations interested in fire protection, and the general public, in order to ensure a practical working out of these recommendations.

I have been asked to say a word in addition as to what the Pennsylvania Railroad is doing in relation to forestry The main line of the Pennsylvania Railroad runs through a hardwood country, mostly second-growth hardwood, where the lumbermen, in the early days, took off most of the valuable timber. The railroad has some thirty thousand acres on which a start has been made in exploiting the timber on a commercial basis. Work has been done on some fifteen properties, and after our logging operations these properties are in a much more productive state than before. The work has been done on a much more economical basis than by lumber companies in Pennsylvania, and the net profits have been approximately $10 per acre. This has been done by finding a market for the products that the lumbermen are unable to sell.

On the technical end we were very careful to cut with reference to a future crop. We found a market for everything produced, and I think the forest has been left in as good shape as is possible in view of the timber being taken off. Utilization has been carried to the finest point, practically everything, even down to the charcoal wood, being cleaned up. We have revived the charcoal industry, and are burning charcoal on old hearths that were abandoned so long ago that six to eight-inch trees are growing up through the centre of them. The question of forest utilization is closely allied with the water supply problem. Therefore, we have had to modify some of the cutting in reference to the water-supply end of the question.

In planting and nursery work, the policy is to plant about a million trees a year. We do not always reach that, and I am not sure that it is advisable. It is a question as to how extensively a corporation should engage in forest planting. This is not what I would be expected to say, perhaps, but I believe that for most Eastern railroads the purchase and long-time management of timber lands is more profitable than planting. Forest planting, from a general standpoint, is very important. The road is trying to teach the farmers to plant waste lands, and also how to handle their wood lots. This coming spring seedlings are to be offered from the company's nursery at practically cost price. How great the demand will be I do not know, for there has not been very much enthusiasm about forest planting because there has been so much second-growth forest land.

Another point is that of fire protection. On the properties which are being logged and planted we have done the usual things in the way of fire protection, with which you are familiar. General instructions have been issued to all trainmen with regard to fire. Recently these instructions were summarized and distributed in booklet and placard form to employees, and also to the farmers along the line. I think the people are pretty well aware that fires are something we do not want.

As to preservative treatment of timber against decay, I think that is more important than planting; I do not know that it is more important than lumbering. It means a good deal in a hardwood country like Pennsylvania, because we have non-durable woods, such as beech, birch and maple, which are now being converted into ties. When these woods are treated with creosote they give better life than the durable and more expensive species, such as white oak, which are used untreated. The railroad treats the equivalent of a million and a half ties a year. By treatment these million and a half ties will last three times as long as they otherwise would, and practically cut down the drain on our local forests to that extent. The railroads, however, are not in the treating business for the purpose of helping the forests, but to save money. Still, wood preservation, in my opinion, is an important factor in the line of forest conservation.

All these specific things the Pennsylvania Railroad and other railroads are doing; but with the exception of the [illegible] Railroad, so far as I know, they are not tackling the major problem, which is that of timber supply. The railroads are continuing their consumption of timber every year, but they are not [illegible] a thing to provide for their demands ten or fifteen years hence. The [illegible] Railroad [illegible] and it has bought land in the South with a view to [illegible] a supply for both the present and the future.

[illegible] the railroads and other large wood-consuming corporations [illegible] It certainly [illegible] of their [illegible] wood [illegible] The planting of trees will not of itself meet the problems for each corporation. We could plant ten million trees a year, but that would not save the day, because the trees would not mature in time. And, what is more important, it will cost more to buy open or cut-over lands locally and plant them than to go into the South and buy mature timber. That can be proven by figures.

It seems to me that the logical thing, the step that will make forestry permanent, is for the consumer to get into the timber-producing business. But this has not been done. It seems to me that one reason for the present do-nothing policy is that the higher officials, the men who really run the railroads and control the finances, are enthusiasts along other lines than that of wood-production. They do not see why they cannot buy ties just as they buy rubber bands. They have been told that difficulties would come, but an idea like that does not sink deep into minds which have developed with other ideas. Other interests, other problems, other policies command attention, and it is a hard job to make these people see that they are going to find they will be in difficulties for wood. Yellow pine ties have increased in price at the rate of three cents per tie per annum, but that does not necessarily mean anything to a purchasing agent, general manager, or president. The fact that tie renewals will cost a few hundred thousand dollars more a year is not overshadowing in importance; it will simply be made upon something else. But this problem may come with a rush. I hope it does, because I believe it will be the greatest thing for forestry that ever happened. The steel tie may come, but that is really not part of the problem.

I merely wish to call your attention to the big wood supply problem that the railroads are facing. They are doing their share along the ordinary lines of fire protection, planting, wood preservation, etc., but the other things, the big problems of wood supply for the consumers of the future, remain unsolved.

◆

THE CASTING OF A LARGE BED-PLATE.

The Mesta Machine Company, Pittsburg (U.S.A.), recently cast an engine bed, the net weight of which was 120 tons. The casting is one of the bed-plates for an engine that is being built by the Mesta Machine Company, and which will be installed by the Youngstown Sheet and Tube Company, Youngstown, for operating its blooming mill. As 130 tons of metal were required to pour the mould, the iron was tapped simultaneously from five air furnaces, each furnace having been charged with iron of the same average analysis. The melting of the metal was so regulated that all of the furnaces were ready to tap at approximately the same time. The metal was tapped into six ladles, four of which were poured at one time, and, after these were emptied, the contents of the remaining two ladles were poured into the mould. Binders were placed across the mould throughout its entire length, and these were held in position by rods extending through the bottom plate. Bottom-pouring ladles were used, such as are generally employed for casting steel. This large mould was poured in an exceedingly short period, as only [illegible] minutes elapsed from the time when the metal was tapped into the ladles until the mould was filled. The casting was allowed to cool slowly in the sand for a period of 16 days. The removal of this casting from the pit presented an interesting problem, owing to its great weight, which, including the cores, must have approximated more than [illegible] tons. The sand was first removed from around the sides of the casting, and each end was gradually raised until the entire casting was clear of the pit. This permitted the removal of the cores and facilitated the subsequent handling of the bed-plate.

THE STRENGTH OF CONCRETE POLES.

Tests on reinforced concrete poles were recently conducted by the Carnegie Steel Company at its plant in South Sharon, Pa., with the view of determining the relative cost and strength of that material as compared with wood for such construction. The poles tested were 32 ft. long, 10 in. square at the butt and 6 in. square at the top. All corners were bevelled and iron steps bent up ¾ in. were inserted in the forms before placing the concrete. The mixture used was 1 part of Universal Portland cement, 2 parts bank sand, passing ¼-in. screen, and 4 parts crushed limestone, passing a ¾-in., but retained on a ¼-in. screen. About one barrell of cement, ¼ yd. of sand and ½ yd. stone were used in the construction of each pole.

The reinforcement consisted of four groups of twisted rods at the corners placed not less than ¾ in. from the surface. Each group was made up of one ½-in. rod 32 ft. long, two ½-in. rods 24 ft. long and 3/16-in. rods 16 ft. long. The reinforcement was thus proportioned to the decreasing stress toward the top of the pole. Sheet steel separators held the reinforcement in place and were cut away to avoid breaking the continuity of the concrete above and below the separator.

The forms used consisted of an upper and lower section held together by bolts, the lower being a single pieces while the upper was made up of a series of units beneath which the concrete was forced. The poles thus made weighed about 2,500 lb., or five times the weight of a wooden pole of the same length.

The tests were conducted with two concrete poles and a 32-ft chestnut pole under the same conditions. It was found that poles of wood showed practically the same deflection as those of concrete up to 2,000 lb., the load being applied at right angles to the pole and at the top. The deformation at 2,000 lb. amounted to 25⅝ in., this loading being far greater than could ever be experienced in actual use. For deflections of less than 15 in. the concrete pole showed no permanent set. The test on one of the poles was carried to destruction and failure resulted at the point where the 24-ft. reinforced rods ended, the concrete being crushed for about 3 ft. above and below the break.

The results obtained showed that the cost of manufacture of such poles should be from $7.50 to $10, as against $4 to $5 for a wooden pole. The cost of wood poles is thus from one-half to two-thirds that of the concrete poles and their life of usefulness is from ten years to a maximum of twenty, whereas the life of a concrete pole is practically unlimited.

◆

METHODS AND COSTS OF APPLYING STUCCO WITH THE CEMENT GUN.

The cement gun is being used a good deal on construction work of different kinds. The methods and costs of its use on certain work will, therefore, be of interest. Mr. R. C. Hardman, superintendent of construction in the U.S. War Department, in a recent issue of Engineering News, describes the use of the gun for placing stucco on the exterior of a small frame building, containing 631 square yards of surface and having 56 door and window openings. The methods and cost of doing the work, as outlined by him, are given as follows:—

The building, which is two stories high, consisted of a main front with two rear wings, in the space between which the gun was stationed, with the sand and cement storages immediately behind. The typical force in the operation of the gun was one man running the engine and gun, two men mixing and sacking dry material and charging hopper, one nozzleman, one laborer to help nozzleman, and two laborers cleaning grounds and screeding.

The entire building was first covered with cheese-cloth, then with a cheap grade of building paper secured by laths running vertically on the studs. This was then covered with mesh reinforcement secured by 1½-in. staples. Grounds were placed on alternate studs to give a stucco thickness of 1¼ in. The panels thus formed were filled alternately to within about ¼ in. of the face of the grounds. The grounds were then cleaned off with a small trowel and about thirty minutes later the stucco was brought flush with their face and screeded off. The screeding was done by unskilled Mexican labor with a straight-edge shod with steel. When these panels were set, the grounds were removed and the panels between were filled in the same way. The work was done in four sections vertically. The top section was done first so that falling material might find a lodging place below. When a section was completed it was lightly sprayed to secure uniform color and cover up joints. The mixture used throughout was one part of Portland cement to three parts of sand.

In shooting the mixture onto the wall the nozzleman stood so that the nozzle was from three to four feet from the wall, and kept the nozzle in continual motion so as not to pile up too much mortar in one place. In accordance with the principle of the device, the dry mixture was mixed with water at the nozzle. The amount of water used was just enough to keep the mortar below the running point. Water was delivered at about 40 lb. pressure. The air pressure used was 26 lb. A higher pressure than this caused too much waste of material (mostly sand) by rebounding and a lower pressure tended to clog the hose with dry material.

The apparatus consisted essentially of an engine, an air compressor and the "cement gun," which is a hopper, having a caisson lock, for receiving the dry material and from which it is forced through a hose to the surface to be covered. As used, the outfit comprised a 4-cycle, 4-cylinder gasoline engine, connected to a 2-cylinder single-acting air compressor by means of belt and pulley operated by a belt tightener. On the front end of the engine and operated by its flywheel was a small water pump for the engine water-cooling system. A second water pump attached to the compressor and operated by its flywheel was available for pumping water to the hose nozzle. Neither of these pumps was used, as the water pressure from the mains was sufficient.

Connected to the air compressor was the hopper or "cement gun" proper. This consisted of two connected air chambers—upper and lower—each closed at its top by a flap valve hinged to swing downward by gravity and closed by outside levers. The feeding mechanism, which consisted of a revolving slotted wheel, was at the bottom of the lower chamber and allowed the dry mixture to fall through and be forced through a hose, at the nozzle of which it was mixed with the proper amount of water.

In operation the lower chamber was first closed by its valve and filled with air. The dry mixture, which previously had been sacked for convenience, was put into the upper chamber, the upper valve closed and the air turned in. As soon as the pressure in the upper chamber equaled that in the lower the valve connecting the two chambers opened by gravity, allowing the dry mixture to fall into the lower chamber where the revolving slotted wheel allowed it to feed through into the hose connected to the bottom of the lower chamber under the feed wheel. When sufficient material had been forced from the lower chamber to allow its valve to be closed, the exhaust from the upper chamber was opened and the pressure reduced until the lower valve was held closed by the pressure in the lower chamber. The upper chamber was then again filled with the dry mixture, so that the feeding and discharge through the hose was continuous and uniform.

The feeding mechanism was operated by a paper wheel and friction disk controlled by a lever. The dry mixture passed through the feed wheel into the hose and was then picked up by air directly from the compressor and forced through the hose. The hose used was a 2-in. steam hose.

In the accompanying table is given an itemized statement [illegible]:

Table Showing Cost of Stuccoing 631 Square Yards of Surface With Cement Gun.

		Cost.	Cost per sq. yd.
Material for lathing:			
Cheese cloth, 631 sq. yd. at	$0.035	$22.09	
Building paper, 56.8 squares [illegible]	[illegible]	17.04	
Wire, 631 sq. yd. at......	0.1278	80.64	
Lath, 500 sq. yd. at......	5.25M	2.63	
N[illegible]	[illegible]	[illegible]	
Staples, 200 lb. at	0.0425	8.50	
		$131.30	$0.2081
Labor for lathing:			
Carpenters......... 16 hrs. at	$0.5625	$ 9.00	
Carpenters [illegible] 59 " "	0.50	29.50	
Carpenter helpers...144 " "	0.375	54.00	
L[illegible] " "	[illegible]	7.22	
Laborers, Mexican.. 41.5 " "	0.156	6.49	
		$106.21	$0.1683
Total for lathing		$237.51	[illegible]
Material for plastering:			
Portland cement, 65 bbl. at....	$3.43	$222.95	
Sand (at site)			
		$222.95	$0.3533
Labor for plastering:			
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
Laborers, mixing..212 " "	0.156	33.13	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]
Fuel:			
[illegible]	[illegible]	[illegible]	
Lubricants.......		4.00	
		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]

[illegible]

[illegible]

stopping, which has a tendency toward clogging the feed hose. Time was also lost by the wearing out of the feed hose about a foot from the hopper, due, apparently, to a whirling motion of the sand as it came from the hopper.

As has been stated, the gun was placed in a recess in the rear of the building so that the entire job was done without moving the plant. Fifty feet of hose was used and all parts were reached by running through window and door openings.

On the whole the apparatus is considered a success, certainly so if used on comparatively large surfaces where little changing of position is required. The quality of stucco secured is the principal argument in its favor.

OUR RAIL MILLS CAN HANDLE THE BUSINESS.

A despatch from Ottawa stated that importations of rails from the United States have been heavy and that Canadian mills could not cope with the demand. Mr. J. H. Plummer, president of the Dominion Steel and Coal Corporation, thinks otherwise. Interviewed at Sydney, he admitted an increased demand, but stated that if it had come to stay, the mills are well on the way to take care of it. It is not clear that the demand is permanent, he thinks. "There is a factor in the case naturally not known to the public. Rail contracts are made each fall for the whole of next season's requirements. The steel companies then proceed to make contracts for the balance of their output of steel. The present shortage represents demands which the railways did not foresee last fall, and it is useless to blame the rail mills. They could not afford to enter on the season's business with any considerable amount of steel unsold, and would be unable to take large extra orders for rails whatever their rail mill capacity might be.

"It is true that we are passing through a period of active railway building but that has been our condition for some years. The present output of 4,000,000 tons would lay over 3,000 miles of railway, and even in these days that represents great growth. In any case, so far from the steel companies being held up as having failed to keep pace with the requirements of the country, they are entitled to credit for having in the face of enormous and sudden growth in the demand for rails, been able to supply 90 per cent. of the consumption."

DIESEL OIL LOCOMOTIVE.

Much attention has lately been paid to the possibilities of the Diesel oil engine. So far it has not been used for locomotive purposes on road or rail, but, as was announced a few weeks ago, Dr. Diesel is at work with Messrs. Sulzer [illegible], of Winterthur, and Herr Adolph Klose, of Berlin, on a 1,000 to 1,200 h.p. Diesel locomotive. Steam locomotives have, of course, been made of much larger sizes, and the above engine will not, therefore, improve on its immediate predecessors in this respect, but it may be expected to show very large economies in fuel consumption. The Diesel engine proposed for this work is of the two-stroke cycle, four-cylinder type, having its cylinders arranged in pairs at an angle of [illegible] deg. The engine is directly geared to the driving wheels, and does not transform its power electrically. An auxiliary engine drives air pumps for giving increased power when starting or when climbing a grade. The whole is expected to weigh about [illegible] tons. It will be seen that this locomotive gives the most direct form of challenge to the steam locomotive.

BRITISH COLUMBIA ELECTRIC RAILWAY.

New rules promulgated by the government of British Columbia will mean that the British Columbia Electric Railway Company will have to invest considerable money in new cars before the first of 1911. The principal regulation is in regard to overcrowding. In Vancouver, particularly, all cars are filled not only in rush hours but also in the early morning. With the new law in force, not only will the company be liable if this continues, but also those who crowd the car after it has its maximum number of passengers according to law. To carry the passengers offering, the number of cars will have to be almost double what it is now. If passengers are not taken care of, there is a provision in the agreement with the city to be invoked.

After a fight of several months' duration, it looks as if Point Grey will come to the British Columbia Electric. The by-law passed by the ratepayers last January was quashed, and since then no cars have been running in Point Grey. There has been complaint from many ratepayers. Now it is proposed to re-submit the by-law to the ratepayers with the necessary alterations, and on September 7th, the voting will take place. With no cars running, building has not been so active in Point Grey as was anticipated early in the year, though the sections reached by the city cars have gone rapidly ahead.

CANADIAN NORTHERN RAILWAY AND VANCOUVER.

The Canadian Northern and the city of Vancouver are still negotiating about a location on False Creek, and it is probable that an agreement will be reached, for the railway wants to get a site for terminals and the city wants the railway. The railway is willing to recoup the city for the $600,000 necessary to extinguish certain riparian rights, the borrowing of which money was approved by the ratepayers two weeks ago. In addition, it proposes certain improvements. On the other hand, some of the aldermen favor a rental basis, suggesting $120,000 per annum, this being reached by a valuation of $20,000 an acre.

After a long rest, the canal project between the head of Burrard Inlet and Pitt River has been revived. This would give the world-famed Coquitlam a sort of direct water connection with the sea.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended August 21st:—

	1911.	1912.	Increase or decrease.
C. P. R.	$2,267,000	$2,694,000	+ $427,000
G. T. R.	[illegible]	[illegible]	+ [illegible]
C. N. R.	307,500	372,900	+ 65,400
T. & N. O.	37,499	31,899	— 5,600
Halifax Electric	5,706	6,308	+ 602

The gross earnings of the Canadian Pacific Railway for July, 1912, amounted to $12,052,399, the working expenses were $7,604,222, leaving as net profits $4,448,177. In July, 1911, the net profits were $3,703,028. The increase in net profits over the same period last year is therefore $745,1[illegible]

The statement of earnings and operating expenses of the Canadian Northern Railway Company for July shows an increase in net earnings over July, 1911, of $133,000:—

	July, 1912.	July, 1911.	Inc.
Gross earnings	$1,829,700	$1,475,900	$353,800
Expenses	[illegible]	[illegible]	[illegible]
Net earnings	464,600	361,600	133,000
Mileage in operation ..	4,297	3,711	586

CHEAKMUS RIVER POWER.

Messrs. Bloedel, Stewart and Welch, Limited, are applying for permission to develop a valuable water-power on the Cheakmus River, which empties into Howe Sound. The enterprise will be one of the largest of its kind in the province and if carried out will mean the expenditure of several million dollars. Messrs. Stewart and Welch are well known in Canada, being railway contractors, and the proposed power is located close to the route of the Pacific Great Eastern Railway, which will extend from Howe Sound to the north. Sufficient electrical energy may be generated to operate a large section of the railway and also for lighting and power purposes all through the district at the head of Howe Sound.

PERSONAL.

MR. R. F. PACK, general manager of the Toronto Electric Light Company, has tendered his resignation to the directors of that company.

MR. C. R. REDFERN has been appointed roadways engineer of the Department of Works, city of Toronto, in succession to Mr. A. A. Kinghorn, B.A.Sc., who has been appointed in charge of the day labor construction throughout the city.

C. H. C. WRIGHT, B.A.Sc., professor of architecture in the Faculty of Applied Science and Engineering, University of Toronto, has been elected recently a Licentiate of the Royal Institute of British Architects. It is not often this comes to a Canadian, and we congratulate Professor Wright most heartily on the honor.

MR. W. FRANK EVANS has been appointed manager of the new Concrete Reinforcement Department of Alfred Rogers, Limited. Mr. Evans will be remembered as the former chief engineer of the Expanded Metal and Fireproofing Company. He will attend to the sales of "Steelcrete" concrete reinforcement, for which Mr. Rogers has obtained the agency from the Consolidated Expanded Metal Companies of Pittsburg. Alfred Rogers, Limited, have already had extensive experience in concrete construction through the work of the cement sales department, which Mr. J. Lavelle has managed most capably ever since its organization some years ago.

W. FRANKLYN EVANS.

OBITUARY.

GEORGE HALSTEAD, professor of engineering in the Manitoba University, died at his South Lancashire home on August 28th. He became ill while crossing to England and died from typhoid fever.

◆

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer. John Keillor, Hamilton, Ont.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June. 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912 Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the [illegible]

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh [illegible] Headquarters McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

[illegible] ASSOCIATION.—President, Mayor [illegible], Hamilton; [illegible] St. Thomas, Ontario.

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible] J. Hingley, [illegible]

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon [illegible]

[illegible]

[illegible] MUNICIPALITIES.—President, [illegible] J. W. McCready, City [illegible]

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. [illegible]

[illegible] MUNICIPALITIES.—President, Mayor [illegible]

[illegible] MUNICIPALITIES.—President, Mayor [illegible]

[illegible] OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; [illegible]

[illegible] OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, [illegible] Man.; Sec.-Treasurer, Reeve Cardale, [illegible] Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer [illegible] Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. [illegible], No. 5 Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. [illegible] Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, [illegible], Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. [illegible]; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan [illegible], Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. [illegible], P.O. Box [illegible], Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
8-31	—Trenching and Backfilling, Edmonton, Alta. (S.)	8-8

(Canora specifications are also on file at the office of The Canadian Engineer, Rooms 617-628, Transportation Building, Montreal.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to. Tenders

Place of Work	Close.	Issue of.	Page
Belle Ewart, Ont., wharf and stone approach	Sept. 17.	Aug. [illegible]	[illegible]
Big Bay Point, Ont., wharf with stone approach	Sept. 17.	Aug. 28.	68
Craik, Sask., town hall, and skating rink	Sept. [illegible]	Aug. 29.	67
Dauphin, Man., superstructures of four bridges		Aug. 22	[illegible]
Dewdrop, Sask., schoolhouse and barn	Sept. 21	Aug. [illegible]	67
Edmonton, Alta., purchase of material at Goose Island, Alta	Sept. 4	Aug. [illegible]	
Montreal, Que., fire trucks and engine	Sept. 5.	Aug. 29.	[illegible]
Moncton, N.B., freight car repair shop	Sept. 12	Aug. 29.	[illegible]
Moncton, N.B., laying water mains	Sept. 1	Aug. 22	[illegible]
North Head, N.B., extension to breakwater	Sept. 12	Aug. 29.	[illegible]
Northern Ont., right to cut pine	Oct. 1.	July 25	68
Ottawa, Ont., designs for monument	Nov. 1	Aug. 1.	67
Ottawa, Ont., Hudson Bay Railway	Sept. 12	Aug. 22	[illegible]
Ottawa, Ont., iron posts	Sept. 25.	Aug. 22.	[illegible]
Ottawa, Ont., twin screw steel steamer	Sept. 2	Aug. 15	[illegible]
Ottawa, Ont., piping systems, etc.	Sept. 16.	Aug. [illegible]	[illegible]
Ottawa, Ont., timber for dredge and scows	Sept. 12	Aug. 29.	68
Owen Sound, Ont., retaining wall	Sept. 28.	Aug. 29.	68
Port Arthur, Ont., railway material	Sept. 2	Aug. 22	[illegible]
Port Arthur, Ont., heating and plumbing, school	Sept. 1	Aug. 22	68
Point Tupper, C.B., station	Sept. 4	Aug. 22	[illegible]
Quarantine Station, St. John, N.B., Houses	Sept. 5	Aug. 22	[illegible]
Regina, Sask., delivery of rock	Sept. 9	Aug. 29	[illegible]
Souris, P.E.I., breakwater	Sept. 11	Aug. [illegible]	[illegible]
Smith's Falls, Ont., wall	Sept. 14	Aug. 22.	68
Toronto, Ont., sale of Normal School property	Sept. 30	Aug. 15	68
Toronto, Ont., purchase of sheet steel mills and equipment	Sept. 11.	Aug. [illegible]	[illegible]
Timiskaming, Ont., purchase of plant	Sept. 10	Aug. 29	[illegible]
Tracadie, N.B., residence of Medical Superintendent	Sept. 11.	Aug. 29.	[illegible]
Victoria, B.C., breakwater, Victoria Harbor	Sept. [illegible]	Aug. 29.	[illegible]
Victoria, B.C., school	Sept. [illegible]	Aug. 29.	68

TENDERS.

Bassano, Alta.—The corporation of the town of Bassano, Alta., invite tenders for the construction of waterworks and sewers. Plans and specifications for contracts "A" and "B" may be obtained from the John Galt Engineering Company, Limited, Winnipeg and Calgary. Specifications for the supply of pipe and castings will be sent on application to the engineers. Geo. B. R. Bond, secretary-treasurer, Bassano, Alta. (See advt. in Canadian Engineer.)

Brandon, Man.—Tenders addressed to Mr. Harry Brown, City Clerk, City Hall, Brandon, will be received until noon of September 27, 1912, for the delivery of two return tubular boilers and stokers. Specifications, etc., may be obtained from A. W. Shaw, engineer, Brandon.

Fort William, Ont.—Tenders will be received at the office of the City Clerk until September 9th, 1912, for the construction of a concrete sewer on Stanley Avenue, from the Kaministiquia River to Superior Street. Plans and specifications at the office of John Wilson, City Engineer.

Franklin, Man.—Tenders for the construction of steel bridge across the Roseau River in township 3, range 4E, will be received until September 5th, 1912, by John R. Witty, Secretary-Treasurer, Municipality of Franklin. Plans and specifications may be seen at the office of the Minister of Public Works, or at the municipal office, Dominion City, Man.

Kingston, Ont.—Tenders addressed to the Director of Contracts, Department of Militia and Defence, Ottawa, will be received until noon of September 16th, for the construction of a model and gun shed at Royal Military College, Kingston. Specifications may be seen and full particulars obtained at the offices of the Officer Commanding the No. 3 Divisional Area and the Commandant Royal Military College, Kingston, Ontario, and of the Director of Engineer Services, Headquarters, Ottawa. (See advt. in The Canadian Engineer.)

Minnedosa, Man.—Tenders for the construction of a public building, will be received until September 12th, 1912, addressed to R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont. Plans, etc., at the office of H. E. Matthews, Esq., Superintending Architect of the Dominion Public Buildings in the Province of Manitoba, Winnipeg, Man.; at the Post Office, Minnedosa, Man., and at the Department of Public Works, Ottawa.

Montreal, Que.—Tenders addressed to the Board of Commissioners, City Hall, will be received until noon of September 10th, 1912, for the construction of sewers in the following streets:—Notre Dame de Graces Ward-Main sewer to Back River, first section. Westmount Avenue and Cote des Neiges Road, Mount Royal Ward. St. Andre Street, Via Jarry, 750 feet southwards. Plans may be examined, and all information obtained in the office of the Engineer Superintendent of Sewers. L. N. Senecal, Secretary, Board of Commissioners, City Hall, Montreal.

Oakville, Ont.—Tenders will be received by C. G. Mar[illegible] Chairman, Board [illegible] W[illegible]ers, Oakville, Ont., until September 12th, 1912, for an extension to the existing water [illegible] completed this season. Plans and specifications may be seen at the office of the Board, Oakville, or at the office of Messrs. Chipman & Powers, Engineers, Toronto.

Oshawa, Ont.—The Director of Contracts, Department of Militia and Defence, Ottawa, will receive tenders until noon of September 17, 1912, for the construction of a new drill hall at Oshawa. Specifications may be seen and full particulars obtained at the offices of the General Officer Commanding the 2nd Division, Toronto, Ont.; Officer Commanding "C" Company, 34th Regiment, Oshawa, Ont.; Town Clerk, Oshawa, and the Director of Engineer Services, Headquarters, Ottawa. (See advt. in The Canadian Engineer).

Port Colborne, Ont.—Tenders addressed to L. K. Jones, Asst. Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, will be received until September 20th, 1912, for the supply and erection of the steel superstructure of an addition to grain elevator at Port Colborne, Welland Canal. Plans and specifications of the work will be on view on and after September 7, at the office of the chief engineer, Department of Railways and Canals, Ottawa; at the office of J. A. Jamieson, designing engineer, Board of Trade Building, Montreal, and at the office of the superintending engineer of the Welland Canal, St. Catharines. (See advt. in Canadian Engineer.)

Port Stanley, Ont.—Tenders for dredging required here will be received until September 13th, 1912, at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, at which place combined specification and form of tender can be obtained.

Regina, Sask.—Tenders for the construction of powerhouse, laundry and refrigerating plants, Regina General Hospital, and addressed to the City Commissioners, Regina, will be received until noon of September 7th, 1912. Full particulars may be obtained upon application to Edgar I. Wenger, Consulting Engineer, Whitmore Building, Regina. A. W. Pool, City Clerk.

St. Catharines, Ont.—Tenders addressed to A. P. Friesman, Secretary of the Board of Water Commissioners, will be received until September 5th, 1912, for trenching and laying of approximately 7,300 lineal feet of 24-inch cast-iron water pipe. Plans, etc., may be obtained at the engineers' office. F. N. Rutherford, Engineer to the Board, 24 Queen Street, St. Catharines, Ontario.

Toronto, Ont.—Sealed tenders addressed to H. F. McNaughten, Secretary, Public Works, Ontario Department of Public Works, Ontario, Toronto, will be received until noon of September 9th, 1912, for all work excepting excavation required in the erection of the Veterinary College at the corner of University Avenue and Anderson Street, Toronto. Also for the heating, plumbing and ventilating of the New Government House, Chorley Park, Rosedale, and for the heating, plumbing and ventilating of the New Dormitory Building at the Institution for the Deaf and Dumb, Belleville. Plans and specifications can be seen at this Department and at the Institution for the Deaf and Dumb, Belleville.

Toronto, Ont.—Tenders addressed to G. R. Geary, Mayor, Chairman Board of Control, City Hall, will receive tenders until noon of September 10, 1912, for the complete supply and installation of a cast-iron sectional steam boiler in Police Station No. 1, Court Street. Full particulars may be obtained at the office of the Property Department, City Hall, Toronto.

Toronto, Ont.—Tenders will be received at the office of [illegible] Street E., [illegible]

Toronto, Ont. Tenders will be received by G. R. Geary [illegible] Property Department, City Hall, Toronto.

Vancouver, B.C. Tenders addressed to the City Clerk, [illegible] Pender Street West, Vancouver, B.C.

Vancouver, B.C. [illegible]

Victoria, B.C.—The Department of Public Works is inviting tenders for the construction of five reinforced concrete sluices in Coquitlam district, for a lock-up at Fort George, for the erection of an industrial school for girls in Hastings townsite, and for school houses at Martin Prairie and North Kelowna.

Victoria, B.C.—The time for the reception of tenders for the construction of the Victoria Harbor, B.C., breakwater, is further extended to Tuesday, October 15, 1912. R. C. Desrochers, Secretary, Department of Public Works, Ottawa. (See advt. in The Canadian Engineer.)

Weyburn, Sask.—Tenders for the erection of a telephone building on lot 10 in block 23, Weyburn, will be received until noon of September 4th, 1912. Plans, etc., at the offices of Messrs. Storey & Van Egmond, architects, Regina, and D. C. McNab, Deputy-Minister, Department Railways, Telegraphs and Telephones.

◆

CONTRACTS AWARDED.

Canora, Sask.—The North Western Electric Company of Regina, have been awarded the contract to install an electric light system in this town at a cost of $20,000.

Kingston, Ont. — The tender of the Ontario Asphalt Block Paving Company has been accepted by the municipal council, providing the company will give a guarantee that will be acceptable to the municipal engineer, Mr. R. J. McClelland.

Lethbridge, Alta.—Messrs. Navin Bros., of Moose Jaw, have been awarded a contract by the Dominion Government for the erection of a new post office in this city. The cost of the work is given as $326,000.

Montreal, P.Q.—Messrs. Ashmore, Benson, Pease & Co., Ltd., of Stockton-on-Tees, England, have been given an order by the Montreal Light, Heat and Power Company to supply and erect at their Outremont station a four lift gasholder of 3 million cubic feet capacity and a steel tank to contain the same. The tank is 184 feet in diameter and 31 feet deep, while the gasholder has four lifts and will be guided by steel lattice standards and girders. It is expected that the work in connection with the erection of the tank will begin some time this week. The foundations having been in the meantime prepared by the Montreal Light, Heat and Power Company. The Canadian-British Engineering Co., Ltd., of London, Eng., and Toronto, are the Canadian representatives for Messrs. Ashmore, Benson, Pease and Co.

Nelson, B.C.—Messrs. John Burns and Son have received the contract to erect a fire hall for the municipal council at a cost of $17,973. Other tenders and prices were:—J. Dancy, $18,974; and Waters and Pasco, $19,300.

Ottawa, Ont.—The contract for the two new fishery protective boats for the Pacific coast is expected to be given to the Dublin Dockyard Company of Ireland. Tenders were called for these vessels in April last.

Vancouver, B.C.—The J. J. Frants Construction Company have received the contract to erect a four-story brick and frame building on Powell Street at a cost of [illegible].

Vancouver, B.C.—Messrs. Wiles and Fisher, were the successful tenders on the contract to erect a two-story mill mill construction warehouse for Mr. J. Harper, of Kamloops. The plans include the installation of a hydraulic elevator and steam heating. The cost of this work is estimated at $16,000.

Vancouver, B.C.—Messrs. F. J. Kelly and Sons were [illegible] for the erection of a six-story apartment house by Mr. D. D. Hutchinson. The cost of this work will be [illegible]

Victoria, B.C. [illegible] have been awarded [illegible] Board of Education [illegible] School at a cost of [illegible] were received from Messrs. [illegible]

Victoria, B.C.—Messrs. Luney Bros. have been awarded [illegible] Other tenders and [illegible]

Isabella Street, Toronto, Ont., treated with Tarvia B.

Toronto's Experience with Tarvia

TARVIA is a dense, viscid coal tar product which retains its viscosity for months and years, despite exposure to weather and dampness. Used as a road binder, it cements the stone together in a tough, plastic matrix, preventing erosion by water or destruction by automobile driving wheels.

The net result to the road builder is a substantial reduction in average annual expenses: to the citizen the result is the abolition of the dust nuisance and a handsome, clean, mudless roadway.

Isabella Street in Toronto received thorough treatment with "Tarvia B" in the summer of 1911. "Tarvia B" is a tar product of such consistency that it flows readily without heat. The macadam was swept clean, "Tarvia B" was applied with a hose from a tank wagon and covered with sharp sand.

The "Tarvia B" filtered into the surface of the macadam and acted as a binder. The street then remained practically dustless the remainder of the season and still continues to be a beautiful bituminous surface.

Next summer probably another treatment will be desirable at a cost of less than three cents a yard and that will take care of the street for another season, making sprinkling unnecessary, abolishing the dust nuisance and preserving the road against the destructive action of automobile wheels.

This is not road repairing—it is genuine road maintenance. The adoption of this policy in any town means the preservation of the roads year after year in excellent condition at much less cost than with any other method of upkeep.

Booklet regarding Tarvia will be sent free on request.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

Winnipeg, Man.—The addition to the Industrial Bureau, now under construction, is being done by the James McDiarmid Company. J. D. Atchison is the architect. The cost is placed at $45,000.

◆

RAILWAYS—STEAM AND ELECTRIC.

Hamilton, Ont.—The management of the Canadian Pacific Railway has recently placed an order with the National Car Company to furnish 1,500 box freight cars.

Ottawa, Ont.—The Department of Railways and Canals have recently received the approval of the cabinet to purchase nineteen powerful locomotives for use on the Intercolonial in Eastern Canada.

Saskatoon, Sask.—Mayor Clinkskill has announced that after an investigation, conducted by himself, this city will save $8,000 per year in the operation of single truck cars in the place of double trucks on the new street railway system that is soon to be in operation in this city.

Vancouver, B.C.—The officials of the Canadian Northern Railway have formally requested the municipal authorities to turn over the ownership of False Creek. If the gift is made the railway agrees to spend the sum of $10,000,000 on reclaiming 200 acres of land and the erection of depot buildings with entrance work.

Welland, Ont.—The Canadian General Securities of Toronto, have received the sanction of the ratepayers to construct a street car line through a portion of their lands in the industrial section.

◆

LIGHT, HEAT AND POWER.

Edmonton, Alta.—The municipal commissioners have received a report from Mr. B. R. Campbell regarding a located natural gas well two and one half miles from the city limits. [illegible]

Canora, Sask.—The ratepayers recently endorsed the expenditure of $20,000 on a municipal electric light plant.

County of Bruce, Ont.—There is a movement on the part of certain residents of this country to induce the authorities to examine the power production possibilities of the Saugeen [illegible] r Rivers, as it is understood that some time must [illegible] the energy furnished by the Hydro-Electric Com- [illegible] l be offered for sale in this portion of Ontario.

Pense, Alta. A valuable flow of natural gas was located [illegible]

Stave Falls, B.C. [illegible] to the British Columbia Electric Com- [illegible] nish this extra output. Mr. C. H. Cahan, Mont- [illegible]

Victoria, B.C. [illegible]

Welland, Ont. [illegible]

GARBAGE, SEWAGE AND WATER.

Brockville, Ont.—A recent investigation of the drinking water by the Provincial Board of Health indicates that the water is contaminated. The citizens have been advised to boil that used for drinking.

Galt, Ont.—A large deputation of citizens from towns and cities near this point, waited upon Premier Whitney regarding a proposed commission to investigate the conditions along the Grand River, and prepare a report on the best manner of removing or remedying the evils of floods due to spring freshets. Mr. W. H. Breithaupt, Berlin, Ont.

Lindsay, Ont.—The municipal council have authorized the laying of a drain about 1,400 feet long. Tenders for the laying of the tiles will be called in a few days. Mr. Smith, engineer to the council.

Paris, Ont.—The municipal council have examined a sewerage system designed by Mr. Chipman, of Toronto. The estimated cost of this work will be about $40,000. The report and plans are to be considered by the committee of streets and sidewalks.

Pense, Alta. A tremendous flow of water was struck at this place recently when drilling operations had reached a depth of 1,500 feet.

St. John, N.B.—The municipal commissioners are considering the installation of an incinerator at a cost of $55,000. The mayor of this city has been authorized to enter into correspondence with a firm in New York who will supply this refuse burner at the price given. W. F. Murdock, city engineer.

Toronto, Ont.—The municipal Property Commission will proceed with the erection of a chlorinating plant inconnection with the septic tanks at Morley Avenue.

Victoria, B.C.—Plans for two garbage stations are completed and tenders will be called in a few days. These are to be erected at Spring Ridge and Fairfield. C. H. Rust, city engineer.

Victoria, B.C.—The Provincial Department of Public Works is inviting tenders for the construction of five reinforced concrete sluices in the Coquitlam district

Victoria, B.C.—Samples of water recently examined from Sooke Lake, the future source of water supply for this city, have shown that the organic qualities are well suited for the needs of a growing municipality.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Calgary, Alta.—The management of the Union Fibre Company, of Winona, Minn., U.S.A., will erect a branch factory in this city at a cost of $250,000.

Calgary, Alta.—The draughting department of the Can- [illegible] posed hotel to be erected in this city as a cost of $1,000,000.

Edmonton, Alta.—The Jesuit Order announces that it will found a college in this city. Father Jean and Hudon, of St. [illegible]

Edmonton, Alta.—The municipal commissioners are con- [illegible]

Fort William, Ont. The Berlin Bedding and Mattress [illegible] a plant, which received the sanction of the ratepayers at the [illegible]

Maisonneuve, P.Q.—[illegible] post office in this municipality. The Minister of Public Works, [illegible]

Moose Jaw, Sask. [illegible]

Niagara Falls, Ont. Messrs. Henry Hope and Sons, of [illegible] with the [illegible] the erection of a branch plant [illegible]

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded

**WOOD
STAVE PIPE**

**CONTINUOUS
STAVE PIPE**

**RESERVOIR
TANKS**

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

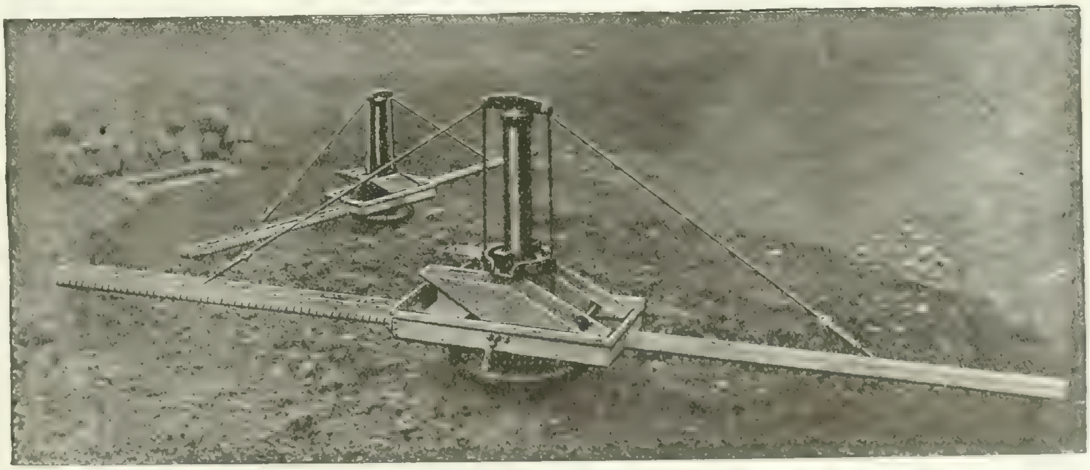
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

THE "IDEAL" DISTRIBUTOR
FOR BACTERIAL SEWAGE FILTERS

Just
a
Moment
Please
!
FACTS
Prove Them



AS A DISTRIBUTOR, gives an even and gentle distribution from the serrated edges of the arms.
AS A MOTOR, obtains greater power from the liquid head for propulsion than any other type of machine, and will revolve in any wind.
AS AN AUTOMATIC MACHINE, having no orifices to choke, does work for weeks without attention

SEWAGE LIFTS & EJECTORS

WRITE NOW FOR OUR NEW 140 PAGE CATALOGUE OF SEWAGE FITTINGS

PATENTEES & MANUFACTURERS **TUKE & BELL LTD.,** 69 LEADENHALL ST. LONDON, ENGLAND.

AGENTS FOR CANADA **LAURIE & LAMB,** ENGINEERS, MONTREAL

Niagara Falls, Ont.—The management of the Visor Knitting Company, of Niagara Falls, New York, will, in all probability, open a branch plant at this point in the old armory building. Considerable alterations will be necessary to the building.

Regina, Sask.—A report states that the management of the Canadian American Egg Company will establish a branch plant in this city. The members of this company state that they have received from Denmark particulars of a system that will keep eggs fresh for a period of two years. Mr. Hammer is president of this concern.

Township of Crowland, Ont.—Four industrial by-laws in connection with the Canadian Northern Steel Company and the Canadian Terminals, have been endorsed by the ratepayers.

Vancouver, B.C.—The management of the Woodward Department Stores have recently completed the purchase of a block of land and will erect a six story steel addition to their present building. Mr. W. C. Woodward is an official of this concern.

Victoria, B.C.—The Provincial Department of Public Works will call tenders for the erection of an industrial school, for girls, in the Township of Hastings, also for the erection of school houses at Martin Prairie and North Kelowna.

◆

BRIDGES, ROADS AND PAVEMENTS.

Kildonan, Man.—The council of this place are considering the erection of a bridge over the Red River, and should the ratepayers of Winnipeg endorse the purchase of a new exhibition site it is probable that the structure will be built. The estimated cost of the work is about $85,000.

◆

FIRES.

Montreal, P.Q.—About $60,000 damage was caused by fire to the plant of the sash and door factory of Mr. Walter Reed.

Newville, N.S.—The buildings and plant of the Newville Lumber Company, were destroyed by fire with a loss of $20,000. This place is ten miles from Parrsboro.

Peterboro, Ont.—An explosion at the plant of the Canadian General Electric Company caused serious damage. The sub-station was partially wrecked.

St. John, N.B.—The plant of the Wilson Foundry, owned by Hon. J. E. Wilson, and the plant of the Canada Brush Company, were destroyed by fire with a loss of about $100,000.

◆

CURRENT NEWS.

Edmonton, Alta.—The municipal council will request the [illegible] by-laws on September [illegible] for the purchase of a [illegible] in Woodward [illegible] for a telephone sub-station [illegible] and [illegible] for the establishment of a plant to manufacture, distribute, and supply gas.

Frank, Alta.—[illegible] at Ottawa [illegible] completed for [illegible]

Fredericton, N.B.—[illegible]

Halifax, N.S.—[illegible]

Medicine Hat, Alta.—Announcement is made of an appropriation to be passed at the next session of the legislature for the purpose of installing an automatic telephone system in this city. A new telephone headquarters is also included in the estimate. Mr. Harman, Deputy Minister of Telephones for Alberta.

Montreal, P.Q.—A report states that the large dry dock for this port has been shipped from the yards of the makers in England. If this is a fact the dock should be in position about October 1st next.

Ottawa, Ont.—For the construction of the proposed dry dock at Quebec, the Federal Government has received but one tender for the work and this is an offer to construct the scheme on a straight cash basis in place of the subsidy method as advocated by the Government.

Prince Rupert, B.C.—The management of the Canadian Fish and Cold Storage Company, Ltd., will, in a short time, have twelve new fishing boats for use in their business. The first of these is almost completed in Vancouver. The vessels will be 85 feet long, 18 foot beam and a depth of hold of 9 feet 7 inches and of schooner rig, equipped with 125 horse power gasoline engines. They will cost about $16,000 each. Mr. Geo. H. Collins is managing director of this company.

Province of Saskatchewan.—Engineers engaged on the Dominion Government work of surveying the Saskatchewan River for the proposed Winnipeg to Edmonton canal route have arrived at Prince Albert for the winter.

Toronto, Ont.—It is probable that the ratepayers will be asked to vote on the by-law calling for the erection of civic incinerators next January.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the Office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending August 19th, 1912:—

Inquiry is made by a London firm of mineral water manufacturers for the names of Canadian producers and shippers of apple juice.

A Lancashire correspondent desires to get into communication with Canadian firms in a position to export hard timber adze trimmed to 5-in. and 8-in. diameter, to cut into lengths of 2-ft. 4-in. to 2-ft. 8-in.; also timber adze trimmed from 24-in. diameter and to cut into lengths from 30-in. to 48-in.

A correspondent in the south of England makes inquiry for the name of a London importer of Canadian evaporated milk.

A North of England correspondent is open to undertake the representation of a Canadian firm manufacturing a proprietary article which they desire to place on the market in Great Britain.

A Yorkshire firm manufacturing gas, oil and spirit engines and suction gas plants desire to get into touch with likely importers or agents.

Inquiry is made for the names of Canadian shippers of ash or hazel twigs, [illegible] for use in the manufacture of handles for stone-breaking hammers.

An import agent at Berlin would like to secure the representation of some Canadian firms open to do business in Germany.

A Dutch correspondent makes inquiry for the names of Canadian importers of cement.

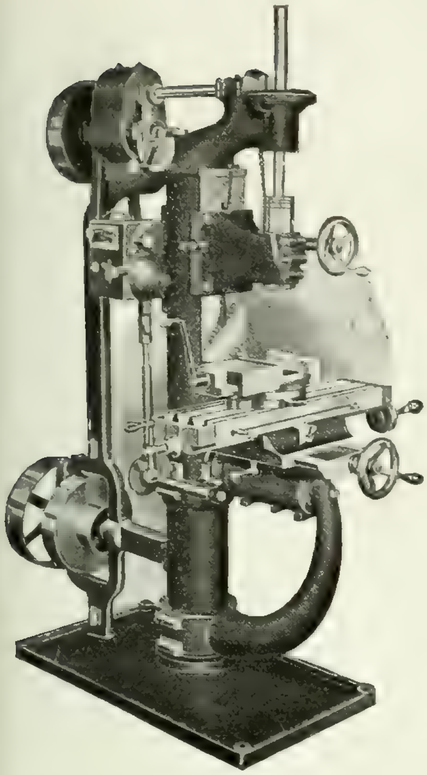
A Toronto manufacturers' agent offers to undertake the Canadian representation of United Kingdom manufacturers, and to arrange for transportation from the United Kingdom ports to all points in Eastern Canada.

From the Branch for City Trade Inquiries, 73 Basinghall Street, E.C.:—

A [illegible] firm manufacturing car pit equipment plant for dealing with electric tramcars, etc., and also engineering tools, wish to arrange for their sale in Canada.

A [illegible] company manufacturing various kinds of paper, [illegible] and other stationers' and bookbinders' supplies, are seeking suitable Canadian resident agents.

A [illegible] manufacturing all varieties of colors [illegible] for suitable Canadian buying agents, preferably in Montreal and Toronto, to whom they would grant their exclusive agency for the whole of the Dominion.



You Need a Machine Like This on a Dozen Different Jobs

It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows:—Spindle of crucible steel, ground bearings; working surface of table, 29 × 8½ inches; feed, longitudinal and transverse; floor space, 60 × 68 inches; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

PATENTS.

The following is a list of patents recently issued to investors by the Patent Office in Ottawa. The list is furnished by Messrs. Fetherstonhaugh & Co., 10 King Street East, Toronto:—R. J. Little, detachable runners for vehicles; A. W. Anderson, flexible films; S. Barnes, cupolas; Wm. R. Bell, Grain tanks; S. Bellemare, ventilating systems; R. W. Burnett, hose protectors; Chas. F. Deck, sashes; I. DeFoy, automatic regulating valves; Ed. Heitman, squirrel cage rotors for electric motors; R. C. Morrow, combined rail chairs and splicers; Jno. Murphy, water controlling apparatus; Wm. H. Roughsedge, floor molds for concrete buildings; Jno. B. Shelton, freight refrigerator or cattle cars; A. E. Spooner, gravity door locks; N. H. Stovell, combination chamfering tools; W. H. Taylor, separable umbrellas; O. Woodall, neckband measuring devices; Thos. H. Knox, vehicle wheels; A. Lewis, berry boxes; O. R. Loewenthal, composition powder for cockroaches; Wm. Maloney, single monorail track constructions; R. C. Morrow, rail chairs.

◆

PULPWOOD PRODUCTION

Pulpwood exported in the raw state during 1911 amounted to 847,939 cords, and fifty-four firms reporting to the forestry branch of the department of the interior used 672,288 cords, making a total cut of 1,520,227 cords valued at $9,678,616. This is 21,401 cords less than was cut in 1910, but the quantity manufactured in Canada was larger, states Mr. H. R. MacMillan, B.S.A., M.T., in an interesting bulletin just issued. Over 95 per cent. of Canadian mills cut the pulpwood used by them from their own limits and consequently ross the wood themselves. Altogether 73,801 cords of wood (i.e., 12.3 per cent.) more were used in 1911 than in 1910. The average price of the wood also increased, so that the value of the domestic pulpwood industry was greater in 1911 by $752,870, or 21 per cent. The average price per cord was $6.07 in 1908; $5.57 in 1909; $6 in 1910; and $6.45 in 1911. Only 22,229 tons more of pulp were produced in Canada in 1911 [illegible] in 1910.

There was a decrease of 93 pounds in the amount of pulp produced per cord of wood; it is difficult, however, to secure trustworthy data as to the output of pulp, since many firms do not give the air-dry weight.

Quebec is the premier pulpwood province of Canada, because of its extensive spruce and balsam fir forests fit for pulpwood, its abundant and cheap water-power and its plentiful supply of labor. The 28 mills in Quebec reported a consumption of 58 per cent. of the total for Canada, or 47,671 cords more than in 1910. The quantity used was 13.9 per cent. more than in 1910, and the value 33.9 per cent. greater. Ontario, although suffering from the flooding of one mill, increased the amount consumed in its fourteen pulp-mills by 3,115 cords, and used nearly one third of the total production. New Brunswick is recovering from the depression of 1910, and contributed 45,824 cords, or 6.8 per cent. of the total. In 1909 it used 88,450 cords, being 14.2 per cent. of the total, so the recovery is still incomplete. In Nova Scotia, where one large mill was burned early in the year, the consumption has increased by 115 cords as com- [illegible] 1911. The province of British Columbia is still experimenting in pulpwood manufacture, and the negligible amount reported from this province is manufactured for test purposes only.

[illegible]

[illegible]

spruce, 3,718 cords less of balsam fir, 2,096 cords less of hemlock, and 641 cords more of poplar. New Brunswick also showed a large increase in the spruce used.

Although the reports furnished from the mills do not indicate it, the proportion of balsam fir used is yearly increasing. Balsam fir and spruce are used in mixture in the manufacture of news print. A few years ago it was thought that if the proportion of fir was increased above twenty-five per cent. an inferior paper would result. Greater skill in papermaking has shown that the proportion of fir may be increased to forty per cent. or over. This is now being done by some mills and the resulting paper has proved satisfactory. In various parts of Eastern Canada, particularly in Quebec, balsam fir forms from twenty to fifty per cent. of the forest. The practice of the companies now operating is to take spruce and balsam as they occur in the forest. On account of the prejudice still existing against balsam fir, it has not been expedient for the mills to keep track of or report the exact proportion of balsam fir used. Hemlock, which was third in 1910, has retired to fourth place in 1911. Although it has fallen off nearly 60 per cent. since 1910, more than twice as much of it was used as in 1909. There is reason to suppose that a larger export of hemlock took place. While more poplar manufactured in 1911 than in 1910, it is still below the amount for 1909. Jack pine has not been reported as a pulp wood since 1908. Before that time it was used considerably by two large mills, but has proved unsatisfactory. Arrangements are now being made by mills in Ontario and Quebec for a further use of jack pine.

The average price of the different species used is the cost to the mill-owner, and so includes varying logging expenses and a wide difference in transportation charges. Maximum and minimum prices for a species in a single province may differ by 100 per cent. The great majority of pulp-mill owners have their own timber limits, and to them the cost of their pulp logs is merely the cost of carrying the limit and the operating charges. Other operators buy in the open market and add transportation charges. Thus the prices quoted are the purchase prices under different conditions, and do not show the relative value of the different woods for pulp manufacture.

The effect of an excessive hauling distance is demonstrated in Ontario, where the prices of spruce and balsam fir were $6.75 and $7.46 respectively. The high price paid for balsam fir and the sustained demand for this species proves its suitability for manufacture into pulpwood. Over the whole of Canada spruce was the most expensive species at $6.47 or 42 cents more than in 1910. Balsam fir is at $6.40, having risen 69 cents since 1910. Hemlock, though still the cheapest species, advanced 75 cents per cord, its average price in 1911 being $5.18. Poplar has advanced 25 cents over 1910, the price last year being $6.17. The cheapest pulpwood bought was a small quantity of poplar in Nova Scotia, which cost $3 per cord. A small quantity of hemlock in British Columbia at $7.60 was the most expensive wood, on the average, used in Canada for pulping; but as much as $10 per cord was paid for spruce in some cases.

During 1911, no slabs or saw-mill waste were reported as being converted into wood-pulp in Canada, but from the reports made to the forestry branch by saw-mill operators it would appear that a very small quantity of mill waste is so utilized by three companies operating saw-mills and pulp mills under the same ownership. This is an economy practised to a greater extent in other countries, and by neglecting it Canada is losing greatly. It has been conservatively estimated that if all useful logs left in the bush by lumbermen, large-sized branches, slabs and other mill waste from the lumber industry in Canada, had been converted into pulpwood in 1911, the annual output of pulpwood would have been increased [illegible] have been cut over for logs to [illegible] pulp only. During 1910, in the United States, six and a half per cent. of the total consumption was from slabs and mill waste. If economy had been practised to the same extent in Canada during the year 1911, as much pulp [illegible] without cutting one additional pulp log, as is manufactured from over 43,000 cords of wood. [illegible] pulp as New Brunswick produced in 1911. The sooner such practical economy and utilization of waste commences, the longer will Canada have an adequate supply of pulpwood.

Volume 23. Toronto Sept. 12, 1912

Contents of this issue on page 451

The Canadian Engineer
An Engineering Weekly

THE AWAKENING OF CANADIAN IRRIGATIONISTS.

By NORMAN S. RANKIN.

NOTE.—A report of the Sixth Annual Convention of the Western Canada Irrigation Association, held at Kelowna, B.C., Aug. 13th. to 16th. Mr. Norman S. Rankin, the Secretary of the Association, who has furnished us with this account of the Convention is Publicity Manager for the Department of Natural Resources of the Canadian Pacific Railway Company.—EDITOR.

"Great oaks from little acorns grow." "Great streams begin as tiny springs," and so great companies and organizations oft-times have their birth in tiny, dark offices, with out-at-elbows desks, and an executive who is at once president, vice-president, general manager, private secretary and office boy.

Everybody interested in irrigation and agriculture in the United States has heard of the National Irrigation Congress. All know what a powerful, influential organization it is to-day, and how delegates from the four corners of the country come together, year after year, in some chosen city, to follow the deliberations and resolutions of that association. They also know that the resolutions of that great congress go up to the Senate at Washington, and there meet with careful, serious consideration.

The Delegates Being Entertained at Kelowna.

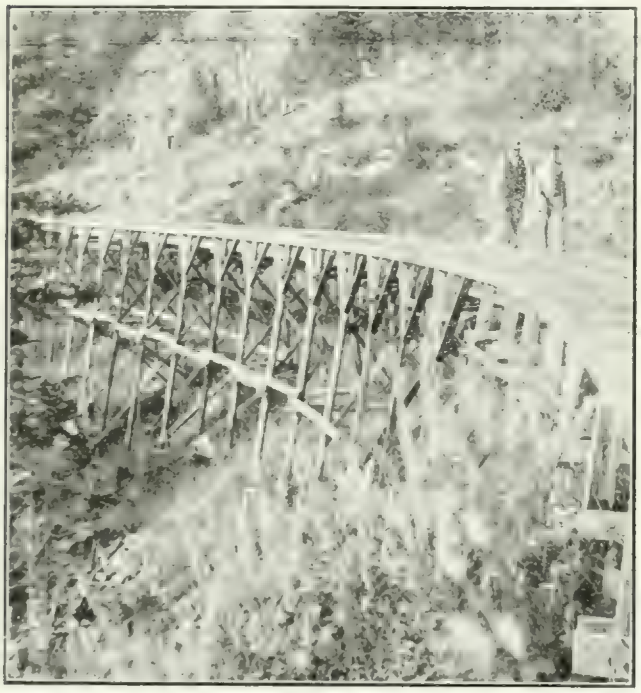
North of the boundary line, the National Irrigation Congress, six years ago, had a little baby brother, known as the Western Canada Irrigation Association. It was then struggling its way through the ills and fevers of babyhood, but now has developed into a sturdy child, standing upright on its own legs, and looking the irrigation world in the face. Very few below the line know that this continent holds a second irrigation association, but the result of its sixth annual convention, held at the beginning of August at Kelowna, in the Okanagan Valley, British Columbia, has clearly demonstrated that the one-time infant will from now on make itself heard.

The Western Canada Irrigation Association—which has practically the same aims and objects as its big brother in the United States—has slowly but steadily extended its scope of endeavor until under its influence has fallen every up-to-date farmer and irrigator in the Western Canadian provinces of Saskatchewan, Alberta and British Columbia, and when this year its interesting and attractive official call went forth the response was hearty and encouraging.

To Kelowna then—a charming little fruit city beautifully situated on the borders of Okanagan Lake—came during August 13th, 14th, 15th and 16th, farmers, irrigationists, students, railroad and government officials and politicians. They left the main line of the Canadian Pacific Railway at Sicamous, and journeying down the fertile Okanagan Valley, reached at length the picturesque lake of that name, and boarding the huge stern-wheeler that awaited them, were borne swiftly to their destination—appropriately named, "The Orchard City." Here with open doors and flying banners, the hospitable citizens awaited them, and visitors were whirled away in automobiles to the various homes and hotels which were prepared to receive them.

View of Kelowna Beach and Bathing Place.

That evening, at eight o'clock, in the local theatre, some five hundred interested irrigationists listened to Mayor Jones' welcoming address, while on the platform sat such distinguished men, as the Hon. W. R. Ross, Minister of Lands, B.C.; J. S. Dennis, assistant to the president, Canadian Pacific Railway; the Hon. Dr. Samuel Fortier, chief irrigation investigations, U.S.A.; Sir William Willcox, an eminent irrigationist; Professor Alfred Atkinson, Department Agronomy, Agricultural College, Bozeman, Montana; John T. Burns, executive, secretary-treasurer, International Dry Farming Congress; the Hon. Price Ellison, Minister Finance and Agriculture, B.C.; Deputy Minister W. E. Scott, B.C.; Professor M. L. Dean, State Horticulturist, Missoula, Montana; A. S. Dawson, chief engineer, Department Natural Resources, C.P.R.; R. M. Winslow, provincial horticulturist, B.C.; P. L. Naismith, manager, Alberta Railway and Irrigation Co.; F. H. Peters, Commissioner of Irrigation, Dominion Govenment; R. H. Campbell, Director of Forestry, Ottawa; Professor C. I. Lewis, Corvallis, Ore.; George Harcourt, Deputy Minister of Agriculture, Alberta, and a [illegible].



Steel Flume of the Kelowna Land and Irrigation Company, British Columbia.

In the audience were delegates from as far west as Victoria, and as far east as Ottawa, gathered to discuss and resolve what was best for the farmer, and best for the [illegible].

[illegible] to the Okanagan Valley and Kelowna in particular, Mayor Jones stated that during the past year nearly half a million dollars had been expended on irrigation works. One hundred and thirty thousand fruit trees had been planted on irrigated lands last [illegible], while the tobacco industry is assuming great im[illegible]

J. S. Dennis, the father of irrigation in the west, vice-[illegible] mittee, in speaking of the Provincial Government and the [illegible] that was of supreme importance, and in order to make it successful, the government required the energetic co-operation of all users of water. All development depended on the proper administration of the Act; value lay not in the land but in the water, as the greater portion of the land in the dry belt of British Columbia would produce nothing unless irrigated. Land above the ditch was worth from $5 to $20 an acre, while that below was valued at from $100 to $400 per acre. The difference was not due to soil or climate, but to the water. It was, therefore, just as important that the law regarding title to water be as definite as that regarding the title to land, but until everyone gave loyal support to the government in the administration of this Water Act, the title to water would not be as good as to land. He spoke of the history, aims and work accomplished by the Western Canada Irrigation Association, and said that the present convention was attended by a larger number of delegates than the previous five. Perhaps this was surprising in view of the remoteness of Kelowna from the main lines of communication, but it was not when it was remembered that British Columbia was looming up as the most attractive part of the West to people south of the line and in the Old Country. From the latter country, the people came to British Columbia readily because the name itself was attractive to them, and it seemed like coming home. There was great need of taking care of these people when they arrived, and he suggested that more complete surveys of government land were needed in order to supplement the Water Act. Southern British Columbia, he believed, was now on the verge of sharing in the great movement from the south which had been greatly increasing during the past few years, and had been directed almost entirely to the western provinces. This year it would total over 150,000 people, and this "spilling over the brim" of the 100,000,000 of the population of the United States would extend to British Columbia. He said that he saw in the future all valleys from the boundary to the main line of the C.P.R. filled to their entire capacity with prosperous settlers.

Each speaker during the convention had something of interest to say to the delegates, and were followed with close attention. The Hon. Dr. Fortier delighted the audience one evening with a stereopticon lecture on "Irrigation in California," and the proceedings were occasionally broken [illegible] a little [illegible] jaunt into the country to inspect [illegible] schemes under operation or construction. [illegible] of great import to the country were taken up, [illegible] and passed on to the government for consideration, while vital subjects such as "The Apple and the Baldwin Spot," "The Irrigation of Alfalfa," "Public Ownership

Orchards at Penticton, British Columbia.

of Irrigation Systems," "Irrigation as Applied to Forestry," and kindred subjects were discussed and resolved.

With a delightful steamboat trip down the lake to Penticton, touching at Summerland, Peachland, Naramata and other points, and a monster banquet, tendered by the citizens of the town of Penticton, at the new Incola Hotel, the convention adjourned to meet in August, 1913, in the ambitious city of Lethbridge, Southern Alberta. So keen was the interest shown in future conventions of the association that bidding for the 1914 and 1915 conventions has already commenced. In 1914 it will again meet in British Columbia, and in 1915 in Alberta, thus carrying out the accustomed procedure of the association to hold its conventions alternately in the two provinces.

The following officers were elected for the ensuing year: Hon. President, the Hon. G. A. V. Bulyea, Lieutenant-Governor, Province of Alberta; president, Hon. Duncan Marshall, Minister Agriculture, Alberta; vice-president, W. C. Ricardo, manager Coldstream ranch, Vernon, B.C.; vice-president and chairman, J. S. Dennis, assistant to president C.P.R., Calgary, Alberta.

Executive Committee.

West of Mountains.—Thomas Bulman, Kelowna, B.C.; F. K. Fulton, K.C., Kamloops, B.C.; J. A. Mackelvie, Vernon, B.C.; C. W. Dickson, Kelowna, B.C.

East of Mountains.—A. S. Dawson, Calgary, Alta.; W. H. Fairfield, Lethbridge; Wm. Pearce, Calgary, Alta.; Prof. W. J. Elliott, Strathmore, Alta.

Official word has been received from Lethbridge that "The Ambitious City" proposes to make the 1913 convention the most interesting and attractive in the history of the association.

◆

APPRENTICES ON THE CANADIAN PACIFIC RAILWAY.

The education of the apprentices on different classes of work is demanding more and more attention from the employer of labor. The railroads have appreciated the necessity of providing such education before other branches of industry. In an article in a recent issue of "Railway and Locomotive Engineering" Mr. E. E. Bailey, the supervisor of apprentices on the western lines of the Canadian Pacific Railway, outlines this company's methods of approaching the question. Mr. Bailey says that considerable attention is paid to careful and systematic education, both practical and theoretical, in the various trades required for the production of the shops at Winnipeg. A well-organized apprentice instruction department, in charge of a supervisor of apprentices under the direction of the superintendent of shops, controls the hundred apprentices employed at Weston, both in their shop training and in their instruction classes. Those learning the machinist trade, about two-thirds of the total number, have also a shop instructor, who is employed to devote his time to showing the boys how to handle their various jobs, and who is responsible for passing them efficiently through the many branches of their trade in due order, scheduled periods for each being allotted. The remainder, including boilermakers, blacksmiths, moulders, pipefitters, tinsmiths, carpenters and patternmakers, are under direct control of their respective foremen. A careful record of their progress, behavior and aptitude is returned to the supervisor, particular attention being paid to inculcating the habit of good timekeeping; twice late per month, or a total of twelve per annum, only being allowed, together with a total loss of time each year of a hundred hours, this being allowance for vacation. Any time over this has to be made up before the boy can receive his increase of pay, which rises automatically from 13 cents the first year to 17 cents the second, 20 cents the third, 23 cents the fourth, and 26 cents the fifth, after which, on receipt of a satisfactory certificate of apprenticeship, they step at once to the schedule rates as tradesmen.

The technical or theoretical training, rightly considered as of great importance, is developed by means of classes conducted by the supervisor, fifteen boys being the average per class. In arithmetic all are taken through fractions, decimals, proportion, averages and roots and powers, and concluding with mensuration. In drawing they are instructed first in freehand, to be applied later in their training to the making of shop sketches. Then geometry, projections, intersections and developments of surfaces, and finally to the making and reading of shop or mechanical drawings, each trade being given, as far as is possible, subjects bearing on their own class of work.

Beyond this any apprentice who elects to pay a small sum per month may continue his studies in more advanced subjects, such as algebra, logarithms, trigonometry, advanced mechanical drawing, steam and kindred subjects, the company's object being as much to enable the boys to realize the advantages of extending their technical knowledge as it is to give all a good training in the rudiments.

During their first year as apprentices, when they must be sixteen years of age or over, they receive two hours' instruction per week; from then for the following two years, four hours per week is given, divided into two sessions of two hours each. At the end of the third year their theoretical training ceases, unless, as stated above, they wish to advance further, when they may continue to attend special classes until they have completed the branch of study chosen, or until they have completed their apprenticeship.

A monthly record of school and shop progress is sent to each boy's parent or guardian, and copies are kept charted up in the Instruction Room for friendly rivalry and emulation. Each December an examination on the general progress of the classes is held, scholarships being presented to the five boys with the highest marks. All apprentices are also eligible to compete for the two scholarships offered by the company covering four years' free tuition in the Faculty of Applied Science of McGill University.

It will thus be seen that generous encouragement is given to every boy entering the Winnipeg shops as an apprentice, and that no effort is spared to turn out in the finished article a thoroughly well-trained and useful member of a trade, and it must be said that the boys themselves appreciate the efforts of the company to this end, and evince a willingness to learn, and an interest in their work, to go far to justify the trouble and money expended upon their training, and finally result to their own particular advantage in the coming years.

◆

THE NEW QUEBEC BRIDGE.

Work is progressing rapidly on the new Quebec bridge. Last year the debris of the fallen structure, a vast mass of tangled steel, partly above the water and partly submerged, was removed and new caissons were sunk, so that the work on the substructure may be considered well enough advanced to predict a completion of the new bridge in 1915. The bridge when finished will be one of the greatest of its kind in the world. Pending its completion, trains of the new Transcontinental will be transferred across the St. Lawrence by ferries.

COMPENSATING GRADES FOR CURVATURE.

The subject of compensating grades on curves in order to offset the increased train resistance due to curvature crops up periodically, and it is evident that practice in this direction is not only very diverse but is based upon a very uncertain foundation. The following article was compiled and published by the Engineering News, and presents the whole matter so fully that we reproduce it in full. It is mentioned in the early and noted "Shunk" and "Searles" field-books, the former giving a formula which is quoted below (by Mr. Beahan). In "Field Engineering" (1887), by W. H. Searles, the curve resistance (lb. per ton) on a curve of given degree is stated as 0.56 x D, while the grade (per cent.) on tangent having the same resistance as the given curve is stated as 0.025 x D. Thus the resistance and compensation were assumed to vary directly with the degree of curve, which is now almost universally recognized to give incorrect results. On the subject of compensation, Mr. Searles stated as follows:

"In locating a road, the maximum grade should be reduced on a curve by the amount of the equivalent grade of the curve [see formula above.—Editor.] so that the resistance may be no greater on the curve than elsewhere. But grades less than the maximum need not be reduced for the curves upon them, unless the sum of the grade and the grade equivalent exceeds the maximum."

The most extensive analysis (and we might say the only thorough analysis) of the subject is that given in Wellington's "Economic Theory of the Location of Railways" (1887), and we recommend a careful study of the exposition there given, with the reservation that the reader should remember that the conclusions may not apply directly under modern conditions of rolling stock and traffic. As a compilation of opinions on the subject would be incomplete without some outline of those of Mr. Wellington, we give below a few extracts together with his summary of conclusions:

Under three different conditions curvature may come (in advance of gradients) as a limiting agent to fix the weight of trains:

1. [illegible] on a maximum grade without reducing the rate of the latter by compensation for curvature, so as to keep the aggregate resistance constant on both curves and tangents. 2. When a line is nearly or quite level, and yet runs through a region requiring curvature which (as is very apt to happen on such lines) cannot be compensated [illegible] there are no grades, or no sufficiently high grades to reduce, in order to eliminate their additional resistence. 3. When on lines of the latter (or any other) class curvature of such short radius is used as to limit the length of trains more than would the same amount of curvature with longer radii. These causes are more or [illegible]

[illegible]

Under these circumstances, prudence would indicate that wherever there is no physical limit to the possible reduction of grade on curves, it should be made ample, so that the curves should certainly offer no greater resistance than the adjacent tangents. At stations this rule would require a grade reduction of 0.1% per degree.

On the other hand, when we are merely trying to equalize the tangent and curve resistance on a long ascent, and whatever is taken off the curves must be added on to the tangents, no such practice is proper. If we come as near to an exact equality as we can, in compensating for curvature, it is of no importance whether our compensation is a little too great or a little too small. In the one case trains will stall on the tangents and in the other on the curves; that is all. Our object is simply to guard against a certainty of stalling on either. Nothing more than this is important.

Hence it may well be that on a long and crooked ascent, where the curvature greatly exceeds the tangents, yet where there are one or two considerable tangents, prudence will require the assumption of a very low rate of compensation; for otherwise a very slight loss of elevation on each curve, multiplied by many curves, will prevent our attaining the desired summit without a considerable increase of the normal tangent grade. If we have guessed right as to the real curve resistance, this may do no harm; but, on the other hand, if we have guessed wrongly, and exaggerated the probable curve resistance, we shall have unnecessarily increased our tangent grade. Hence, by assuring a low rate of curve resistance in such a case, we can hardly in any case lose anything appreciable, and may save a needless loss of grade. A compensation rate of 0.03% per degree of curvature may then be proper, below which the rate of comsation should never fall.

For the same reasons, it may well happen that at different points on the same line different rates of compensation may be proper. Where the loss of elevation by a high rate of compensation is a very serious matter, because of a great amount of curvature, it may be taken at a minimum. At other points, where there is less curvature to be compensated and a higher compensation can be had at little or no cost, it should there be used. The effect will be to make most of the maximum grade scattered over the division a little easier to handle trains on than the longest or worst grade. This may well result in handling a car or two more than would be deemed possible were the resistance as great at two or three points as it is at one.

It is always worth while to keep a little below the maximum where possible, at moderate cost. This is only another application of the same principle, but, owing to the uncertainty which hangs about the question of curve resistance, it is a wiser way of attaining the same end than to reduce the nominal tangent grade, especially in the vicinity of stations.

Conclusions. 1. With short grades or under favoring topographical conditions compensate as liberally as possible up to a maximum at special points of 0.10% per degree.

2. Where speed may sometimes be very low, and hence invariably on or very near to known stopping places, this maximum rate appears, with our present knowledge, none too much. In general, however, 0.05% per degree (= 1 lb. per ton) is an ample equivalent for curve resistance, and for fast trains alone probably 0.02 to 0.03% (= 0.4 to 0.6 lb. per ton) is sufficient to balance the resistance.

3. On sections where curves largely predominate over tangents it is particularly desirable to have ample compensation, and if excessive, it will do least harm.

4. On sections where the amount of curvature is small it is less important to have full compensation, and if excessive it will do most harm.

5. When the rate of compensation can only be increased at the certain cost of a corresponding increase in the rate of tangent grades (making very sure that it is certain, and not an over-hasty conclusion from inexperience or lack of care), no larger rate than we feel practically certain will be required to balance the curve resistance (0.03 to 0.04) should be chosen. Otherwise, we are committing the folly of making a certain addition to the grade in one place, to avoid one in another place which is merely problematical.

6. On any minor gradients where the curvature is not sufficient to bring the virtual profile up to the maximum it is not important to compensate for curvature at all, although it is generally as well to do so, especially at points where to do so will slightly reduce the cost of construction, as is very apt to be the case on long curves. When not compensated, the curvature merely has an equivalent effect to a slight undulation of gradient, which produces no shock to the train and so is not a measurable disadvantage.

7. It is not in the least essential or important to precisely adapt the compensation to the exact length of each curve. The reduced rate may as well as not begin and end at the nearest even station, and may be made a little less on one curve and a little more on one immediately above if a horizontal slice of a foot or more may thereby be taken off a high fill on the tangent connecting them, but never so as to cause the grade to rise above the uniform grade line.

8. Curves immediately below a known stopping place for all trains need not and should not be compensated at all.

9. The rate of compensation should be uniform per degree for all degrees of curvature, or in no case made greater for the sharper curves. It may even be made less for curves of over 10 deg. If the rate be reduced one-half for the excess over 10 deg., making the compensation for a 16 deg. curve thirteen times that for a 1 deg. curve, it will certainly lead to no bad results, although a rather rough rule. This is directly contrary to the usual practice, which is to increase the rate of compensation with the sharpness of the curve, if anything; but this practice rests upon the assumption (which is the direct contrary of the truth) that the curve resistance increases with the degree of the curve. The results of experience on the New York elevated lines and numerous others with very sharp curves, both of standard and narrow gauge, is enough to disprove this, confirmed as it is very directly by the indications of theory.

10. Since there is no reason to believe that curve resistance increases per ton with the length of the train, or even (appreciably) with the type of engine, there is no reason for varying the compensation because of the grades or length of train, except that it is usually easier to spare the elevation for a liberal rate of compensation, with low grades than with high ones. It is, therefore, proper to do so.

This author states as follows in his "Field Practice of Railway Location" (1909):

"In laying the grade line on the location profile, the rate of maximum grade per station must be reduced by such an amount as necessary to compensate for resistance due to curvature. The reduction in gradient formerly[*] was 0.05 ft. per station of 100 ft. for each degree of curvature. If the maximum gradient was 1%, then a 20 deg. curve would have to be level. As this rate was established by trial of locomotives it varied on different roads. Shunk's formula for equating gradient for curvature was: Degree of curvature (squared) + 10 times degree of curvature ÷ 500. This gives the reduction in grade per 100 ft. and gives an 18 deg. curve as being level when the maximum grade is 1%[†]. The amount of curvature, 5 deg. and flatter, that exists in America on unreduced maximum gradients is enormous. The equating of curvature remains in use as it is based on observed fact."

In his "Curves of Civil Engineering" (1903), this author gives a table of compensation for curves on maximum grades, in which the rate of compensation per degree decreases from 0.03% for a 1 deg. curve to 0.02% for 20 deg. The total compensation then ranges from 0.03% for 1 deg. to 0.1% for 3½ deg., 0.2% for 8 deg., 0.34% for 15 deg. and 0.4% for 20 deg. This idea of decrease in rate of compensation with increase in degree of curve is suggested by Wellington and also later by Raymond and Webb (as noted below), while some writers have advocated an increase in rate of compensation with the increase in degree of curve. On this subject Mr. Haynes states his views as follows:

"When laying a maximum grade or where uniform resistance is desired, the rate of grade should be made less on curves than on tangents by the amounts shown in the table [noted above.—Editor.]. In the lower portions of a maximum grade, where high velocities are admissible and can be had, compensation for curvature is unnecessary. But where the velocity may fall to 8 m.p.h., curve resistance should be compensated fully in the grade so that the resistance and velocity will be uniform. If the velocity drops so that the centrifugal force is lost, the train stalls. A maximum grade in a district is not necessarily one of maximum ratio, but one which produces a maximum tractive power, where curves and velocity are considered."

From "Railroad Location Surveys and Estimates" (1906), we take the following extracts relative to grade compensation on curves, but omitting portions which relate to the ultimate effect of such compensation upon the profile and the operating conditions:

As the resistance to the passage of trains is greater on curves than on tangents, this varying directly with the degree of curve (or, in other words, with the radius), the ruling grade used on tangents must be lessened on the curves, so that the combined resistance due to the curve and the grade on the curve will not be greater than the resistance of the grade alone on the tangents.

Owing to varying conditions of track and rolling stock, the compensation necessary cannot be determined exactly, but is ordinarily assumed to be about 0.04% per degree of curve; that is to say, with a maximum grade of 0.6% on tangents a 4 deg. curve, for instance, should not have a heavier grade than 0.6 — (4.0 × 0.04) = 0.44%. The amount of compensation for curvature is assumed usually to be the same per degree for any degree of curve; thus, if it be assumed at 0.04% per degree, a 1 deg. curve would be compensated 0.04 per station and a 6 deg. curve 0.24 per station. It is generally conceded, however, that the resistance due to curvature does not increase proportionately as the degree of curve, and the writer prefers to use a sliding scale somewhat as follows: Curves up to 2 deg., 0.6% per degree; 0.05 × to 4 deg., 0.04% to 8 deg. and 0.03% per degree to 14 deg. This is intended only as an approximation and suggestion.

The proper amount of compensation for curves is a matter on which opinions vary, and which varies with the state of the track, type of engines, etc. Where curves are few, and, therefore, probably of large radius, the compensation can be increased to as much as 0.1 % per degree, with little probability of increasing the cost of construction, and any error surely will be on the right side. On long ascents, where often every inch counts, and where often a high rate of compensation will mean a higher rate of grade on tangents, or a much longer line, compensation as low as 0.03% for all curves will probably be sufficient. It will be seen that a most important point in locating long lines on ruling grades is the avoidance of curvature as far as possible. More curvature means less rate of grade and, therefore, longer line.

---

[*] The same statement is made in the 1906 edition of Mr. Beahan's book, but he does not explain what period is referred to by the term "formerly."

[†] See quotation further on from a modern edition of Shunk's field book.

Where possible, grades should always be compensated for curvature, whether they are maximum grades or not; provided, however, that such compensation of grades is less than the maximum does not unduly affect the cost. The ideal line from the operative standpoint, as regards fuel economy, and to a certain extent the wear and tear on rolling stock, is one where the differences in resistance due to varying curves and rates of grades are reduced to a minimum. In other words, where, with a constant head of steam, the throttle can be set at a certain point and the train will pull just the same all the way. [For momentum grades] curvature on the maximum grade, when this is greater than the ruling grade, must, of course, be compensated the same as elsewhere, though probably a little more liberally; and in calculating the length of the momentum grades the entire resistance of the curvature must be taken into consideration.

Compensation for curves should be from the nearest even station to the ends, and where spirals or easements are introduced this may generally be from the ends of the true curve (that is, the true curve from the offset points, including the whole central angle), except where the spirals may be very long and then an average rate for the spiral may be introduced.

The subject was under discussion some ten years ago in Engineering News, and in the issue of September 5th, 1901, Mr. Merriam stated his opinion as follows:

"The compensation for curvature should be on a sliding scale, beginning with about 0.04%, or 0.03% per degree, and decreasing as the degree of curvature increases. All the experimental data I have been able to gather confirm this conclusion, but as the condition of the rail with regard to wear enters so largely into this proposition, the results do not point to any definite formula for compensation. The general tendency of modern practice is in the direction of lower compensation all along the line, one prominent western road with easy curves uses only 0.02% per degree."

In commenting upon this, J. L. Campbell stated that he thought it rather doubtful practice to adopt lower rates of compensation on sharp curves, for, while they will give a lower resistance per degree when new rails are laid, the [illegible] through greater wear, more nearly proportional to the degree of curve. He con- [illegible] elevation [illegible] However, as noted [illegible] the views in favor of lower rates for sharper curves. Following up this [illegible]

"[illegible] trains which barely maintained speed on maximum grades on tangent, gained speed on curves; all curves had the same compensation, and more speed was gained on 6 deg. curves than on 2 deg. curves. I have never had the opportunity to measure the resistance due to curvature, but believe the observations above mentioned were carefully taken. They were repeated a number of times and were confirmed by the trainmen operating on the districts where the most curvature existed.

"The condition of the rail is of such importance in this connection that it will be well to state that the rail was new when the above observations were made. The rapid wear of rails would seem to be an argument against the position stated by me in 1901, but Wellington's conclusions regarding rail wear indicate a wear proportional to the degree of curvature. This being true, the increase in surface of contact would be less, after a short time, in sharp curves than in easy curves. Rail maintenance would seem to be one of the conditions required to be known before the rate of compensation can be fixed for any given line, and as this is very hard to forecast, I am using 0.03% in my own practice."

The following is from "Elements of Railroad Engineering" (1909):

"It is customary to offset curve resistance on heavy grades, and on all grades where the combination of curve resistances and grade resistance would more than equal the grade resistance of the ruling grade of the road or division, by reducing the grade. On a crooked road of light grades, curve compensation is impracticable, the curves being in effect the ruling grades. The usual allowance is 0.04 to 0.05% per degree of curvature. But it is thought that on good track 0.025% will be sufficient for 5 deg. curves. The compensation, however, should vary with the degree of curve, and the following values are suggested: 1 deg., 0.04%; 2 to 4 deg., 0.03%; 5 deg. and over, 0.025%. When there is no necessity to save in gradient, full compensation (even up to 0.05%) can do no harm. With poor track and badly curved rails, compensation should be high."

A formula given by Shunk has been mentioned already (in the quotation from W. Beahan), but we do not find this in the 1902 edition of Shunk's "Field Engineer." The subject of grade compensation for curvature is there covered by the following statement favoring a high degree of compensation:

"It is a good custom, and one which cannot prudently be neglected where long stretches of maximum gradient are encountered, to 'slacken grade' on the curves. Opinions differ as to the right allowance per degree of curvature, and no experiments seem to have been made from which to deduce an authoritative rule. Some say 0.025% per degree; others, 0.05; others, variously between the two. Probably 0.05 is the safer rate. This amounts to 2.64 ft. on a mile of continuous 1 deg. curve, and makes a 9 deg. curve about the curve of double resistance at ordinary passenger speeds."

The following extract is from "Railway Track and Track Work" (1908), and is accompanied by figures of the practice on several railways (see Table 1), showing that at that time the ordinary rate was 0.03 to 0.04%, with special rates near stopping places, and sometimes a special compensation in tunnels (to offset decreased adhesion due to damp or slippery rails):

"When curves occur on heavy grades, the grade should be so reduced that the combined train resistance due to grade and curve will not exceed that due to the maximum grade allowed on the tangent. This reduction is taken variously at 0.03 to 0.05% per degree of curve. Thus, with a maximum grade of [illegible] on tangent, and a rate of compensation of [illegible], the maximum grade on a 6 deg.

curve would be 4.76°. The amount of elevation lost by compensating the grade is found by multiplying the degree of central angle of the curve by the rate of compensation; and this elevation divided by the length of grade will give the rate by which the maximum grade on tangent must be increased to avoid a final loss in elevation.

"The change in grade may commence at the nearest even station, and not necessarily at the P.C. The reduced grade extends usually beyond the curve. To avoid too great a loss in elevation or too heavy a grade on the tangent, it may be necessary to modify the rate of compensation, but this will depend largely upon traffic conditions. In general, the compensation should be introduced even upon easy grades, especially those which approach the rate of ruling grade, in order to provide for future increase in train loads or reductions in grades. For curves of 10 deg. or over, the rate of compensation may be reduced (as curve resistance does not increase with the degree of curve). There is a great diversity of practice which is based largely upon opinion and experience, and there is much need for careful experiments in order to give some definite knowledge as to the requirements under modern conditions of rolling-stock and traffic."

The following quotation is from Webb's "Railway Construction" (1909):

On minor grades the addition [of resistance due to curvature] is of little importance, but when the grade is nearly or quite the ruling grade of the road, then the additional resistance induced by a curve will make that curve a place of maximum resistance, and the real maximum will be a virtual grade somewhat higher than the nominal maximum.

The proper rate of compensation evidently is the rate of grade of which the resistance just equals the resistance due to the curve. But such resistance is variable. It is greater as the velocity is lower; it is generally about 2 lb. per ton (equal to a grade of 0.1%) per degree of curve when starting a train. On this account the compensation for a curve which occurs at a known stopping place for the heaviest trains should be 0.1% per degree of curve. The resistance is not even strictly proportioned to the degree of curvature, although it is usually considered to be so. On this account the compensation per degree of curve may be made less on a sharp curve than on an easy curve. The compensation actually required for very fast trains is less than for slow trains, say 0.02 or 0.03% per degree of curve. But since the comparatively slow and heavy freight trains are the trains which are chiefly limited by the ruling grade, the compensation would be made with respect to those trains. From 0.04 to 0.05% per degree is the rate of compensation most usually employed for average conditions.

1. On the upper side of a stopping place for the heaviest trains, compensate 0.10% per degree of curvature.

2. On the lower side of such a stopping place do not compensate at all.

3. Ordinarily compensate about 0.05% per degree of curve.

4. Reduce this rate to 0.04 or even 0.03% if the grade on tangents must be increased to reach the required summit.

5. Reduce the rate somewhat for curvature above 8 or 10 deg.

6. Curves on minor grades need not be compensated, unless the minor grade is so heavy that the added resistance of the curve would make the total resistance greater than that of the ruling grade, or unless there is some ground to believe that the ruling grade may be reduced some time below that of the minor grade under consideration.

The American Railway Engineering Association, through its standing committees, has given a considerable amount of attention to this subject. It is to be noted that the committees which have reported upon it have been of a rather exceptionally high character as to the members and their work, and for this reason their statements deserve careful consideration. Extracts from the several reports, covering practically all that is said on this particular subject, are given below:

1901—In connection with a complete change of location or a modification of the existing location, the maximum grade and curvature should be decided and the necessary compensation calculated for the curves, to make the resistance on curves equal to that on a straight line. On lines where tests have been carried out on an extensive scale, it has been found that it is good practice to use 0.03% for each degree of curvature for all curves up to and including 2 deg., and 0.04% above that to 4 deg. (Committee on Grading.)

1902—From the result of the committee's inquiries it would seem that the practice in this country at present favors compensation proportioned to degree of curve, and 0.04% per degree represents average practice. The observation of the effect of compensation, however, seems on the whole not to have been critical enough to determine definitely whether or not it should be proportional to the degree of curve, and further experiment and critical observation are needed. The effect of curves, as shown on a speed recorder capable of recording slight changes in speed, is suggested as a desirable method of experimenting. (Committee on Roadway.)

1907—Curve resistance is estimated by different engineers at different values. The compilation made by the Committee on Roadway (1902), showed that 0.8 lb. per ton per degree on central angle, or 0.04% for compensation per degree, well represented average practice. (Committee on Economics of Railway Location.)

1908—An inquiry was made by the above committee as to whether any experiments had been made in recent years which confirm or modify the commonly accepted value of 0.04% per degree of curve as the rate of compensation for curvature. Although independent experimental work was referred to, many of the answers merely stated the practice regarding curve compensation. There was a remarkable amount of unanimity in saying that 0.04% was a little higher than necessary, that 0.03% was too small and that 0.035% seemed the proper figure. The variations ranged from 0.02 to 0.08%. In investigating the accuracy of allowance for compensation, the widening of gauge on curves should be tested.

1910—We are interested in curve resistance chiefly from the standpoint of its compensation. In the location of a railway, curvature evils may be eliminated partially by reducing grade on the curve by such an amount as to make the engine effort the same on curve as on tangent. Tests made on the Baltimore & Ohio R.R. (1904), show that on the portion compensated 0.03%, the resistance on curve was greater than on tangent, and on the portion compensated 0.04% the resistance on curve was less than on tangent. In replies to a circular sent out in 1907, the consensus of opinion was that 0.035% per degree gave the best results. (Committee on Economics of Railway Location.)

The committee's recommendation, as adopted by the association, reads: "In order to equalize resistance on curve and tangent, curves ordinarily should be compensated 0.035% per degree of curvature. The effect of curve resistance is dispelled more slowly at slow speed than at high speed."

In the discussion, some of the speakers proposed to substitute 0.04%. Further it was pointed out (following the Wellington line of reasoning) that the rate of compensation should never be made absolutely constant, as the effect of the compensation on construction and on the ruling grade should be taken into account. In some places a high rate of compensation can be introduced without harm; but in other cases the rate has an important influence upon the cost of construction. To adopt as standard a rate that is excessive for average conditions means waste of money and improper compensation. It was with this idea also that the meeting added the word "ordinarily" to the recommendation as originally formulated. It was suggested also in the discussion that on a line built exclusively for freight service, and having curves superelevated for low speed, 0.03% will be too much. The committee's report was accompanied by a table representing actual practice on different roads. This is given herewith, supplemented by figures from Tratman's "Railway Track and Track Work."

Railway Practice as to Grade Compensation for Curves.

N. Y., N.H. & H.	0.03 too light, 0.04 too heavy.
B. & O.	0.03 too light, 0.04 too heavy.
So. Pac. (At. Sys.)	0.03 too light, 0.04 too heavy.
*No. Pac.	0.03 too light; 0.04 fairly good results (not quite enough with curves frequently changing direction, slightly in excess for long continuous curves).
C., R. I. & P.	On 0.03 (with new rail) trains retarded at less than 10 m.p.h. and accelerated at higher velocities.
G. T. Pacific	0.04 too high for new rail.
N. Y. Central	0.03 made limiting grades on curves; 0.04 satisfactory.
*C., M. & St. P.	0.035 generally on maximum grades; sometimes 0.03.
P. & L. E.	0.035 satisfactory.
[illegible]	[illegible] satisfactory.
N. & W.	0.035 satisfactory; trains accelerate on 0.04.
Car., C. & O.	Trains loaded for 1% grade accelerate on curves compensated 0.035.
*L. & N.	0.03 too low; 0.05 to be used.
W. & L. E.	0.03 used, but 0.04 preferred.
Can. Pac.	0.04 satisfactory up to 5°; too high for sharper curves.
Wes. Pac.	0.04 used, but probably higher than necessary.
Wash. & Ore.	Trains stalled or retarded on 0.04; 0.05 satisfactory. On 0.05 trains loaded for 10 m.p.h. on ruling grade tangents retarded; trains for 15 m.p.h. accelerated.
*Ill. Cen.	0.04. On Ind. So., 0.04 when curve [illegible] at maximum train, 0.03 when not more than half as long as train.
[illegible]	[illegible]

---

*From Tratman's "Railway Track and Track Work."

◆

A LOCK TIE BRICK COMPANY.

A new corporation, the Lock Tie Brick Company, of [illegible] has been organized by [illegible] Securities Agencies, and among the directors are Mr. J. B. [illegible], Evans, Coleman and Evans, Limited, and Mr. H. J. N. [illegible]

THE DISPOSAL OF SEWAGE SLUDGE.

Of the many difficult problems which the sewerage engineer is called upon to solve none gives him more anxiety than the one connected with the satisfactory disposal of sludge. In a paper read before the Royal Sanitary Institute Congress at York, England, Mr. Arthur Hindle and P. Holt Whitaker gave one solution of the sludge problem. The authors state that, in common with other engineers who are called upon to advise local authorities as to their sanitary arrangements, they have been faced with this difficulty, and at some sewage disposal works recently carried out under their guidance have installed a system of treating the sludge which has proved so efficient as to justify them in giving a brief description thereof in the hope that it may be of some interest to their professional colleagues. The system referred to was provided at the sewage disposal works which the authors designed and carried out for the Penrith Urban District Council.

Penrith is a market town in Cumberland, and has a population according to the last census of 8,993. There are no works or manufactories beyond two small breweries, so that, with this exception, the sewage is purely domestic. The original sewerage works for Penrith were carried out in the year 1850, and comprised a system of main sewers and sewage disposal works on the broad irrigation system on a large area of land known as Westmorland Holme, situate near Eamont Bridge, about one mile from the centre of the town. The new works, which are now practically completed, comprise an entirely new system of main and subsidiary sewers throughout the town, an outfall sewer about 2½ miles in length, including crossing of the River Eamont, which was done by means of a gravitating cast-iron pipe carried by a lattice girder bridge of 120 ft. span, and sewage disposal works on lands forming part of Whinfell Holme, which were acquired from Lord Hothfield, the price being fixed by arbitration. An area of 25 acres was acquired, but only about 12 acres have as yet been laid out. The subsoil is eminently suitable for filtration purposes, consisting of a deep bed of gravel, which is overlaid with about 2 ft. of fibrous soil.

The sewage treatment consists of sedimentation in tanks and filtration through land on the intermittent downward principle. There are four circular sedimentation tanks, each 40 ft. in diameter and an average of 7 ft. 6 in. deep, so arranged as to enable them to be worked on the quiescent or continuous-flow principle, either separately or in series, as circumstances dictate. Inlet and outlet channels, junction wells and controlling valves are provided. Before entering the tanks, the sewage passes through screening chambers, which are arranged in duplicate and fitted with Stott's revolving screens. Between the screening chamber and the mixing buildings there is a dividing well, whence the storm water flows to specially prepared areas. Three times the dry-weather flow passes to the works for full treatment, and three times passes to the storm water beds. The buildings comprise mixing-house, small engine-house, with oil engine and pump, store-room, and office. Up to the present time it has not been found necessary to use any precipitants, but arrangements are made in the mixing-house therefor should their use ever be required.

After leaving the tanks the effluent passes over aeration weirs, thence into a main carrier, and is subsequently distributed by means of subsidiary carriers over the land filtration areas, which are underdrained with [illegible] in agricultural tiles, the number depending upon the nature of the subsoil in each area, and these in turn are connected to a main effluent drain, which discharges the purified effluent into the River Eamont, a well-known fishing river.

The levels of the outfall site were such as did not permit of the sludge being drawn off from the bottom of the tanks so as to gravitate to the sludge drying-beds. It was, therefore, necessary to provide some means of lifting it to the desired level, without, if possible, incurring the cost of pumping. This was accomplished by utilizing the head of the water in the tanks for the purpose of forcing the resultant sludge to the drying-beds, and to assist in this object an apparatus known as Fidler's revolving scraper was placed in each sedimentation tank.

The Fidler scraper arrangement is intended to facilitate the removal of sludge without interfering with the continuous working of the sedimentation tanks and to deliver the sludge at a level only a few inches below the top water level of the tank. The scraper, by means of which the sludge is directed to a sump in the bottom of the sedimentation tanks, is helical in form; it is attached to and supported from a lattice girder, and is rotated by gearing fixed at the side of the tank adjacent to a sludge discharge chamber so as to give opportunity for careful regulation of the discharge. When it is desired to remove the sludge the scraper is revolved and the sludge directed into the central sump, from the bottom of which it is forced to the sludge drying-beds. Valves are provided on the several pipes to regulate and control the flow.

The sludge drying-beds are four in number, each 25 ft. long by 10 ft. by 6 ft. deep; they are constructed of brickwork, backed on the outer side with concrete; the floors are made of concrete, laid with proper falls in the direction of the drains. Each bed is provided with doors, constructed in sections, extending the full width of the bed at the lower end, which can be raised or lowered at will as the material in the beds increases or decreases. Cross walls are formed of perforated boards laid in grooves so as to be easily adjusted.

When the sludge is about to be emptied from the sedimentation tanks, a layer of straw, litter, dried weeds or the like is first laid in each tank or compartment in such a manner that the whole surface of the bed is covered; the litter is also drawn slightly up the sides of the beds or compartments, as well as round the vertical perforated pipes or shafts. These perforated vertical pipes are about 6 in. in diameter, in lengths of about 2 ft., provided with sockets and spigots, so that they can be built up in continuous shafts from the floor to the top of the bed as it is being filled. A layer of sludge, to the depth of 4 in. to 6 in., is then run on to the litter, which acts as a filter, the litter allowing the liquid to filter through and find its way to the perforated pipes, which in turn are connected to drains laid on the floor of the beds. This operation of filling the beds alternately with litter and sludge is repeated until the bed or compartment is filled, when operations are transferred to the next bed. The liquor draining from the sludge beds is conveyed to a well, and is then pumped, by the oil engine and pump previously referred to, into the feed channel of the tanks for re-treatment. As the beds are being filled the increasing weight compresses the sludge and litter, thus forming, after proper settlement, a firm bed of manure, which is easily handled and is very portable. A layer of litter is always placed on the top of a layer of sludge to obviate any nuisance from smell, which one usually expects to arise from open sludge beds or lagoons.

The authors were assisted by the Surveyor to the Penrith Urban District Council, Mr. J. J. Knewstubb (member), who acted as resident engineer throughout the construction of the sewerage works, and who has supplied, for the purpose of this paper, the following information:—

Population dealt with in the scheme, 8,000.

Daily dry-weather flow per twenty-four hours, 290,000 gallons.

Quantity of wet sludge passed on to the beds per day, 2½ tons average.

Quantity of dried sludge taken out of the beds per day, 16 cwt. average.

Quantity of dried sludge removed from the beds and sold per annum, about 300 tons, average.

Quantity of litter used in the beds per year, 70 tons.

Length of time occupied in drying the wet sludge; this varies according to the season, but averages about six weeks.

Length of time occupied in filling one bed, about four weeks. This again varies according to the time of the year and atmospheric conditions.

Rate of consolidation varies according to depth of bed.

Length of time required for the dried sludge to attain its most beneficial condition as manure after removal from the beds, twelve months.

The sludge is sold by open tender every year, and the average price per cart load realized has been 1s. 9d. per load. The authors are informed that the manure removed from the sludge beds after treatment under this system is most beneficial for use on land growing turnips and mangolds, and also gives good results for clover and seed grass at any time and under almost any conditions. It has also been found to be an excellent material for ploughing into land of a light character.

No additional expense is placed upon the Council in dealing with the sludge, as the operation of filling the beds is performed by one of the regular men employed on the farm, and occupies but an infinitesimal portion of his time. The emptying of the beds is undertaken by, and at the expense of, the purchaser of the dried sludge, who also provides and brings to the beds part of the litter required; this, of course, being a consideration of the purchase price. So far as Penrith is concerned the sludge problem has been solved; the authors have, however, up to now hesitated to supply any description of the system, as they were desirous it should have a fair and ample trial before doing so.

This description is given purely from an engineer's point of view, apart from that of the chemist. There is, however, the practical side of the question in that the farmers of the district are competitors for the dried material. The works were completed in the latter part of 1907, were formally opened on, and have been in continuous operation since, the 19th of March, 1908.

◆

CANADA'S COOPERAGE INDUSTRY.

Seven million two hundred and ninety-three thousand oak staves were imported into Canada during 1911, while only 2,768,000 were cut in the Dominion. These figures which show that Canada is fast losing her possibilities as a producer of tight cooperage, are contained in a bulletin issued by the forestry branch of the department of the interior.

In the manufacture of slack cooperage, used for the dry rough commodities such as lime, potatoes, apples, dry fish, flour, cereals, etc., which predominate in Canada's products, elm is the principal wood employed, forming over 50 per cent. of the total consumption. Spruce is rapidly coming into more general use as a source of stave supply, eleven million more spruce staves and nine million fewer elm staves having been used in 1911 than in 1910. When elm is exhausted birch will probably take its place, being comparatively flexible and available in great quantity.

The total value of the materials used in the slack cooperage industry in Canada for the past year was $1,465,702. In 1910 it was $1,595,119 or some $130,000 more. Imports and exports of materials and finished product were, respectively, $329,992 and $135,463, an excess of imports over exports of $194,529.

THE CYLINDER PERFORMANCE OF RECIPROCATING STEAM ENGINES.

In the report of an investigation by Mr. J. Paul Clayton, printed in the Journal of the American Society of Mechanical Engineers, April, 1912, the author states that it has been found that the indicator diagram contains in itself the evidence necessary for an almost complete analysis of cylinder performance, the results of which have not heretofore been considered possible. In obtaining these results the pressure and volume values of the indicator diagram have been plotted on logarithmic cross-section paper; and by the aid of this logarithmic diagram it has been found that the expansion and compression curves of all elastic media used in practice obey substantially the polytropic law $PV^n = C$. From this and other discovered facts the author has developed rational methods of closely approximating the clearance of a cylinder, of locating the cyclic events, of detecting moderate leakage, and of determining the actual steam consumption of the engine.

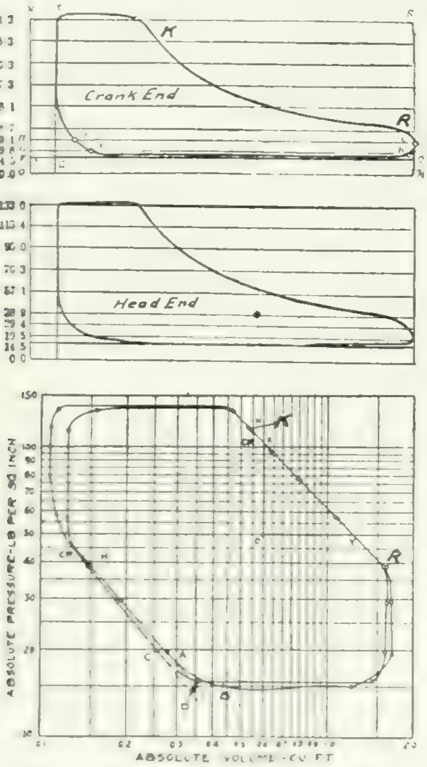


Fig. 1.—Construction of the Logarithmic Indicator Diagram.

Construction of the Logarithmic Diagram.—Fig. 1, in its upper half, shows the indicator diagrams taken from both ends of a 12 x 24-in. single-cylinder Corliss engine used in the tests; ON is the line of zero pressure, OM the line of zero volume, and FQ the atmospheric line. The clearance is 7.04%, and is represented by FE. Horizontal lines are ruled over the diagram, at known pressures, as shown. Thus, absolute pressure at K = 115.3 lb., and at R = 38.7 lb.; absolute cylinder volume at K, measured from the line MO = 0.521 cu. ft., and at R = 1.572 cu. ft. These values are plotted as shown in the lower diagram and the procedure is the same for all other points in each indicator diagram.

[illegible]

Rational Method of Approximating Clearance.—When [illegible] the expansion and compression lines in the logarithmic diagram are straight lines. When the value assumed for the clearance volume is greater or less than the true value, these lines are curved. Fig. 2 gives logarithmic plottings of an indicator diagram taken from a 42 x 60-in. gas engine, the clearance being assumed successively at 14, 16, 18, 20 and 22%. The approximately straight line for the value of 18% is the transition between the two families of curves bending to the left and right, as shown, and the true value of the clearance is therefore very close to 18%. All that is necessary, therefore, is to assume different values for the clearance, plot and logarithmic diagram for each value and determine the straight-line value by trial and error. This may be found to within 5 to 10% of the true value, depending as the clearance itself varies from 20% to 2%, respectively, of the piston displacement.

Locating the Stroke Position of Cyclic Events.—For ordinary purposes these can generally be located by inspection of indicator diagrams themselves; thus cut-offs may be generally located on a Corliss engine diagram to within 1/16 in. measured along its length. The actual beginning of true compression, however, can never be accurately located on the PV-diagram. True compression, unaffected by leakage, begins after the exhaust valve, in closing, has acquired enough seal to prevent leakage; its point of beginning is generally at least 5 lb. above the back pressure. The point at which leakage ceases cannot be located on the PV-diagram because the curve of true compression, and the curve during the time the valve has insufficient seal, are of the same direction of curvature, and are not reverse curves as in the general case of admission and expansion.

As expansion and compression of a constant weight of medium take place according to the law $PV^n = C$ and are indicated by straight lines in the logarithmic diagram, it becomes easy to locate thereon the events of cut-off, release, compression and lead by noting when the expansion and compression lines become straight. These events, though obscure in the PV-diagram, may be located to well within 1/16 in. in the logarithmic diagram, which is equivalent to about [illegible] in. when retransferred to the PV-diagram. [illegible] These methods largely eliminate the variable element of personal judgment. The upper part of Fig. [illegible] shows cards taken from a [illegible] superheated steam locomotive running at [illegible] and high speed. Below these cards are plotted in the form of logarithmic diagrams, showing how the cyclic events may be readily located.

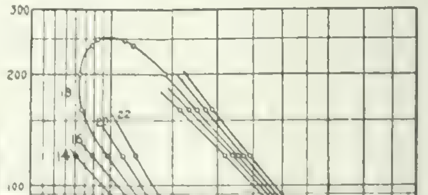


Fig. 2.—Determination of Clearance by the Logarithmic Diagram.

The Detection of Leakage.—The law $PV^n = C$ applies only in cases where the weight of the working medium remains practically constant during any expansion or compression. When this weight changes materially, either by leakage into, or out from, the cylinder, the resulting expansion or compression no longer obeys the law and it becomes a curve on the logarithmic diagram. Leakage is usually the result of wear, and occurs, as a rule, only when the pressure difference is over about 20 lb. This latter fact, founded on the analysis of numerous diagrams, makes it possible to divide the expansion and compression lines roughly into three equal parts on the logarithmic diagram (when these lines extend from the initial pressure nearly to the back pressure): (a) the upper third, influenced by leaks out from the cylinder; (b) the middle third, practically uninfluenced by leakage; and (c) the lower third, influenced by leakage into the cylinder. Thus, fairly reliable values of n, free from the effect of leakage, may be obtained from the middle third. The important result attained by this method of examination is the knowledge that leakage is taking place, so that it can be located and stopped.

The Approximate Determination of Steam Consumption from Indicator Diagrams.—The devising of an accurate method of measuring the weight of steam consumed from the diagram has hitherto been regarded as impossible, but, after many examinations into the cases of different types and sizes of engines, with non-jacketed cylinders in good order with pressures between 60 and 120 lb. absolute, and exhausting at or near atmospheric pressures, it has been found that while the initial condensation is subject to the action of ten or more variables, yet the value often resulting from a given value of Xc (or proportion of the total weight of steam mixture present as steam at cut-off, i.e., quality) is almost always substantially the same, and is expressed by the relation $Xc = 1.245n - 0.576$.

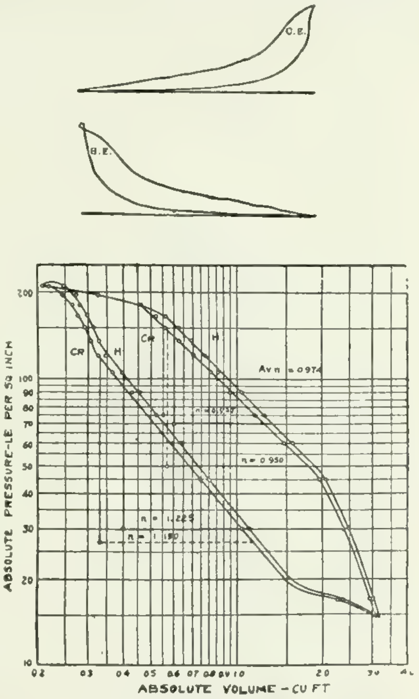


Fig. 3.—Locating the Stroke Position of Cyclic Events.

This relation is practically independent of cylinder size and of engine speed. The point of cut-off and the value of n being obtained from the logarithmic diagram, the value of Xc may be readily calculated and the actual steam consumption obtained by this method to well within 4% (on the average) of the amount consumed as measured by test.

This method is more accurate than the average test; it is the only accurate method available for testing certain classes of engines; it virtually measures an instantaneous rate instead of an average quantity over a long period, and thus enables a large number of points to be obtained for a water-rate curve; it permits of making tests at frequent intervals instead of once in the engine's life; the expense is not to be compared with that of an equally accurate test; it involves in the routine of the plant tested.

THE STRENGTH OF WOOD FOR PAVEMENTS.

The wood pavements in Paris, France, last on an average nine years, but in the most frequented roads they have to be renewed every five or six years. This rapid wear has led to the undertaking of various experiments in the Municipal Testing Laboratory in an effort to find means for increasing the strength and at the same time the durability of the materials for wood pavements. The following description of these experiments and the resulting conclusions are taken from a paper of M. P. Labordere, Engineer of Bridges and Roads, and M. F. Austett, Director of the Municipal Testing Laboratory of Paris, prepared for presentation at the Sixth Congress of the International Association for Testing Materials:

Up to the present time the only treatment to which the woods used in Paris are subjected has the aim of diminishing decay. It consists in impregnating the newly cut blocks with a heavy coal tar oil which is rich in phenols; this impregnation is as a rule simply effected by means of immersion. The Municipal Testing Laboratory, however, has for some years been occupied with securing some better impregnation by making the heavy oil enter the wood under a pressure of 5 kg. The first series of experiments which was executed in the laboratory in 1908 and 1909 brought out the conclusion that the impregnation with heavy oil under pressure improves the wood as regards the physical qualities, because it diminishes the porosity of the blocks (that is to say, the quantity of water which is capable of being absorbed by the wood after immersion), as well as their expansion under the influence of moisture, but that it remains without effect on the mechanical strength of the wood.

In order to compare the mechanical strengths of wood prepared in different manners the pressure per square centimetre which enacted in the direction of the fibres will produce crushing was adopted as a measure of this strength. The specimens used in these experiments were prisms of 75 x 75 mm. basis and 125 mm. height, and they were obtained by cutting three equal specimens out of each of the blocks, the blocks serving for the experiments being 240 x 80 x 120 mm. Care was taken to keep the different blocks employed for these experiments apart from one another, to number the blocks of each balk from one end to the other, and to mark each of the specimens cut out of each block in such a way that the specimens belonging to the same fife reckoned in the longitudinal direction of the balk could be compared. The different blocks of one and the same balk were submitted to different treatments, and the specimens cut out of these blocks were crushed in the hydraulic press.

The determination of the crushing strength does not offer any difficulties; for in the moment at which the specimen fails the pressure gage of the machine will mark a sudden fall. In order to take account of the effect of humidity which cannot be avoided on the roads, care was taken in each case to experiment on two specimens in the dry state, and on a third specimen which had been immersed in water for 30 days.

As the length of the longest balks, which the laboratory had at its disposal, 2.30 m., does not permit of cutting more than 18 blocks (or 18 comparable specimens), and as moreover the number of methods of preparing the specimen for the test was greater than 18, it was necessary to agree upon a reference basis for all these experiments. This standard was taken as the strength of an ordinary crude block and consequently in each balk two blocks at least were reserved which were left in the crude state and sawn into two specimens to be crushed in this state.

Attention having been drawn to various attempts of improving the wooden pavements by mixing the oil, with which they were to be injected, with alkaline carbonates and silicates, a study was made in the experiments of the influence upon the quality of the pine wood of a mixture of the following products:

Pine tar.
Alkaline carbonates (sodium or potassium).
Sodium silicate.

In order to study the conditions of the experiments the temperature of the bath was varied and in a more restricted manner also the proportions of the chemical products applied were varied.

The experimenters used a bath of pure pine tar heated up to 60, 80 or 110° C. They then, at analagous temperatures, made use of pine tar to which one of the following ingredients had been added:

Sodium carbonate......	2 grammes per litre of tar 4 grammes per litre of tar
Sodium silicate	4 grammes per litre of tar

The results obtained did not show any appreciable superiority of the one or the other bath composition.

Raising the temperature of the bath, on the other hand, produced a marked increase (12 per cent.) in the strength of the specimens which had been kept dry; but it had no appreciable effect on specimens which had been preserved in water.

The objection to this process was the high price of the pine tar. Attempts were then made to replace this product by a low price hydrocarbon, and the heavy coal tar oil which is used in the works of the city of Paris for impregnating wooden pavements was employed. The impregnation was effected under the same conditions as with the pine tar at temperatures lying between 112 and 140° C. With the highest temperature applied the strengths became the same as with the bath of pine tar, at the lowest temperatures, however, the strength was equal or even inferior to that of the ordinary crude blocks. This showed the possibility of employing the heavy tar oil in the place of a vegetable tar, but only on condition that the temperature of the bath be raised up to something between 115 and 140°, and probably best to 125 or [illegible]°.

As an improvement had been realized by the application of a complex bath (liquid No. 7, heavy oil, sodium carbonate), steps were taken to find the cause of this amelioration, and the experiments were recommenced by adding successively to the heavy oil some carbonate of soda (liquid No. 8) and some silicate of soda (liquid No. 9).

The strengths which, in the case of blocks treated with the mixture of sodium carbonate and silicate, had remained inferior or at the best equal to that of the crude blocks, underwent a sensible increase when the wood was treated alone with carbonate and, more still, when treated alone with the silicate. This result appeared at first decidedly contradictory.

[illegible] trary, decidedly more favorable in the case of balks impregnated at [illegible]

It appears then that, [illegible]

found for the blocks which had been kept in the dry were as follows:

		Mean strength.
Non-treated blocks		323 kg cm²
Temperature of bath	80°	337 "
	90°	347 "
	100°	330 "
	110°	358 "
	120°	345 "
	140°	487 "

Fresh experiments were conducted by heating blocks in baths up to 150 and 200°, care being taken to make the bath simply of tar or heavy oil, in order to verify the correctness of the previous conclusions relative to the usefulness of the mineral constituents.

The temperature of 200° was not exceeded because at that temperature the wood begins to visibly undergo disaggregation. The escape of the constitutional water leads to the production of numerous fissures, parallel to the fibres, which would certainly not be unobjectionable, if it were only on account of the facility which the cracks provide for water to enter into the wooden paving.

The new baths studied gave sensible improvements over those previously applied, as the following figures will show:

Temperature of the bath.	Mean strength.
150°	516 kg/cm²
200°	536 kg/cm²

It was therefore concluded that up to 200°, the limit of temperatures admissible for impregnation baths, a rise in the temperature of the bath will lead to an increase in the strength of the pavement. It appears, however, that, with regard to the improvement of the strength, little would be gained by heating the wood above 130 or 140°. The inconvenient production of cracks or fissures, which allow the water to penetrate from outside, and the heavy expense incurred by heating the wood to very high temperatures would render it advisable to limit the temperature of the bath to these figures.

As a further experiment some wooden blocks were heated in a dry air stove, at the same time that other blocks of the same balks were being heated in a heavy oil. The temperature was the same in the two cases, 200°. There was the increase of the strengths in both cases, though less marked in the former than in the latter. The result was, however, sufficient to put aside the hypothesis of an improvement of the wood simply by the action of the oil. It would therefore appear that the improvement is, to a large extent, at least due to the dehydration of the wood and to a transformation of its fibres wholly owing to the action of heat.

It would moreover appear that experiments conducted a few years ago in America (related in the work of Petsche: Wood, page 272) have established that, after heating wood up to a temperature ranging from 150 to 200° under a pressure of from 10 to 14 kg. per cm. square, a blackish antiseptic mixture is formed which remains imprisoned in the wood and which contains acetic acid, acetone and tarry matter. Should it be these substances which increase the strength of the wood? It would be premature to form more than hypotheses as regards this point.

However that may be, heating in the dry state, such as was employed in the Municipal Laboratory for certain blocks, could not practically be applied, because the blocks of wood heated in the dry would lose their water more rapidly than when heated in oil and would begin to split. At 200° moreover they would undergo a very sensible superficial carbonization. It was, therefore, concluded that it must be the heating in the oil which is the essential thing in improving wood, and for reasons already stated the temperature of the bath should be fixed at 130 or 140°. There remained the question, for how long a period the immersion in the hot bath should be continued.

A pretty long period is forcibly necessary; for the elevation of the temperature must be progressive, lest the humidity contained in the wood should suddenly escape giving rise to fissures. In the French experiments the blocks were always put in the cold oil and the oil heated. In industrial processes this practice might be replaced by the use of several successive baths at increasing temperatures. The length of the heating period which was 10 hours in the first experiments has progressively been reduced to 8, 6 and 3 hours. It is with this last mentioned period of 3 hours that the highest strength was obtained at temperatures lying between 150 and 200°.

Experiments made with heating periods of from 2 to 3½ hours have demonstrated, that up to about 3½ hours an improvement can be noticed which is practically proportional to the length of the heating period. It was, therefore, concluded that it will be advisable to fix the heating period so far as possible at 3 or 3½ hours. The exact determination of this period depends upon the relation between expense and improvement realized, and practice alone can decide this point. The results so far alluded to all concern specimens which had been kept in the dry, although particular precautions were not taken to dry the specimens more than the surrounding air. This condition is very different from that of a wooden pavement laid on a public road, where it is always more or less soaked with water, both by rain and the frequent sprinklings.

In order to meet this later condition all the experiments mentioned above were renewed with specimens kept for 30 days in baths filled with water. Contrary to what had been established with regard to the dry specimens, the experiments yielded under these new conditions much less important results. The investigators concluded that it would therefore be advantageous to prevent the penetration of water into the wood so far as possible, in order to secure all the benefits of the hot treatment. The experiments seemed to demonstrate that to prevent the soaking of the pavement with water, impregnation by immersion and heating even up to high temperatures of 150 or 200° in heavy oil or in tar constitute altogether insufficient remedies. From experiments conducted in 1910 it was concluded that creosoting under pressure, which makes the oil penetrate more deeply into the wood, prevents the invasion of the wood by water. Experiments were therefore conducted by making this treatment at high temperature sometimes precede, and sometimes succeed the impregnation. To further vary the experimental conditions, the heating was effected sometimes in an oil bath, sometimes in a bath of dry air. The experiment seemed to have established that creosoting under pressure combined with heating noticeably improves the strengths of blocks kept dry. But as regards the blocks which had been kept immersed this treatment only resulted in imparting a strength which was about equal to that of the crude block. This was a remarkable fact; for the amount of water which is absorbed by wood is much reduced by creosoting under pressure as is well known. One may therefore declare that it is the first portions of water absorbed after desiccation which play the most injurious part. It might therefore be concluded that creosoting under pressure does not suffice to counteract the detrimental effects of soaking with water.

Efforts were made to find other means for preventing this penetration and experiments were tried with a view to surrounding each block with a superficial protective layer. This layer can easily and economically be obtained by the aid of a pitch or tar analogous to the products which are used in tarring the macadamized roads. It was found that when the wooden blocks, crude or creosoted, and consequently very permeable were simply plunged into hot pitch, there is indeed, formed about them a shiny continuous coating which suffices to keep the water out to a large extent. The increase in the weight of such blocks which have been immersed in water is indeed considerably diminished by this treatment especially when they are left in the pitch for appreciable periods (10 minutes).

When this process of coating with pitch with creosoting by immersion and particularly with creosoting under pressure was concluded altogether remarkable results were obtained. It is, however, particularly a prolonged lying of the wood in pitch which is very efficacious in preventing its invasion by water. When the immersion period lasts a sensible time, the holes, which were formed in the coating of the pitch at the moment of their being soaked by the escape of the water contained in the superficial layers of the block which were exposed to contact with the hot tar, are indeed being closed.

Attempts were made to confirm the conclusion as to the efficacy of pitch by measuring the crushing strengths of specimens which have been cut out of blocks plunged into pitch. But owing to some circumstances which have remained obscure, the results of this experiment were really contradictory. The experiments show for blocks, which were coated with pitch and then immersed in water, sometimes an increased strength and sometimes a decreased strength.

Meanwhile, however, the investigations conclude from the very small quantity of water which penetrates into blocks coated with pitch, and especially in the case of those which remain for 10 minutes in pitch at 110°, that there is some advantage in making them undergo this treatment after heating. In order to simplify the operations it might perhaps be best to heat the blocks in the pitch itself, since the nature of the heating bath does not appear to have any important influence; but it will only be after some more prolonged experiments that the practical applicability of this heating process can be decided upon.

As regards the wear of the protected coating due to the traffic, this can be obviated by proceeding periodically to a superficial tarring of the road, under the same conditions as with macadamized roads.

The experiments show that the tar can be made to enter to depths of several mm. into the wood, when sprinklers at high pressure are applied.

The conclusions arrived at by Messrs. Labordere and Anstett as the results of these experiments are as follows:

From what we have explained we consider that the crushing strengths of wooden paving blocks can considerably be improved by heating in a bath of heavy oil tar at a temperature of 130° or 140°, maintained during a period which may provisorily be fixed at 3 hours, but which further experiments may perhaps permit us to diminish. The heavy oil to be used should be chosen such as does not contain any notable quantities of products which are volatile at 140°.

In order to reduce the diminution in the strengths which is due to the inbibition of the wood paving with water, we may employ, separately or together, the two following processes:

1. Add to the oil bath a small quantity of sodium carbonate and of sodium silicate, which may approximately be fixed at 0.6% for the carbonate and at 0.1% for the silicate.

2. Immerse the blocks after heating and creosoting under pressure in a bath of liquid pitch at 110°, the immersion being kept on for about 10 minutes; then apply superficial tarring of the laid pavement as described above.

The pitch to be used should be half-dry gas pitch including about 10% of anthracene oils.

The second method appears to be of a much superior efficacy. As long as the pavement will remain in good condition the protective layer will not be attacked. The addition of alkaline salt is yet not useless; for it permits of maintaining a certain improvement even in cases where, by consequence of the wear, the blocks should no longer be protected against the infiltration of an appreciable amount of water.

COMMERCIAL UTILIZATION OF PEAT FOR POWER PURPOSES.*

By H. V. Pegg, of Belfast.

The question of the utilization of peat fuel for power purposes has received a large amount of attention from engineers for many years past. Efforts in this direction have mostly taken the shape of some form of preparation of peat fuel in order primarily to get rid of the superabundant moisture in the fuel. Very large sums of money have been spent on peat-preparing machinery with generally very inadequate results, hence it has always appeared to the author that, in order to bring the utilization of peat to a commercial level, the first consideration would be the utilization of the peat as far as possible in the condition in which it leaves the boglands without any preliminary and expensive machine treatment.

The author had the opportunity about seven years ago of experimenting with air-dried hand-cut peat fired into a special form of gas-producer. With all gas-producers using bituminous fuel the main trouble is to get rid of the tarry by-product. In this instance the gas-producer was arranged to work intermittently, there being periods of "blowing" during which the fuel in the producer was urged to incandescence, and periods of gas-making during which the tarry by-products were passed through the incandescent fuel, where they were split up into gas. The chief difficulty experienced with this plant was the high thermal value of the gas generated, about 330 B.Th.U. Owing to the high and varying percentage of hydrogen in the gas, it proved unsuitable for use in the works gas-engine; and although the plant was running more or less continuously for ten days driving the whole works, very considerable trouble was experienced, not only in the engine, but also in the plant, [illegible] the producer plant being decidedly sensitive in regard to this latter [illegible] patents and to the author's specification. This plant, which has been running since last September, has been so often dealt with in the daily and technical press that there is no need for the author to dwell upon the details of the plant, but he proposes to make a few remarks in regard to the difficulties experienced.

Air-dried peat is not a very convenient fuel to fire into the producer, and as it was uncertain whether it would be possible to burn the fuel direct in the form in which it came from the boglands, provision was originally made in the plant to deal with peat fuel prepared by being reduced in size to blocks of about 5 in. cube; but it was found possible to dispense with the preliminary treatment, and the construction of the plant was thereby considerably simplified.

As regards the general running of the plant, last October it was subjected to a test run of six hours' duration with a load of 250 brake horse-power, the peat consumption per brake-horse-power hour averaging 2.55 lb., the peat fuel containing 18.98 per cent. of water; this was with both producers running, although the load was considerably below the total capacity of the plant. When necessary it has been found that the above load can be safely carried with either producer working singly, and the plant has run under these conditions for several days.

It will be noted that the percentage of moisture in the fuel during the above test was unusually low. This was owing to the unusually dry summer of 1911. During November, and especially December, last the fuel fed to the plant was extremely wet, as the rainfall in those months was very heavy and the fuel supply was and is entirely exposed to the weather. The plant, however, worked just as well with sodden peat as it did with the drier peat, the only difference being the amount of fuel consumed. The amount of water in this "sodden peat" varied considerably from day to day, and the exact percentage was not arrived at; as near as could be estimated it was at least 70 per cent.

The separation of the tar from the gas was the chief difficulty to be overcome; it was found far better to rely on an ample watery-spray through which the gas passed rather than any form of a coke-scrubber, as the coke rapidly became clogged with tar. The main portion of the tar was thrown out into a tar-sump by a centrifugal tar-extractor; but unless the gases were subjected to a thorough washing and cooling by the water-spray above referred to, it was found that a certain proportion of tar got past the extractor, collected in the gas-mains, and finally found its way into the gas-engines. It was a matter of experiment as to the precise amount of water sprayed into the cooler which was necessary in order to ensure that the tar vapor should be sufficiently condensed before reaching the centrifugal extractor, so as to enable the extractor to effect the needful separation. As now arranged, the proportion of tar in the gas after passing the extractor is small, and the engine-valves do not want cleaning out more than once a week.

When first started, the plant generally, and especially the producers, required a thorough cleaning once a week; at the present date the plant can be run, if necessary, for three weeks without cleaning, though the weekly cleaning generally takes place as a matter of policy. This result has been obtained owing to the increased amount of washing-water used, which now amounts to about 7 gallons per brake horse-power per hour. The proportion of tar recovered is about [illegible] per cent of the weight of fuel consumed, and during the [illegible] stages of the running of the plant a certain amount of this tar was sold to tar-felt manufacturers at a [illegible] per ton, [illegible] in this direction ceased owing [illegible] odor which per[illegible] not only to the tar itself, but to all the [illegible]

---

* [illegible] Belfast, [illegible]

Experiments have also been made with the tar in oil-burning boilers, but owing to the very high percentage of water in the tar—up to 50 per cent.—and the large quantity of solid matter also present, a very large amount of preliminary treatment is necessary. For a considerable period the tar at Portadown was used mixed with coal and burnt under a Stirling boiler; the precise heating value of the tar so consumed has not, however, been ascertained. At the present time the whole factory at Portadown is run entirely on peat-fuel, the consumption being about 44 tons per week, of which the producer plant takes about 22 tons. The nature of the peat varies considerably; with good black heavy peat the weekly consumption for all purposes drops as low as 35 tons, and with light top peat from the surface of the boglands the consumption rises to 54 tons. It is also interesting to note that the quality of the peat is reflected in the carrying capacity of the barges which bring a load of 35 tons with heavy peat and 24 tons light peat. The peat is unloaded from the barges and conveyed to the producer platform and boiler-house by a transporter. Clinker troubles are not often experienced, and only when burning the inferior grade of peat, the presence of sand in the fuel causing the trouble.

The author is indebted to Mr. W. A. Mullen, manager at the factory of Messrs. Hamilton Robb, Limited, for the following figures in regard to the cost of fuel, these figures being given on June 12 last:—

Cost of Running Factory on Coal Per Week.

	£	s.	d.
8½ tons of anthracite at 35s.	14	17	6
19 tons of steam coal at 17s.	16	3	0
	31	0	6

Cost of Running Factory on Peat Per Week.

	£	s.	d.
Say up to 50 tons of peat at 6s.	15	0	0
Weekly saving	16	0	6

Allowing for 15s. for extra labor, the net weekly saving figures out at £15 5s. 6d.

The author would here refer to the letter in Engineering of January 26 last, in which the general manager of the Power Gas Corporation, Limited, gives some very interesting particulars in regard to peat plants, more especially an ammonia-recovery plant working in the south of England. It would be of great interest if some figures as to the working costs of this plant could be laid before this meeting. It will be noted that plant is worked with ammonia recovery, which would mean a very much larger plant than that at Portadown. The amount of the nitrogen in the South of England peat is apparently high, and would appear to be considerably more than in the peat used at Portadown, analysis of which is appended hereto, together with analysis of the refuse tar and gas from the producer.

Analysis of Tar Made by Messrs. Totton and Hawthorne.

Sample of Tar No. 2.

The sample was grey when received, but very quickly turned black. On distillation it yielded:

	Per cent.
(1) Water	37.2
(2) Light oils (distilling below 230 deg. Cent.)	5.8
(3) Middle oils (distilling at 230 to 270 deg. Cent.)	8.3
(4) Heavy oils (distilling above 270 deg.)	23.2
(5) Coke	17.8
(6) Loss	7.7
	100.0

Much frothing occurred until the water was distilled off. Towards the end the temperature went higher than a mercury thermometer will record (360 deg. Cent.). The different fractions obtained were as follows:—

1. Water, faintly acid to litmus. Phenol could not be detected.

2. Light oils (below 230 deg. Cent.) became rapidly dark red in color. Specific gravity of crude liquid 0.930.

3. Middle oils (230 deg. to 270 deg. Cent.) became dark red. Specific gravity of crude liquid, 0.944.

4. Heavy oils (above 270 deg. Cent.), on standing, crystals of paraffin wax separated out to the extent of 5.42 per cent. of the fraction (= 1.26 per cent. of the original tar). The specific gravity of the liquid portion of this fraction was 0.906.

Analysis of Sample of Peat.

(Received on September 14th from Mr. Hamilton Robb, Portadown.)

Proximate Analysis.

	Per cent.
Water	18.98
Volatile matter	55.17
Fixed carbon	24.75
Ash	1.10
	100.00

Ultimate Analysis.

	Per cent.
Carbon	44.60
Hydrogen	5.42
Nitrogen	0.97
Ash	1.10
Moisture	18.98
Oxygen (by difference)	28.93
	100.00

Analysis of Average Sample of Gas During a Ten Hours' Trial.

Moisture in Fuel, 26 Per Cent.

	Per cent.
CO_2	10.6
CO	20.1
H_2	13.0
CH_4	3.7
Total Combustible	37.7
Calorific value (calculated from analysis)	144.0 B.Th.U.

THE BEAUHARNOIS ELECTRIC COMPANY.

A new electric company has obtained letters patent from the provincial government of Quebec. It will be called the Beauharnois Electric Company, Limited. The new company will have powers in the city of Montreal, and in the counties of Laval, Jacques Cartier, Hochelaga, Laprairie, Chateauguay, Beauharnois, Two Mountains, Argenteuil, Soulanges, Vaudreuil, Terrebonne, L'Assomption, Chambly, Huntingdon, Napierville, St. Jean and Iberville. They intend to construct large power houses and electric plants at different places.

The Beauharnois Electric Company, Limited, is an independent company and they declare they will never consent to join any trust or combine of companies. The first generating station will likely be constructed at Beauharnois and the power will be taken from the rapids in that locality.

THE LATERAL PRESSURE OF LIQUID CONCRETE.

The lateral pressure of liquid concrete is a most important question for the constructing engineer. In a paper before the Institution of Civil Engineers Mr. H. St. G. Robinson has presented some notes on a series of experiments to ascertain this pressure. The first experiments were conducted about five years ago, during the construction of a heavy retaining wall, by placing boards between the uprights of the vertical forms and noting the deflections caused by the various heads of concrete.

These experiments, however, were thought to be somewhat unreliable, owing to want of refinement, and Mr. Robinson has since carried out further experiments of a similar nature, but with an apparatus constructed to secure more accurate results. This consists of a strong cast-iron chamber, fitted with a sheet-rubber working face, and is arranged so as to be readily fixed in position on the forms. The chamber is filled with water or other suitable fluid, and the pressure exerted by the concrete against the working face is recorded on two sensitive low-pressure Bourdon gauges, conveniently situated behind the chamber.

In the apparatus first used the chamber was formed of timber lined with zinc; this, however, distorted on becoming wet and was abandoned in favor of cast iron. A glass tube water-column was also fitted for recording the pressures, but it was thought that the movement of the pressure face caused by the displacement of the water was not conducive of accuracy, as it caused the concrete to arch over, a movement that does not occur when Bourdon gauges are used.

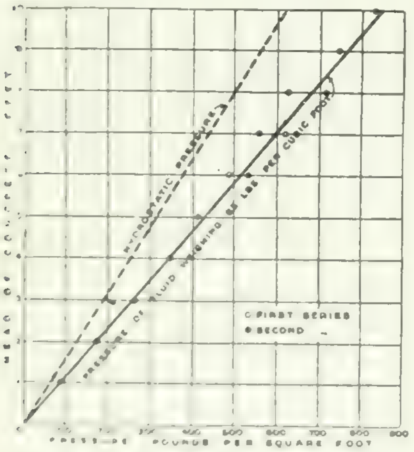


Diagram of Comparative Pressures.

A large number of experiments were made on different types of concrete structure. In heavy walls, large piers, and other members of fair size the lateral pressure exerted was found to be fairly uniform and practically constant for equal heads; but in reinforced-concrete columns of small dimensions, thin walls, and other light concrete work, the [illegible] forms and the concrete, together with the arching action, [illegible]

[illegible]

[illegible] sets of readings were taken, and each point on the curve represents the average value at that head.

The second series was carried out on large piers 4 feet square, the concrete in this case being a 1:2:4 mixture of cement, sand and Thames ballast, weighing 145 pounds per cubic foot. The conditions as to mixing and laying were similar to those of the first tests, and the concrete was carried up to a height of 10 feet above the centre of the pressure face. Each point of this second series represents the average of six readings.

In the first series the temperature was fairly uniform throughout, while in the second considerable variation was experienced; but the effect of the differences in temperature on the lateral pressure cannot be traced, and would appear to be very small.

The general conclusion to be drawn from these and other experiments is that the lateral pressure of concrete for average conditions is equivalent to that of a fluid weighing 85 pounds per cubic foot. For concrete in which little water is used in mixing the pressures are rather less, having an equivalent fluid value as low as 70 pounds per cubic foot in very dry mixtures.

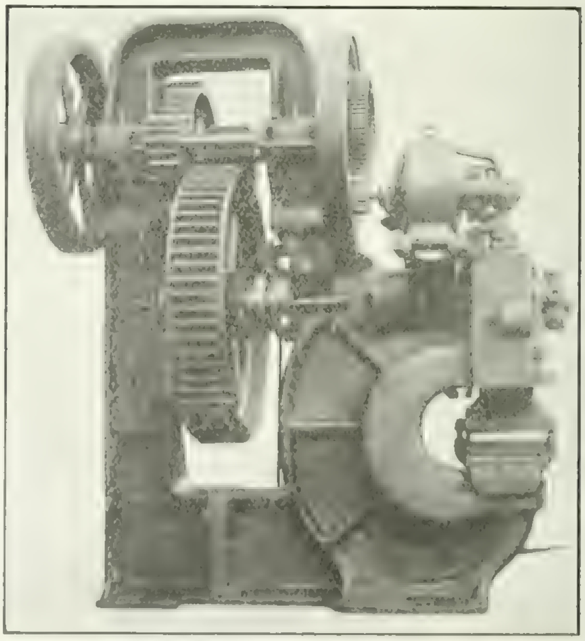
* * *

PUNCH AND SHEAR PRESS.

Economy of floor space, always an important item, is particularly so in a machine shop when it is desired to install any additional tools. The accompanying illustration will indicate how this may be effected in the case of a motor-driven punch and shear press, made by the Cleveland Punch and Shear Works, Cleveland, Ohio. The arrangement of overhead gearing renders it possible to make a very compact machine and one that is economical of floor space.

The machine complete with its motor weighs approximately 50,000 pounds. It is designed for very heavy work, having sufficient capacity to shear twelve inches of [illegible]-inch flat bars, and to punch a five-inch hole in [illegible]-inch plate. The various attachments, such as those for angle shearing, bar shearing, and punching are interchangeable.

The motor is of [illegible] horsepower capacity at 230 volts, and is of the well-known direct-current, commutating pole type, [illegible] adapted for this kind of work by the Westinghouse Electric and Manufacturing Company.



Motor-Driven Punch and Shear Press.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director

T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **60** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 12, 1912. No 11

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Canadian Public Health Association 451
The Calling of Tenders 451
The Canadian Highway Association 452

Leading Articles:

The Awakening of Canadian Irrigationists 435
Apprentices on the Canadian Pacific Railway 437
Compensating Grades for Curvature 438
The Disposal of Sewage Sludge 442
The Cylinder Performance of Reciprocating Steam Engines 444
The Strength of Wood for Pavements 445
Commercial Utilization of Peat for Power Purposes 448
The Lateral Pressure of Liquid Concrete 450
Punch and Shear Press 450
Investigation of Effect of Fire in a Large Reinforced Concrete Paper Mill 453
Canadian National Exhibition 455
Transportation of Materials in Modern Large Industrial Plants 456
The Municipal Zone System 457
Public Utilities and Regulations 459
The Simmen System of Railway Signalling and Despatching 460
Programme of Canadian Public Health Association 464
Personals 465
Coming Meetings 466
Engineering Societies 466
Market Conditions 24-26
Construction News 67
Railway Orders 74

CANADIAN PUBLIC HEALTH ASSOCIATION CONVENTION.

The second annual congress of the Canadian Public Health Association will be held at Toronto next week on Monday, Tuesday and Wednesday.

This Dominion Public Health Association was formed about two years ago as a result of the meeting of Federal and Provincial public health officials invited to confer with the Commission of Conservation of Canada.

The formation of such a society has been well justified to date by the interest and enthusiasm shown in its work. Last year's meeting in Montreal was well attended, not only by medical health officers, but also by a great number of engineers who are interested in sanitary and public health matters. A special session of the congress last year was devoted to such subjects as water supply, sewerage, town planning, and the removal of garbage, etc. This section, therefore, dealt with the questions of public health, which are in the province of the engineering profession. One of the features of the general session was a symposium upon the question of biological sewage disposal, and the papers and discussion contributed thereon were among the most valuable features of the congress.

There is a great lack of combined and sympathetic action between the medical and engineering profession where these professions overlap, in matters appertaining to municipal and sanitary engineering. We have had occasion to note this regrettable feature before. It can only be by cordial co-operation and becoming acquainted with others' aims and ideals, that the best results will be secured.

We feel, therefore, that the Canadian Public Health Association Congress should be well supported by the engineering profession at this coming meeting. We sincerely hope that the engineers will be present in far greater numbers than last year, and will enter into the discussions with interest.

◆

THE CALLING OF TENDERS.

In Australia there has been a good deal of discussion lately concerning certain questions of interest to Canadians. The discovery that, though the prices of British firms were considerably lower, contracts for material had been given by the Victorian Railway Department (as also indeed, by the New South Wales Railway Department) to German houses (principally Krupp's) produced some plain speaking by the Premier of Victoria, who had ascertained that, though the English firms had been given the "go by" because their goods were "not sufficiently known" to an official concerned for the public safety, their specifications comply with the requirements of the British Board of Trade, and that they have for many years supplied most of the other Australian States with the particular line of goods in question. Judging by the Premier's specific directions, **it is not likely that the lowest tenders will ever again be rejected** in Victoria without most adequate reason, and it is not improbable that similar directions will issue from the Government offices in Sydney. Since then the tenders for rails for the Transcontinental Railway have all been rejected, because of the prices asked, but the Minister concerned hoped to induce one of the firms at least to take "a reasonable view of the expenditure that should be incurred by the Commonwealth for the rails."

In future it can be reasonably expected that British contractors will receive as generous treatment from the railway officials of Australia as German contractors. Analagous cases to the above sometimes arise in Canada. We believe, however, that British firms are receiving fairer treatment than they did some time ago. There is still great room for improvement, however.

* * *

PANAMA CANAL EXCAVATION

The estimates of excavation remaining to be done after July 1st, 1912, in order to complete the Panama Canal, according to the Canal Record, show an increase of 16,903,000 cubic yards over the estimate of July 1st, 1911.

In the Atlantic Division, the increase is 295,000 cubic yards, chiefly to provide for silting in the finished channel not covered by the estimate of July 1st, 1911.

In the Central Division, an increase of 4,615,000 cubic yards is made to provide for an extension of slides and changes in the Obispo Division.

The Pacific Division has an increase of 11,993,000 cubic yards, of which 3,199,000 cubic yards are to cover excavation in the Canal prism, in the locks and dams, and silting in the finished channel, which has become necessary since the estimate of July 1st, 1911. The remainder—8,794,000 cubic yards—is for the newly begun excavation for the drydock, coaling station, and terminal at Balboa.

* * *

THE CANADIAN HIGHWAY ASSOCIATION.

The first sign-post of the Transcontinental highway was planted on May 4th, 1912, in the town of Alberni, on the west coast of Vancouver Island. The Canadian Highway Association, which is responsible for the inauguration of the idea of a highway from coast to coast, was formed at New Westminster, B.C., about eight months ago, and one of the outward symbols of the progress they have made, is this marking of the route of the Canadian highway.

The conception of a transcontinental highway is a magnificent one, and one which we hope will be carried to a successful conclusion. In his address to the Association at the recent Alberni meeting, President Kerr said:

> "As with the building of a new railway, so with the starting of this Canadian Highway, we have decided that the first actual step should be marked with fitting ceremony, and in this we have received splendid assistance from the towns of Nanaimo, Alberni and Port Alberni, our hosts on this occasion.
>
> "From now on the route of the Canadian Highway is eastward, with Halifax as its destination. British Columbia has nobly done its share, thanks to the untiring energy of our Minister of Public Works, Mr. Taylor, and his able deputy, Mr. [illegible]. Over [illegible] is being spent on road improvements in this province this year, and could we but procure the active co-operation of all the other provinces in Canada the road would be completed, and completed within three years.
>
> "The Province of Saskatchewan has decided to spend [illegible] on roads this year, and a total appropriation of [illegible], has been made for the roads of that province. This is to be spent within the next two or three years. In Manitoba, only $200,000 has been allotted for road-building. This sum is, in my opinion, inadequate to the needs of that province, for my recollections of Manitoba are anything but pleasant, and I know of some roads where this total amount could be expended and yet leave that particular road in an unfinished condition. Ontario is waking up to the need of good roads; this is largely owing to the activities of Provincial Commissioner of Highways MacLean, who has $6,000,000 to spend on his work this year. In Quebec, we find that old province giving $10,000,000 for road work, and I think I am safe in saying that there is more interest in good roads in that province than in any other in Canada to-day."

If this transcontinental highway serve no other purpose than to arouse enthusiasm for the good roads cause, its inception would be justified. The thought of a first-class road running through province after province from coast to coast, is one which, if carried out, cannot do else than promote the good roads movement throughout Canada.

* * *

EDITORIAL COMMENT.

It is understood that the steel work on the Quebec bridge will be begun by November next. The Quebec Bridge Commission has just completed an inspection of the progress made to date on the substructure.

* * * *

The citizens of Galt recently had a repetition of the floods which caused so much damage last spring. The recent heavy rain storms were the cause. The Provincial Government will soon be forced to move in the matter of flood regulation by the force of public opinion.

* * * *

The Provincial Government of Quebec has recently appointed a Parks Commission composed of Sir William Van Horne, W. D. Lighthall, J. C. Walsh, Senator Boyer, Dr. Lachapelle, Mayor Lavallee and A. Michaud, for the city of Montreal. To any one who is at all acquainted with Montreal, it will be appreciated that the step has been taken none too soon. The growth of the city during the last few years has been phenomenal. The narrow streets and thoroughfares, however, have caused an increasing traffic congestion which, if allowed to exist much longer, will have the effect of throttling future progress. There is ample room for work on the part of the new commission in developing a unified plan for the future growth of the city and to the relieving of the present congested condition.

* * * *

In putting a price upon any sort of work one realizes that there is a price at which under the most favorable conditions one can do the work. There are contingencies which arise in the course of a job which are not included in the ideal programme. Some of these can be removed by foresight and good management, others seem to come under the class of "unavoidable." The bidder must not only decide the cost under average conditions, but must judge whether the conditions of the proposed job are average or special. He must balance the probabilities of unforeseen circumstances and decide how narrow a margin he dares to leave between the actual possible cost of the work and a living profit. The wisest bidders are not commonly those who disregard difficulties.

INVESTIGATION OF EFFECT OF FIRE IN A LARGE REINFORCED CONCRETE PAPER MILL.

At 11 p.m., May 25th, 1912, fire broke out at the pulpboard mill of the Androscoggin Pulp Company, South Windham, Maine. The Aberthaw Construction Co. built this structure in 1906, L. W. Jones, of Milton, New Hampshire, being the engineer. The building is of reinforced concrete excepting for a wooden roof carried on trusses of the same material. The window frames and sashes are also of wood.

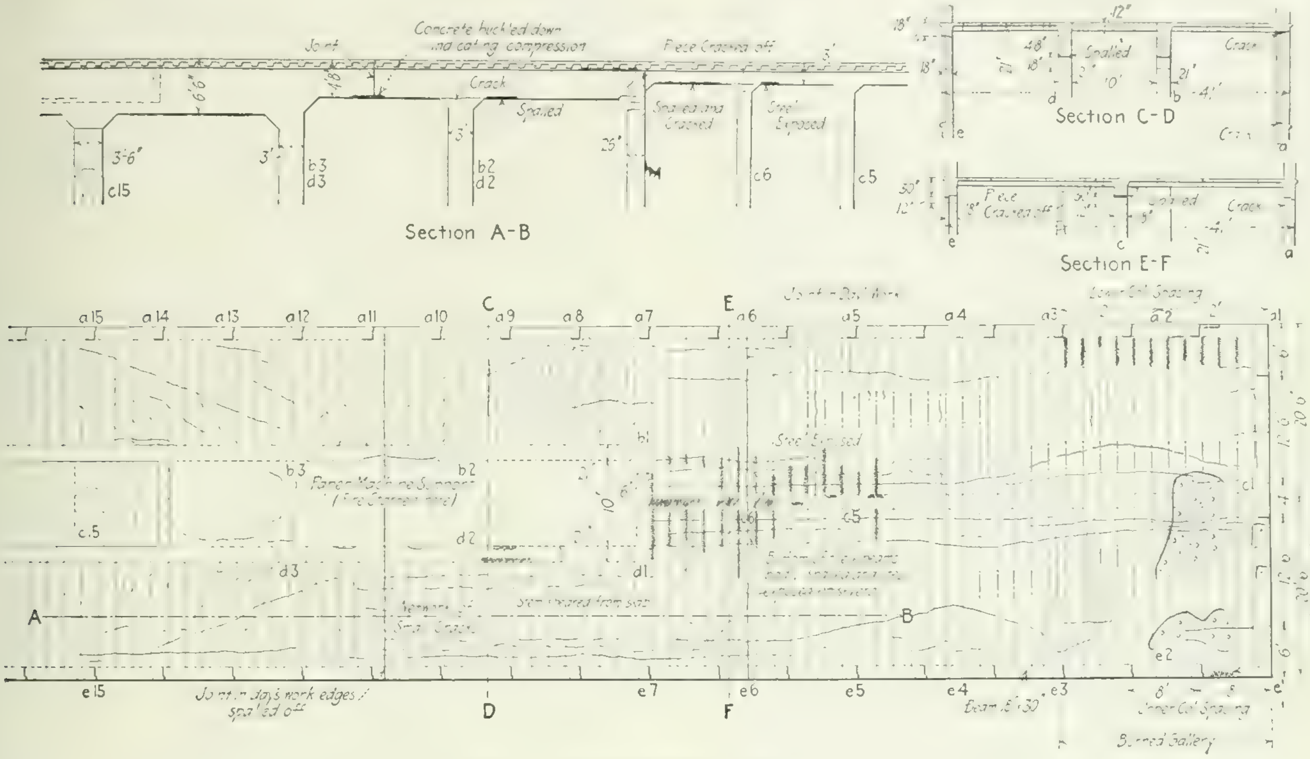


Fig. 1.—Androscoggin Pulp Co. Fire.

The blaze started below the machine room floor in the main building and set fire to the wooden panelling between the piers forming the outside wall of the lower story of the building. The burning panels set fire to the wooden sash of the window of the second story and from there set fire to the roof and to a wood and plaster gallery which was located along the side of the mill.

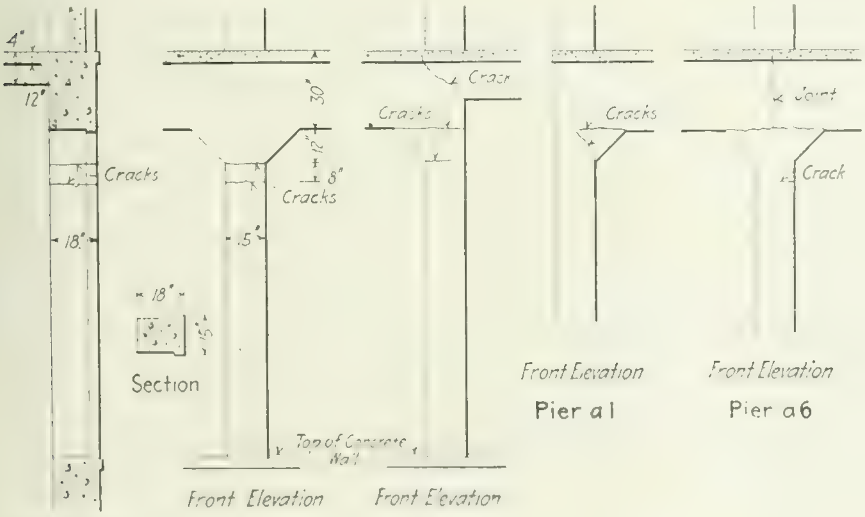


Fig. 2.

The fire was extremely hot, there being a large quantity of dry pulp-board piled inside the building and which burned at the same time. The intenseness of heat was so great that it bent and partly melted cast iron. Streams of water were thrown at the hot surfaces with considerable force and altogether the fire offered a particularly interesting test of the effect of fire on reinforced concrete work.

On May 28th, Morton C. Tuttle, secretary of the Aberthaw Construction Co., examined the building with Seth A. Moulton, of Portland, Maine, the engineer in charge of the rebuilding, and the latter made many shrewd suggestions as to the cause of some of the results observed. A few days later the engineer and superintendent of the Aberthaw Construction Company made a careful investigation and report, which is embodied herewith.

The fire started under the first floor in the middle of the building (Fig. 1). As far as could be observed, the principal effect of the heat was to expand the floor, causing a movement of the column. It was reported that on the morning of the 26th the end wall of the mill was observably out of plumb. At that time the concrete was generally so hot that one could not stand putting his hand on it outside of the building. Later on, this particular wall drew back again to the perpendicular. The crack at the pier, crack "A-7" (Fig. 2) shows the effect of this movement on the outside wall, where the size of the wall beam changes due to different spacing of the columns. The cracks above and below the bracket of the column also seemed to indicate the longitudinal movement of the floor.

The cracking of the columns at the side of the building seemed to indicate the same sort of expansion. These cracks occurred at both top and bottom of some of the columns. The top cracks are shown in Fig. 2.

It will be noticed (Fig. 1) that in the section of the floor at the wall end of the building (right end) the main cracks run longitudinally and are clearly marked, and that the cracks at right angles to the building are comparatively few.

Where the floor span decreases next to the large girders which support the paper machine the cracks begin to run at right angles, and end with diagonal cracks which die away into the part of the floor which was not heated. It is suggested that the cracks at the wall end of the building which are parallel to the main girder occurred because of the unequal heating of the big mass of this girder and the thinner floor slab. causing unequal expansion of the two masses. A similar cause may have produced the crack along the wall beam.

Because there was a considerable amount of water thrown upon light colored pulp and because the under side of the ceiling was blackened by the smoke from the fire, when the water carried the pulp through these cracks in the floor it showed these cracks very clearly on the under side. The cracking of the floor at the end of the paper-machine foundation is shown on cross-section "CD" (Fig. 1.)

At the end of the machine room, in the gallery, there was a stock house built with concrete piers, supporting a wooden floor carried on steel beams, with wooden columns carrying a wooden roof. The walls of the building were "hy-rib" metal. At the base of the building there were some brick walls. The interesting feature of the particular building was that the foundation piers which were subjected to high heat were built of concrete, rich in mortar. This concrete withstood the action of the heat much better than did the granite concrete of the main mill.

The stone used in the concrete on this job was coarse grain crushed granite. The sand was of good quality and the work was carefully done. The placing of the steel was better done than on the average job.

* * *

NON-PULSATING PUMPS.

A most interesting exhibit at the Canadian National Exhibition was that shown by the Luitwieler Pumping Engine Company, of Rochester, N.Y.; Canadian agents, The General Machinery Co., Limited, 526 Traders Bank Building, Toronto. One of the pumps exhibited by them is a triplex non-pulsating pump with 4 x 6-inch cylinders and six-inch stroke. The pump is operated by a five-horsepower motor, and pumps about 150 gallons per minute. It is designed to operate from 150 to 200 pounds pressure. One [illegible] vibration in the running of the pump. The power is applied continually and evenly at all times by a nicely balanced arrangement of [illegible].

The [illegible] of the Luitwieler pumping engines [illegible].

[illegible]

The power transformed by the cams is applied to the pistons in cylinders at any depth below the pump-head through two balanced sets of rods, hung one from each of the sliding yokes. By means of this arrangement it is always possible to keep the pumping engine at the surface no matter what the depth of the well or shaft may be. As the moving reciprocating parts throughout the entire equipment are in equilibrium at every part of the stroke, operation is effected upon much less power than ordinarily is required.

The pump shown at the Exhibition was an electric pumping engine operating at full speed while supported upon eight water glasses standing in pairs bottom to bottom upon an ordinary square saw-horse. It was not braced or supported in any manner. The pump was operating at 50 revolutions or 100 pump strokes per minute, and with so little vibration that a coin placed on edge on the pump frame remained without falling.

The non-pulsating triplex pumps are used for suction and pressure service, and are particularly adapted to water supply and fire protection of tall buildings and to municipal and corporate waterworks. The company use the duplex cam type upon all well work, with submerged pumping cylinder whenever possible, or the double chamber pump when suction is preferable.

All pumps made by the company are adaptable for direct connection with any kind of driving power. Valves of various types are used according to the nature of the substance to be pumped. The pumps are made to handle any liquid or semi-fluid matter.

* * *

CONSOLIDATION OF STREET CAR FRANCHISES.

During the past few weeks there has been quite a change in public opinion in respect to the British Columbia Electric Railway Company. For many weeks past, a Greater Vancouver committee has been at work trying to effect a consolidation of the street car franchises of the various surrounding municipalities. This city has the option of buying the system in the city proper in 1918, this will not give control of the franchises in outside places, where they extend for varying terms of years. Some of the aldermen think that because they have the option of buying that they have the street railway market cornered, and are standing firm. On the other hand, ratepayers are now taking up the matter, and at a meeting in Fairview voted against this attitude and suggested that the people be given a chance to express an opinion in the matter. Even those who stand for muicipal ownership, confess that civic ownership of public utilities might obtain in instances. create irritation and that these franchise entanglements would be quite an incubus. It is realized that while the principle of civic ownership o public utilities might obtain in instances, this principle is subject to qualifications and the laws of general expediency. At first it was thought a twenty-five year term was too long for a general consolidation, but it is recognized by many that such a period is not out of the way if extensive enlargements are to be constantly carried on, for money cannot be had at a satisfactory price with a shorter term. Business men recently returned from the Old Country report that investors there are looking for a better rate of interest than formerly. That being the case, a short-term franchise would be of little use to the British Columbia Electric, which will need much money. With the feeling now obtaining, it is not improbable that the company and the city will be able to get together and agree to some mutual proposition, especially in view of the fact that at Point Grey there is a strong desire to have the street cars running once more.

CANADIAN NATIONAL EXHIBITION.

There has not been a season in which so much competition has been shown among mechanical manufacturing firms as this present one. A walk through the Machinery Hall showed many European firms that were competing against local firms and those from the United States, that heretofore have had the displaying space to themselves.

The Consolidated Optical Company, Limited, of Toronto, again secured their advantageous station near the main entrance of the Manufacturers' Building, and displayed a line of surveyors' instruments and meteorological devices that are made in Canada. In connection with the latter they showed a wind-gauge and automatic recorder, made-to-order for Government officials.

Messrs. William Hamilton Company, Limited, of Peterboro', Ont., had a prominent position in the Machinery Hall, and took full advantage of the same to demonstrate the qualities of the Samson Water Wheel. One large turbine was erected in their booth, and ample facilities were given to examine the mechanism.

The Canadian Boving Company, of Toronto, had an interesting exhibit in the north-east portion of the Machinery Hall. This was made up of a twelve horse-power "Bolinder" semi-Diesel crude oil engine driving a dynamo and water pump, the easy working of the latter being shown by a stream of water flowing into a large galvanized iron tank. A large sign overhanging their exhibit stated that this firm make a specialty of power apparatus, and numerous devices demonstrated below amply bore out the statement.

Messrs. John Millen & Son, Limited, occupied the south-west corner of the Machinery Hall, and had on display an interesting exhibit of chains, and a cabinet which was fitted up for the special purpose of demonstrating the mechanism of the "Coventry Noiseless Chain," for which they are the agents. They also had a number of link chain and several blocks and tackles, together with other labor-saving devices dependent upon chains for their operation.

The Canada Metal Company had their usual artistic and useful exhibit of various alloys and ingot metals, and were showing samples of lead wool and demonstrating its qualities as a calker for pipes. This wool resembles in appearances the steel wool often used by cabinet makers to remove varnishes and polish from woodwork. It is in very thin threads and well tangled together; resulting in a mass that is soft and spongy to the hand.

Messrs. Baines and Peckover, of Toronto, secured the southeast corner of the Machinery Hall and showed products coming under the title that they have selected for their exhibit, viz., "The Iron Store." Bar iron and steel, both plain and ornamental were shown in various lengths, and one wall was devoted to the display of "Atlas" metals, alloys and babbitt. The front of their booth is taken up with two or three rolls of "Lincona" belting, for which they are the agents. This belting is a composition with a canvas finish on one or both sides, resulting in a surface that has a powerful grip on the pulleys.

The General Machinery Company, local offices Traders Bank Building, Toronto, were demonstrating the merits of the Luitwieler pump in their exhibit, and for this purpose have erected a tripple stroke pump and a means of showing the force and evenness of the stream. A hydro-pneumatic water supply system is shown in the rear. This is intended to give a high-class water service to country residences and other buildings difficult of access to the mains of a municipal pumping plant. The pump was driven by an electric motor, and the latter controlled by the water level in the tank. A device was also shown whereby a gasoline engine may be started at a signal, which is automatically given, when the water in the tank falls below a pre-ascertained level. The electric device is entirely automatic but the gasoline option is a good substitute in localities where a reliable electric pressure cannot be obtained.

Messrs. Wettlaufer Brothers erected a large tent to the southwest of the Machinery Hall and gave semi-open air demonstrations of the merits of their heart-shaped concrete mixers as well as their various concrete block and brick machines, and other concrete specialties.

The building formerly occupied by educational exhibits and hand work was given up entirely to the Canadian Gas Association. In this building several interesting exhibits might be seen, among which was that of H. Mueller Mfg. Co., Canadian factory, Sarnia, Ont. (about November 1st). This firm specializes in the manufacture of gas main equipment, gas cocks, service boxes, waste cocks, etc. Their exhibit was much enjoyed by municipal officials, while the other attractions in the building, being to a large extent of a domestic nature, were visited by householders.

The Canada Cement Co., Limited, had a booth under the grandstand at which complete information could be obtained in regard to concrete roads and all other forms of concrete construction. This exhibit was one of the most unique in the grounds. It consisted of a set of illuminated transparencies of everything from a concrete fence post to a concrete viaduct. Another feature of this exhibit was the illuminated posts around the booth, being the first used on the grounds.

A feature of the fair this year was the new Government Building, erected during the past season to the west of the grounds. All the provincial governments were allotted space to demonstrate the representative merits of the districts coming under their jurisdiction. Excepting the province of Ontario, all the exhibits were of a mercantile nature and the spaces were used to exhibit wheat, minerals and natural advantages. The province of Ontario have a separate building, which is devoted exclusively to exhibits of this nature, so that their space in the Dominion Government building was used as a health exhibit and every effort was put forth to educate the visitors regarding the means of combating disease and the importance of this department of the provincial governing body.

A fair-sized pressure filter, manufactured by Messrs. Bell Bros., of Manchester, England (local representatives Bell Filtration Company, of Canada, Limited, 305 Kent Building, Toronto) was installed and a Luitwriter triplex pump connected in such a way as to illustrate a water purification system suitable for a town of one thousand persons with an estimated consumption of one hundred gallons per day each.

A bacteriologist was in attendance at the display of disease producing cultures which formed a splendid show. Many antitoxins were also shown, which graphically showed the progress made by science in combating diseases known to be due to the presence of micro-organisms in the body.

TRANSPORTATION OF MATERIAL IN MODERN LARGE INDUSTRIAL PLANTS.

By H. W. Arnold, Supervisor of Power and Maintenance, The Jeffrey Manufacturing Co.

During the last few years much has been written and spoken relative to efficiency in so far as the manufacturing end of the matter is concerned, but in very few instances has the transportation of material in and about manufacturing plants received the attention its importance deserves.

View of Part of Industrial Track System.

Necessarily, the transportation facilities of a plant include all the surface and overhead devices used in moving material from one point to another, but in this brief article it is propos·d to consider only the surface [illegible]

In most instances large manufacturing plants present a rather difficult transportation problem. This is due to the unsymmetrical growth of plants of large proportions owing to the fact that in a great majority of cases the expansion was not anticipated or provided for in the original conception.

The Jeffrey Manufacturing Company, of Columbus, Ohio, is spread out over an area [illegible] of floor space. This plant manufactures a [illegible]

[illegible] sideration.

[illegible] truck working on a 36-inch gauge industrial track. A careful study of existing conditions made plain the fact that a very material saving could be effected by establishing a more efficient transportation system.

After considering the problem from every angle, it was decided that the Jeffrey storage battery trucks and industrial cars offered the best and most efficient means of surface transportation. Accordingly, the industrial railway was extended to take in all departments and a systematic method of car dispatching established. The accompanying plan gives an idea of how thoroughly the different buildings are served by the industrial track.

As soon as this system was established, very rigid instructions were issued that absolutely no material was to be transported by other means than the storage battery trucks and industrial cars. It was immediately found possible to dispense with the services of a two-horse team, 28 two-wheeled warehouse trucks, 13 four-wheeled trucks, 8 wheelbarrows and 18 men whose whole time had been devoted to this purpose. This effected an annual saving of more than $600 per month over the cost of the former system, taking into consideration the interest and depreciation on the investment, operating, maintenance, costs, etc. The monthly tonnage handled is close to 4,000 tons. Viewed from its present efficiency, it would seem almost an utter impossibility to go back to the previous or any other method of transporting material.

The Jeffrey storage battery truck is so simple in design and rugged in construction that it does not require the service of skilled operators, and the maintenance and operating costs are extremely low.

Operation of Industrial Track System.

The industrial railway track shown in the illustrations gives a comprehensive idea of the system, and the wide range of usefulness for transporting material with the trucks. These trucks will pay for themselves in a very short period of time and especially where an industrial track system is already installed.

THE MUNICIPAL ZONE SYSTEM.*

By B. Antrim Haldeman.

Some of the nations of Europe, out of a wealth of unfortunate experiences in the rapid growth of industrial cities and the crowding together of the people in them, have evolved what is known as the "Zone System" for controlling the use and occupation of land.

The system had its origin in the deplorable living conditions which were forced upon the working people and poorer classes of Germany during the period of industrial progress that has absorbed the energy of the German people since the Franco-Prussian war, and during which old feudal towns have been transformed into metropolitan cities and the country side into a forest of factory stacks. The administrative machinery of the towns, confronted with new and perplexing problems due to the rapid increase of population, were for many years unable to cope successfully with the new conditions by reason of the manner in which land was held, its sudden rise in value, and the lack of any authority to interfere in any effective manner with the owner's disposition and use of it.

The swift progress of industrialism throughout the German States encouraged the rapid growth of industrial towns at a time when the social conditions and the manner of living of the common people were not conducive to either the morals or health of crowded communities; the workshop and factory drew upon the farm and rural hamlet for their labor. and the working people, unable to obtain proper dwelling places, herded in caves, cellars, and unsanitary buildings. like rabbits in a warren. The rapid increase or urban population offered a fertile field for exploitation by the great landowners who erected barrack-dwellings of many stories and rooms which were an improvement over tne caves and cellars and into which the working people crowded. Although these dwellings marked much improvement in living conditions they still bred many evils from the too intensive occupation and to correct these and provide greater assurance of the public health and safety a multiplicity of building regulations were enacted by the municipal authorities.

Ministerial decrees were issued tending to enlarge the authority of local councils in matters relating to the erection and occupancy of dwellings; gradually the fact dawned upon the law makers that the power and prestige of the empire among the nations of the earth depended as vitally upon the health and efficiency of its working people as upon the courage and loyalty of its fighting men. By slow degrees, slow because opposed by the great landowners who dominated many of the legislative bodies, the ministerial decrees were enacted into laws granting broad autonomy to municipalities and enabling them to strike at the root of the evil of their housing system by checking the increase of the speculative value of land, such speculative increase in some cities having risen 400% in a single year. Municipalities were also authorized to purchase ground, to erect dwellings, and to loan public funds to societies for the erection of workmen's homes; much encouragement has been given to the erection of one-family houses, and home owning has been made possible among the working people.

The story of the industrial and social evolution of Germany is an intensely absorbing one, but we consider here, and that but briefly, only the manner in which the municipal authorities exercise the powers vested in them to regulate the development of private property. This is accomplished mainly through the employment of the "zone system," under which the municipal department having charge of city planning, in establishing and extending the street system, also establishes the building lines, determines what percentage of the property may be built over and the arrangement of the buildings themselves, whether they shall be erected in solid rows, in pairs, or singly; also the distance between the buildings when built singly or in pairs, and the number of floors or stories. No appeal from the established regulations can be taken after the plans have been completed, examined, and finally approved by the several independent committees having jurisdiction. The plans frequently show three fixed lines in a block; the line to which the street is to be opened and improved, a line of restriction, a certain distance from the street line beyond which no building is allowed to extend, and an interior line fixing the boundary of the court yard or garden within which no structure is permitted.

The term "zone" as applied to the system is somewhat of a misnomer and misleading; although the general theory under which it is applied is, that the buildings should be lower and farther apart the greater their distance is from the centre of the city, the arrangement is not one of concentric girdles, as might be supposed, but a division into districts. irregular as to area and boundary and regulated in accordance with some local characteristic or special adaptability for certain classes of buildings; in fact, it sometimes occurs that a "zone" consists of a single city block, or even part of a block. True zones girdling the city would result in alternating rings of high and low buildings or a single indeterminate outer zone, regardless of topography or local conditions, and are considered unwise, if not impractical; so also are very large zones, or districts, since the application of absolute restrictions would prevent the establishment of local business and trade centres for the convenience of the people.

The system has undergone considerable modification since its introduction; keen judgment and great care are essential in determining boundaries and in imposing regulatons which will permit property to be used for the purpose for which it is best adapted; although there was, and still is, considerable opposition to it in some instances, it is gradually producng the desired results, checking land speculation and inflation of values, discouraging the erection of barrack-dwellings, encouraging the erection of one-family houses, and making it possible for people of modest means to own their own houses.

Just as the industrialism and commercialism of Europe has created congestion and bad housing conditions, so are the same evils following in the wake of the tremendous activity along industrial lines in this country; the centralization of trade and the lack of adequate transportation facilities are, perhaps, the most powerful factors in producing a too intensive occupation and use of land; the desire to make property produce the largest possible income is a characteristic of landlords the world over, and tenement houses under lax regulations are splendid revenue producers.

Although the zone system as employed in Europe is the outgrowth of a long and persistently fought battle for the improvement of housing conditions, it has resulted in other economical and administrative reforms and it is along these lines that its application in the United States might also produce important results and be of great benefit. It would enable the municipal authorities to predetermine the character of improvement in any given area and, as the permanence of the improvement would be assured, very large economies in planning of streets, the construction of public works, and the conducting of general public service could be affected.

Under the zone system the permanent population of any given area may be determined with a reasonable degree of accuracy before a single building is erected upon it; with this factor known it is possible to intelligently forecast the needs of the district for every class of public works and public service and to plan accordingly, with the confidence that whatever is done will be done properly, permanently and economically.

---

*Abstract of a paper read before the City Planning Conference, Boston, Mass., May, 1912.

Transportation is the great, controlling factor in the growth and development of the modern city, and the most difficult problem municipalities are called upon to solve; its difficulties would be greatly lessened if the density of population could be kept within reasonably certain limits; this is understood in the German system of town-planning and the locations of the trams, or street-railway lines, are determined as the street system is extended and are based upon the volume of traffic likely to be created by the known population and the predetermined character of the territory they will serve; the same is true of main, or trunk, lines of every kind of underground service: sewers, water pipe, electrical lines, pneumatic tubes; and subways, pipes, and tubes for every purpose of subterranean transportation. The number and capacity of public service structures under, upon, or above the surface depends upon the density of the population and the local needs of the community; these elements being known the original construction of public works can be of the most permanent character and the liability for repairs, reconstruction, and enlargement can be reduced to a minimum.

Wide streets, planned with the almost certain knowledge the zone system would give of the traffic requirements for long years of service, would permit of a far more economical system of secondary and residential streets than we now find in most of our cities. In almost every city we find large areas laid out with streets of uniform width and uniform improvement, but they seldom carry an equal amount of traffic or are of equal public use except in congested localities; certain ones, by reason of easier grades, better connections with important points, greater business activity, or other favorable local conditions, attract the greater volume of traffic, leaving perhaps half a dozen adjacent ones unused and unlovely expanses of costly pavement.

[illegible] permit property to be restricted to the use for which it is best adapted by natural conditions. If hilly and picturesque districts were reserved for high-class residences, or for residences requiring lawns or gardens, the cost of improvement, both as to property and streets, would be greatly reduced by removing the necessity for the [illegible] small [illegible].

It [illegible] neighborhood enabling the builder to realize large profits; [illegible]

[illegible]

the difficult problem of transportation and with its brother evils, the subway and the tenement house, for both of which it is partly responsible, it is moving steadily toward the creation of an abnormal condition of urban life. This menace of the skyscraper, the subway, and the tenement can only be removed by the enactment of regulations limiting the height of buildings, defining the areas within which those of maximum height may be erected, and prescribing the percentage of surface area they may cover and the amount of light and air space around them.

In no department of city building is there a larger opportunity for the advantageous application of the zone system than in the defining of the areas within which industrial establishments may be erected. Mills, factories, and workshops of almost any kind may now be set down in any locality which seems favorable to the promoter of the enterprise. Such establishments must invariably have facilities for transportation by rail or water, or both, especially if they are conducted upon a large scale, as most modern establishments are. Their random placing may work to the disadvantage of an entire neighborhood. There is a large economy for any concern in having transportation companies deliver and receive freights directly at its doors and the problem of supplying such service is a difficult and complicated one where industrial plants are distributed widely throughout a community.

The confinement of industrial establishments within certain prescribed areas would protect residential districts from invasion by incongruous or otherwise objectionable institutions and would immeasurably simplify the problem of industrial transportation, both local and foreign. The creation of factory zones in locations conveniently reached by rail or water would permit the development of terminals of maximum efficiency at a minimum cost; drayage between the mill and the shipping station is a large item of expense to the manufacturer, and the collection, classification, and distribution of freights from or for scattered and isolated yards are distracting problems for the traffic manager and the yard master; the short haul, the reduction or concentration of trackage, and the saving of time and energy where freights originate, or are distributed, within certain prescribed areas, all count for economy in trade and transportation. Main traffic streets for through travel could be kept clear from obstruction by railroad crossings and sidings, and to a considerable extent from costly bridges, if freight yards and freight carrying lines were kept within industrial zones.

So apparent do the advantages of the industrial zone seem, and so complex and costly are the problems of industrial transportation under present methods, that it is strange the manufacturers and transportation companies, in their efforts toward scientific and economic management, have not used their influence to establish such a system; indeed, some of the large industrial concerns have found such an arrangement so desirable that they have established their own industrial colonies in which their factories and freight service are entirely separated from the residential sections; only the most extensive ones, however, have been able to do this successfully, the smaller ones having found the problem of obtaining and keeping skilled labor a difficult one at a considerable distance from large towns.

Any attempt to engraft the zone system into American schemes of municipal development would probably meet with great opposition from landowners, real estate speculators and speculative builders, and from large interests not directly concerned in the development of land. The objections of the first would doubtless be based upon the abridgement of their right to do as they pleased with their own property, of the second upon the cutting off of prospective profits, and of the third upon the general proposition of the invasion of vested rights. All of these arguments were advanced against the system in Germany and all had to give way at the behest of the people.

The plea for the protection of the vested right has not the force it had a few years ago. The great unrest we find throughout the country to-day may readily be traced to the exploitation of nearly every line of activity under the so-called vested rights; the days of the perpetual franchises and special privileges are passing away, and, while every reasonable safeguard must be maintained around the rights of property and invested capital, their leveling down to the service of people who have given property its value and capital its reward is proceeding steadily.

A long process of reasoning might be necessary to convince people that our municipal officers may be trusted with such large powers as are involved in the practical application of the zoning system, for there is a too well-founded suspicion that public service does not always mean serving the public. But the administrative machinery of our cities is passing from the control of political and corporate interests to the control of enlightened public sentiment; the people have been thinking and inquiring into public affairs, and they are learning that the city, with all its vast resources and wealth, is theirs, created by their energy and labor; they are learning what a tremendous organism the modern city is, and, in the pride of their own work, are beginning to assert their right to rule it. Municipal government in the United States is undergoing an evolution that points toward material improvement and the time may not be far distant when our cities will be governed as wisely and honestly as those of Germany, where the power of the local officials is so great, and so unrestrained by constitutional or statute laws, that only capable and trustworthy men dare be placed in the public service, and where election to a public office is a real honor.

PUBLIC UTILITIES AND REGULATION

From its very nature the operation of a public utility, both from the standpoint of the public and of the utility corporation, must be a monopoly. Operation by two or more companies means additional poles, wires, tracks, or pipe mains in the streets and while competition may for a brief time mean lower rates, such lower rates mean a poorer service until finally one, or all, of the corporations are forced to the wall, or the weaker company is merged in the stronger with inconvenience to the community and loss to the investor.

These opinions were expressed by ex-Mayor MacIlreith, of Halifax, at the recent convention of municipalities.

"But to most people," he continued, "the words corporation and monopoly signify the necessity of girding on armor for immediate warfare in order to obtain even a semblance of public rights. Therefore, at the outset, it behooves the public utility corporation to show to the community within whose bounds it operates, by actions, not promises, that a good service at reasonable cost is furnished and that sufficient capital is provided from time to time, to expand or extend the service as the fair claims of the community for such expansion or extension arise. By acting thus, the natural prejudices of the public against the corporation ought to be very largely removed and fair treatment should be accorded the corporation by the community evidenced by a willingness to pay a fair and reasonable price for the service accorded.

"If these ideal relations could be established, there would be no need for regulations, but perhaps, while not possible of absolute establishment, they can be approached unto, and the necessity of recourse to the regulating body rendered unnecessary in most cases.

"The right of the state to set up bodies to regulate public utility companies is undoubted, and the duties and powers of such bodies are, of course, contained in the acts of the legislature creating such utility boards. After such a board has been created, the fear of the public of the monopoly largely vanishes. Under all utility commission acts, it is the duty of the board to see that the corporation renders good service at a fair cost, allowing the legitimate investor a fair return for the money he has invested.

"In our province the Act creating the public utilities board is chapter 1, of the Acts of 1909. At the last session of the legislature an Act (chapter 64), amending the above Act, was passed to come into force when proclaimed by the Governor-in-Council. As these Acts are available to all it becomes practically unnecessary for me to do more than mention a few main points.

"In the first place every public utility is required to furnish reasonably adequate service and facilities, and the charge made for such service shall be reasonable and just, and every unjust or unreasonable charge for such service is prohibited and declared unlawful.

"Secondly all rates must be filled with the board and there must be no discrimination. And thirdly, the board is empowered to value the property of public utilities and regulate the issue of stock.

"The method and procedure for the hearing of complaints is made as simple as possible. In order that personal or imaginary grievances may not be made the pretext for hearings the Act provides that the complaint must be made by a municipal corporation or by any five persons, firms or corporations. Our Act, like other utility Acts, is designed to safeguard the rights of the public and at the same time to only require the utility corporation to do what is fair and reasonable and in filing rates and charges to have in view a fair return to the investor.

"While as a rule the public sees only its own side it must be remembered that there are two sides to every question, and it is for the regulating body to weigh these carefully and dispassionately, and while having in view the reasonable demands of the community, they must treat the corporation with fairness."

LOCATING UNDERGROUND PIPES.

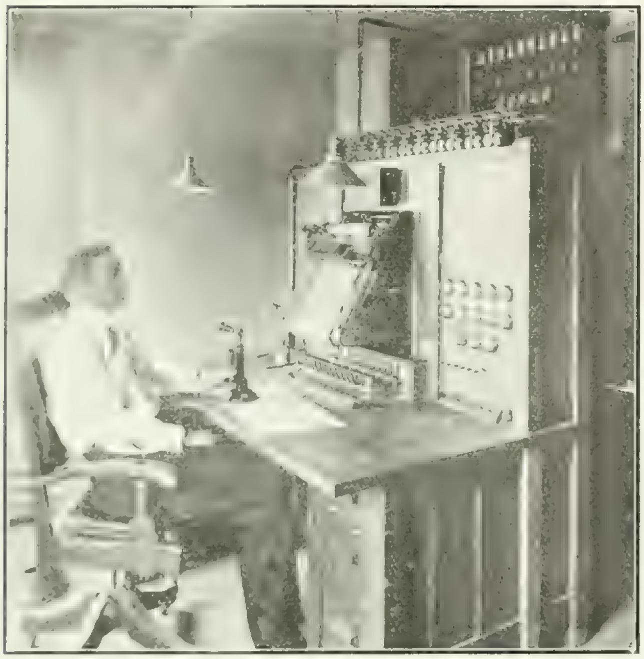
In waterworks systems there are often pipes, the exact position of which is not recorded, and when repairs or new connections are to be made with such pipes, a great deal of time and money may be saved by the use of a device which will indicate their positions, says Engineering News for August 15, 1912. Some electric devices have proved successful in this field, one of them being based on the principle of causing a slight flow of electric current in the pipe, which thus becomes a conductor. When an electric coil is brought within the field of this conductor, a current will be induced in the coil and cause a sound in a telephone receiver connected to the coil. The sound increases or decreases as the coil is carried nearer to, or farther from the underground conductor, but ceases when nearest to it; that is, directly over it. By locating a number of points directly over the pipe, its situation is accurately determined.

In using the instrument, wires from a portable battery are attached to suitable connections and the operator, carrying the instrument in his hand and the receiver at his ear, walks across the supposed line of the pipe, the exact position being indicated by the absence of sound. To locate a service pipe the battery wires would be connected to the house cock and hydrant, creating a current along the service line. This device is manufactured by the Modern Iron Works, of Quincy, Ill., and is used by a number of water companies.

THE SIMMEN SYSTEM OF RAILWAY SIGNALLING AND DISPATCHING.

By Mr. Paul J. Simmen.

The executives of both steam and interurban electric railroads in Canada and the United States are earnestly seeking greater safety, greater facility in operation, greater track capacity and better discipline for handling their traffic at a cost bearing some reasonable relation to their earning capacity.



Dispatcher Reading Movements of Cars from Sheets.

The present systems of train control divide themselves broadly into two divisions, namely, dispatching and signalling.

The dispatching section requires elaborate rules, timetable rights and dispatchers. These dispatchers must, through some form of telegraph or telephone system, including operators at numerous stations along the line, convey orders to the conductor and engineer; reports of the actual train movements being wired to the dispatchers by the operators or train crews.

The efforts of the signalling section have been to prevent collisions between trains endeavoring to follow the running orders based on the time table rights, train rules and dispatchers' order. This second section involves all sorts of devices from target boards to elaborate automatic [illegible] ing devices, and, in some instances, automatic stops.

Practically no improvements have been brought about in the dispatching section for a generation, and the various [illegible] of railroad [illegible], [illegible] and State Boards, have repeatedly condemned these methods as being totally inadequate to meet the requirements of present day traffic. The large number of accidents annually recorded on roads throughout the country forms conclusive evidence of this fact.

In the signal division fine results have been obtained, but these results have been accompanied not only with a large first cost, but more important still, with a large yearly maintenance expense. Automatic or manually controlled block signals are essentially only auxiliary to the dispatching section, and where used, the combined operating expense of both the dispatching and signal section is materially larger.

The Simmen system is especially designed to meet a long-felt want. It is absolutely safe; it reduces delays in train movements; it increases the track capacity and it affords a simple and ready means of increasing the efficiency of train crews, at a cost much below that of any other known system.

The Simmen system is radically different, both in intention and mechanism, from anything else now offered to railways. It breaks new ground by combining into one all the essentials of the dispatching and signalling sections. It is not an effort at detail improvement, but an entirely new and effective system for the management of railway traffic, which is safe, accurate and inexpensive. The claims made for the system and its many desirable features have been fully justified by the results obtained from actual installations and tests of the system under service conditions.

The actions of the persons upon whom the safety of the traffic depends, namely, the dispatchers, train crews and telegraph operators, are all protected against error. The responsibility first of all rests upon the individual himself, but any error which he would unwittingly make is throughout the system prevented or corrected by electrical or mechanical means. The dispatcher is protected against error by an interlocked switchboard. The engineer or motorman is given a more effective signal than heretofore, appealing both to the sense of vision and hearing, but should he fail to obey the signal to stop, the air brakes are automatically applied. The telegraph operator, whom statistics prove to be the weakest link in the present chain of train operation, is dispensed with altogether by the Simmen system, thus removing a frequent cause of error, and making a large saving in operating expense possible.

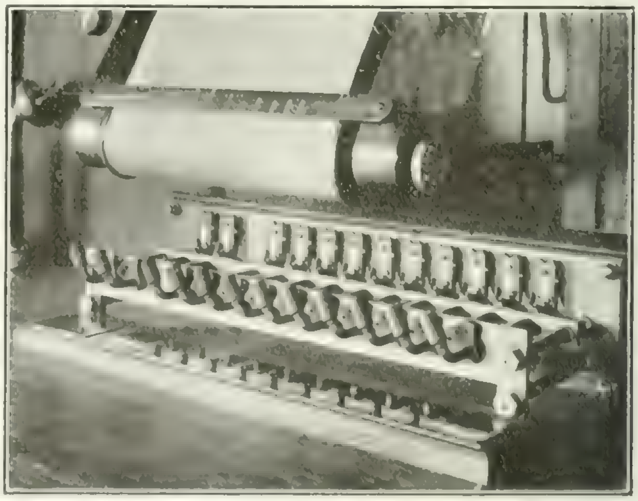


Fig. 1. Dispatcher's Switchboard. (Switches all Set for Westbound Movement.)

The system is not an experiment. It has been in use for nearly three years on the Toronto and York Radial Railway with marked success. A test installation of 18 miles was made on the Indianapolis & Cincinnati Traction

---

[In the issue of *The Canadian Engineer* of June 11, [illegible], there appeared a description of the Simmen Automatic Railway Signal System which had, at that time, just been installed on the [illegible] division of the Toronto and York Radial Railway. The following article presents a more complete description of the system, prepared by the inventor.—Ed.]

Company's line, in the State of Indiana, and has been in use successfully for three months, operating successfully at speeds of 85 miles an hour. As a result of this test the Railroad Commission of Indiana has approved the system and has ordered its use on the entire Shelbyville division of this company, a distance of 45 miles. The Indianapolis & Cincinnati Traction Company were so well pleased with the test that they placed their order for the equipping of their entire mileage of 100 miles with Northey-Plummer, Limited, of Toronto and Indianapolis, Indiana, who control the patents of the Simmen System. The system is approved for test by the Block Signal and Train Control Board, and is endorsed by many signal engineers of the country. Electrically speaking, it is throughout, in accordance with the requirements of the Electric Railway Association.

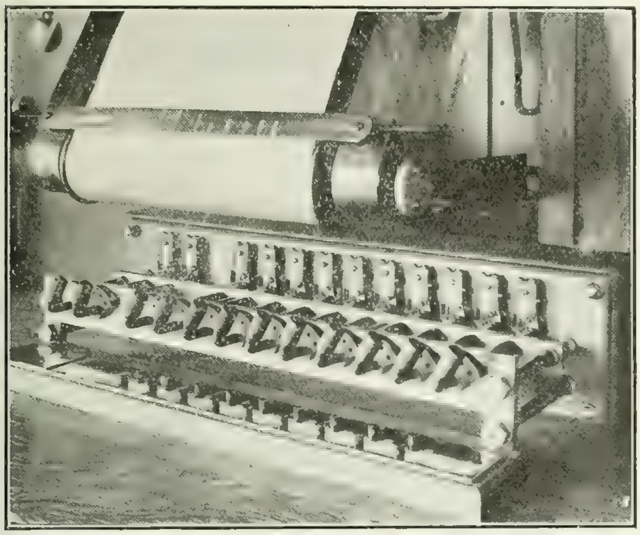


Fig. 2.—Dispatcher's Switchboard. (Switches all Set for Eastbound Movement.)

An attractive feature of it is its elasticity and its fundamental simplicity. It provides for an automatic record of train movements in the dispatcher's office in graphic form, interlocked switches by which dispatcher can signal danger or clear indications to engineer or motorman direct in his cab, and direct telephone communication, between engineer and dispatcher. Additional protection which may be desirable and justifiable for heavy or high-speed traffic, such as automatic block, track circuits and automatic stop, can be added from time to time and made to fit in and work as auxiliary to this system without prohibitive complication.

The following are some of the advantages of the system:

Safety.—The dispatcher and engineer are protected against error by automatic devices. The entire system is so designed that any failure whatever in the equipment will result in danger indications. The telegraph operator being eliminated, his errors disappear also. Every movement into a new block must receive a positive clear signal, which an engineer must await, irrespective of the running orders or time table rights.

Facility.—The system facilitates quicker train movements to an extent equal to placing (eight-hour shift) telegraph operators at every passing siding on a single track road, or block station on a double track road. The time requisite to deliver instructions to the train crew through a third party (the telegraph operator) is saved, as all dispatchers' instructions go direct to engineer. The dispatcher can change a meeting or passing point instantly, without the least risk, simply by changing the switches in his office. Therefore, in case of delay to one train opposing trains will not waste time waiting for a meet. Extra trains and other unexpected train movement are directed with as great facility as the movements of regular trains.

Track Capacity.—Fifty per cent. more trains can be handled over a single track road, therefore the double tracking of a line may be postponed for many years. On double track roads westbound movements on the eastbound track or vice versa, are quickly arranged for.

Efficiency.—Ninety per cent. of all apparatus used is stock apparatus, simple in construction and thoroughly tested for signal and other purposes. A high degree of efficiency is therefore assured. The principal apparatus is in the dispatcher's office and under the dispatcher's immediate and direct care. The simple signal apparatus is entirely located on the locomotive or car and is subject to inspection by efficient mechanics at least once a day. Line wire and third rails are the only part of the system installed along the roadway, and are subject to few failures since they contain no moving parts. Lightning troubles cause no delay because all fuses and arresters are placed in the dispatcher's office and can promptly be replaced when burnt out. Trains are directed both by signal and telephone, therefore a complete tie-up is not possible unless both signal and telephone apparatus are out of order at the same time.

Discipline.—The automatic record in the dispatcher's office serves two purposes. It gives the dispatcher the fullest possible knowledge as to the whereabouts of all trains, etc., and enables him to direct very perfectly all train movements; and in addition to this it serves as a permanent record of many important acts of the train crews, such as a train running behind or ahead of schedule; the speed maintained through any block; length of delays; the efficiency of dispatcher in directing train movements, etc. This information is all recorded in graphic form and a few minutes perusal by the superintendent of each day's record will enable him promptly and justly to correct any weakness in his organization.

Economy.—The first cost is far less than the automatic block system and is in direct proportion to the amount of traffic. Maintenance expense is low because no specially trained men are needed to look after the apparatus along the track. Dispatchers maintain the office equipment, and roundhouse or barn men the signal equipment. Roads now using the manual block system will save a large amount in operating expense by the elimination of block operators, and will find that expenses, arising from overtime to crews of delayed trains, are much reduced.

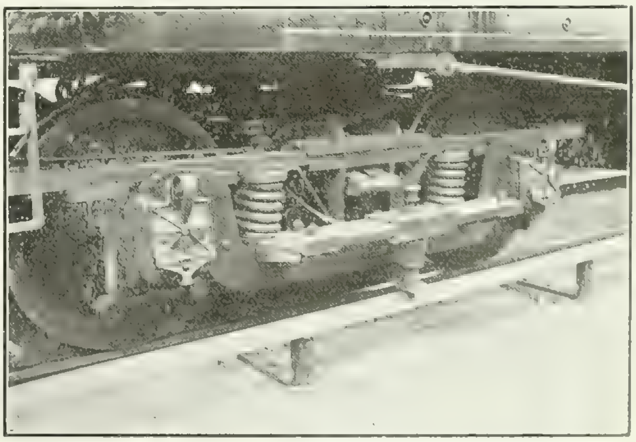


Fig. 3.—Showing Contact Shoe on Third Rail. (Cap Removed to Show Contact Detail.)

Description of the Simmen System.

The elements which enter into the system may be divided as follows:—

(1) A record sheet of train movements in graphic form.

(2) An automatic means for the recording of train movements upon the sheet.

(3) A means by which the dispatcher can display "danger" and "clear" signals on moving trains (or any other type of signals).

(4) A direct telephone connection between the engineer, on his engine, and the dispatcher.

(5) A new, simple, inexpensive and effective cab signal.

(6) An inexpensive automatic stop, based on a new principle, by which the stops and proper speeds are enforced over every foot of the road.

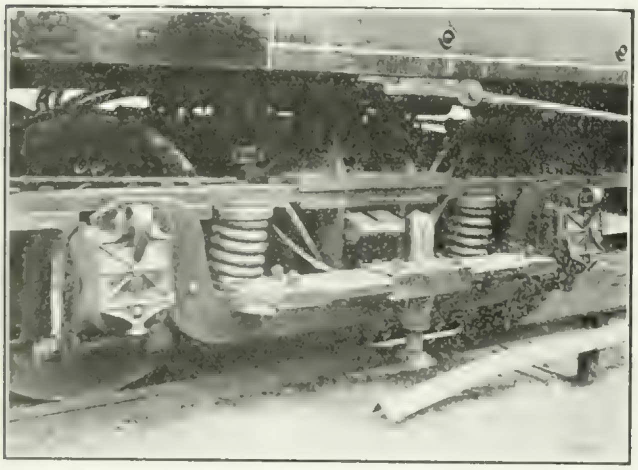


Fig. 4.—Shoe About to Make Contact on Third Rail.

Dispatcher's Record Sheet.—The record sheet is divided into time lines in one direction (10 a.m., 10.20 a.m., etc.) and block lines in the other, (e.g., Sunnyside, Humber, Mimico, Long Branch, etc.). (Figs. 1 and 2). On a single track road, blocks usually run from passing siding to passing siding and are spaced on the sheet proportionately to their length.

Each day a new record sheet is placed upon the dispatcher's recording table. The recording table is provided with clock-work for continuously moving the sheet, and with electrically operated perforating needles. Two such perforating [illegible] are provided for each block, one recording eastbound movements and the other westbound. The record sheet, when placed, is regularly and continuously moved by clockwork, so that the correct time line, as marked upon the sheet, is always directly under the perforating needles.

[illegible]

[illegible]

[illegible]

An Automatic Means for the Recording of Train Movements Upon the Dispatcher's Sheet.—At every siding along the road there will usually be four "third" rails placed at suitable locations. These third rails are insulated from the track and their length depends upon the speeds attained upon the particular road. For fast traffic they are from 70 to 80 feet long. Two of these rails are for the direction of westbound movements and two for eastbound. One "eastbound" rail is placed near the beginning of a block, and is known as the "home rail." The other is placed at a point one to two thousand feet back from the beginning of a new block and is known as the "distant rail." Similarly with the "westbound" rails.

A locomotive or motor car is provided with a shoe which makes an electrical contact with the third rails when sliding over them. (Figs. 3 and 4). When a shoe is in contact with a third rail, the (normally) open circuit between the third rail and track, is closed, the closed circuit then running from third rail through the contact shoe, and apparatus on cab, to a ground return on the truck and track rails.

The third rails (home rails) at siding are connected by wire to dispatcher's office and there are connected to one side of the dispatcher's switch.

From the other side of the dispatcher's switch a wire connects through the winding of the main relay to the pole of the storage battery, the other pole of the storage battery being connected to ground at track rails. The instant a contact shoe on a train makes contact with a third rail a circuit is established as follows. From storage battery in the dispatcher's office, through wire, main relay, dispatcher's switch, wire, third rail, contact shoe, signal relay on cab, ground on truck, and track rail, back to dispatcher's battery. The closing of this main circuit energizes the main relay which in turn closes a local circuit through the perforating magnet as follows:—

From storage battery through wire, perforating magnet, armature of main relay, to negative side of storage battery. The perforating magnet, being energized, acts on its armature, which forces the perforating needle upwards, thus perforating the dispatcher's record sheet and recording upon it the time and place of a train passing siding. The perforating circuits provide only for a single punch upon the recording sheet when a train is passing a third rail. To

Fig. 5.—Motorman in Cab. (Shows Position of Red and Green Lights.)

give continuous perforation as long as a train is in the block, a polarized relay is used.

Signalling Means.—A new type of cab signal has been developed which, by means of inexpensive intermittent third rails, gives as complete signal information as can be accomplished by a continuous third (signal) rail. The underlying principle of the cab signal is that if a third rail is electrically energized, a train in passing will receive a clear signal; if the third rail is de-energized a danger signal is displayed. Furthermore, a clear signal received in entering a new block will continue to show clear throughout the block, and a danger signal once displayed will continue at danger until it is automatically cleared when a train is passing an energized third rail. Either a clear or a danger signal is always in evidence every foot of the way. The cab signal circuit is shown in Fig. 6, and Fig. 5 shows motorman in cab with position of red and green lights. The third rail has inclined approaches at each end. When the contact shoe approaches the third rail the shoe is raised and the arm of the contact shoe separates from the front stop.

If so desired a bell can be inserted into the danger circuit so that both visible and audible danger signals will be given. This bell gives one tap each time a third rail is passed, thus calling the attention of the engineer to a possible change of signals, as well as being a positive signal that the cab equipment is in perfect operating condition.

When a third rail is energized a clear signal is displayed; when de-energized, a danger signal is displayed. Since the dispatcher's switch controlling the signals at siding is closed, it is evident that the third rails at siding are energized, and therefore set for a clear signal. To display a danger or stop signal at siding the dispatcher simply opens switch, thus depriving the third rails of electrical energy from the storage battery.

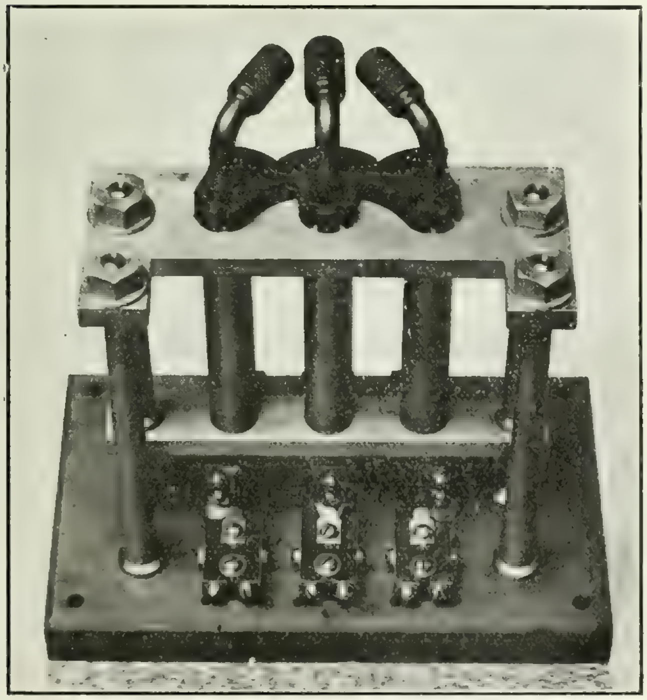


Fig. 7.—Unit of Three Switches.

Interlocking arrangements on the dispatcher's switchboard prevent the dispatcher from giving a clear signal to an eastbound train entering a block until the signal for the westbound train at the opposite end of the block is set to danger.

Only the broad essentials of the circuits and their functions have been described. Various modifications and combinations with the present signalling methods are possible, by which any special traffic requirements can be met. Telephone communications are established over the same circuit as is used for signalling, the telephone apparatus being placed in shunt with the same and provided with condensers. Fig. 7 is a photograph of a unit of three switches.

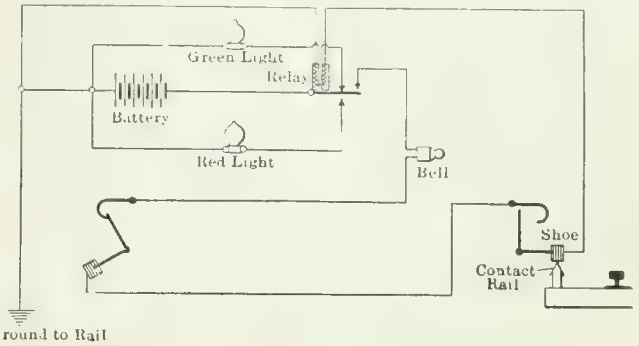


Fig. 6.—Diagram of Car Circuit.

The Simmen automatic stop provides for the automatic application of air brakes under the following conditions:—

(a) Where danger signals have been given but not obeyed.

(b) Where proper speeds at curves, grades, yard limits, or grade crossings are not observed.

(c) Where reduced speed for permissive or backward movements are not observed.

* * *

NEW WAREHOUSES OF THE NEW ENGLAND WASTE COMPANY.

The warehouse and waste plant of the New England Waste Co., at Revere, Mass., is an unusually attractive reinforced concrete building. The architects and engineers, Lockwood, Greene & Co., of Boston, specified the use of brick curtain walls, which make an effective and pleasing contrast with the concrete. The building is located adjacent to the tracks of the Boston & Maine Railroad, rendering excellent facilities for shipping.

This structure is 180 by 56 feet, four stories high with basement, and has a projecting tower on the front enclosing stairs, laboratories, and boiler for heating. As is usual with concrete, maximum window area has been obtained. The building is equipped with automatic whip hoist trolley conveyors and baling presses.

The floors of this building were designed to carry a live load of 150 lbs. per square foot. The column spacing is 20 by 18 feet, and the height of stories is 14 feet. It is interesting to note in this connection that although the floors were designed for 150 lbs. live load they were only slightly damaged by the accidental falling of a 4,000 lb. weight. On the second floor was located a baling press with plunger running through the third floor and counterbalanced by a 4,000 lb. weight made up of pieces of cast iron. The weight was suspended from the fourth floor by a through bolt with hook and pulley attached. The rope parted and the 4,000 lb. weight fell to the floor through a distance of 8½ feet. The only damage done to the concrete was a flaking of a space of about 20 inches in diameter on the under side of the floor.

The building was erected by the New England Concrete Construction Co., of Boston, and the methods employed by them in handling the materials and concrete are of unusual interest. The aggregates for the concrete were handled mechanically from the time they left the railroad cars until they were dumped into the mixer. The concrete, after being hoisted to a sufficient elevation, was distributed through spouts to the various forms.

The practice of placing concrete by spouts instead of by carts or wheelbarrows, while not unusual is still not common. Where the job is large enough it is a most economical way to handle concrete. On the work in question the amount of concrete used was approximately 3,000 yards and the contractors report that they placed concrete rapidly and at a very low cost with the plant adopted.

This warehouse of the New England Waste Co. presents a convincing answer to the argument that reinforced concrete buildings are unsightly. This structure is of excellent design and its appearance is more excellent than could be obtained in the ordinary brick and timber construction.

◆

PROGRAMME CANADIAN PUBLIC HEALTH ASSOCIATION.

The Canadian Public Health Association convention will be held in Toronto September 16th, 17th and 18th, 1912, at the University of Toronto. The following is the programme:

Monday, September 16th.

Physics Building, Toronto University.

10 a.m. to 11 a.m.—General opening business meeting, [illegible]

General session, room 43: 11 a.m. to 11.30 a.m.—"How Shall Canada Save Her People from the Physical and Mental Degeneracy Due to Industrialism as Seen in the Great Cities of Older Civilization?" Dr. P. H. Bryce, seperintendent of immigration, Ottawa.

11.30 a.m. to 12.30 p.m.—Symposium. "Tuberculosis," Dr. J. H. Elliot, Toronto.

Discussion—Dr. G. D. Porter, Toronto; Dr. Harold Parsons, Toronto; Dr. W. B. Kendall, Muskoka Sanatorium; Dr. C. D. Parfitt, Gravenhurst; Miss Dyke, Toronto; and others.

12.30 p.m. to 1 p.m.—"Prevention of Tuberculosis in the Country," Dr. H. G. Roberts, Guelph, Ont.

2.30 to 3 p.m.—"Hospitals, Their Relation to the Community and Public Health," Dr. Bruce Smith, inspector of prisons and public charities for Ontario.

3 p.m. to 3.30 p.m.—"Dust in the House and in the Street," Dr. Adam Wright, chairman Ontario Board of Health

3.30 p.m. to 4 p.m.—"The Ontario Public Health Act," Dr. John W. S. McCullough, chief health officer for Ontario.

[illegible]

7.30 p.m.—Moving health pictures, Ontario Provincial Board of Health.

[illegible]

Tuesday, September 17th.

[illegible]

Section I.—"Military Hygiene," at room 30. Convenor, J. T. Fotheringham, Lieut.-Col. P.M.O., A.M.S., D.G.M.S., Canada.

[illegible]

[illegible]

11 a.m. to 11.45 a.m.—"Some Observations on Sanitation for the Soldier," T. B. Richardson, major A.M.C.

11.45 a.m. to 12.30 p.m.—"The Militia as a Factor in Public Health," Lorne Drum, major, A.M.S.

12.30 p.m. to 1 p.m.—Election of convener and committee of section.

Section II.—"Milk Inspection," at room 42. Convenor, Andrew R. B. Richmond, V.S., B.V.Sc.

9.30 a.m. to 10.15 a.m.—"Municipal Milk Inspection in Toronto," G. G. Nasmith, director of laboratories, city of Toronto.

10.15 a.m. to 11.00 a.m.—"Municipal Food Inspection," Robert Awde, chief food inspector, Toronto.

11 a.m. to 11.45 a.m.—"Dominion Meat Inspection," L. W. Wilson, in charge of Dominion meat inspection staff, Toronto.

11.45 a.m. to 12.30 p.m.—"Municipal Inspection," Andrew R. B. Richmond, chief of staff of veterinary inspectors, Toronto.

12.30 p.m. to 1.30 p.m.—Election of convenor and Committee of section.

Section III.—Engineers and Architects, room 62. Convener, T. Aird Murray, M.Can.Soc.C.E.

9.30 a.m. to 10 a.m.—"Toronto Filtration Plant," Jos. Race, bacteriologist, city of Ottawa.

10 a.m. to 10.30 a.m.—"A Complete Sewage Disposal Plant for a Public Institution," T. Lowes, C.E., Toronto.

10.30 a.m. to 11.00 a.m.—"How to Obtain Efficiency from Pressure Filters," H. W. Cowan, C.E., Toronto.

11 a.m. to 11.30 a.m.—"Housing and Ventilation," N. Couchon, C.E., Ottawa.

11.30 a.m. to 12.00 a.m.—"Storm and Surface Water Drainage in Relation to Sewage Disposal," R. R. Knight, C.E., Toronto.

12.00 a.m. to 12.30 p.m.—"The Relations Between the Medical Health Officer and the Engineer," Thos. H. Hogg, C.E., B.A.Sc., Toronto.

12.30 p.m. to 1.00 p.m.—Election of convener and committee of section.

Section IV.—Medical Officers of Health, at room No. 41. Convener, James Roberts, M.D., medical officer of health, Hamilton.

9.30 a.m. to 10.15 a.m.—"A Modern Hospital for Cummunicable Diseases," Dr. Chas. J. C. O. Hastings, medical officer of health, Toronto

10.15 a.m. to 11 a.m.—"The International Hygiene Exhibition, Dresden," Dr. J. F. Honsberger, Berlin, Ont.

11 a.m. to 11.45 a.m.—"Municipal Control of Milk Supplies," Dr. Whitelaw, medical officer of health, Edmonton, Alta.

11.45 a.m. to 12.30 p.m.—"The Importance of Trained Sanitary Inspectors," Dr. A. J. Douglas, medical officer of Health, Winnipeg, Man.

12.30 p.m. to 1.00 p.m.—Election of convener and section committee.

Section V.—Medical Inspection, at room 18. Convener, Dr. W. E. Struthers, medical inspector of schools, Toronto.

9.30 a.m. to 10 a.m.—"Tuberculosis in Children," Dr. J. H. Elliott, Toronto.

10 a.m. to 10.30 a.m.—"Nursing Side of Medical Inspection of Schools," Miss L. L. Rogers, R.N., Toronto.

10.30 a.m. to 11.00 a.m.—Lantern slides on the work of medical inspection of schools in Toronto, W. E. Struthers, B.A.M.D., Toronto.

11 a.m. to 11.30 a.m.—"The Dental Aspect of Medical Inspection of Schools," W. H. Doherty, D.D.S.

11.30 a.m. to 12 a.m.—Paper and lantern slides: "The Open Air Schools of England," A. J. Green, headmaster of Birley House Open Air School, London, Eng.

12 a.m. to 12.30 p.m.—Election of convener and section committee.

Section VI.—Social Workers. Convener, Helen MacMurchy, Toronto. (See printed list).

Section VII.—Laboratory Workers, at room 39. Convener, J. A. Amyot, M.D., Toronto.

9.30 a.m. to 10.15 a.m.—Paper, Dr. H. W. Hill, director, Institute of Pubic Health, London, Ont.

10.15 a.m. to 11 a.m.—"Vitality of Bacilli in Water Supplies," Jos. Race, bacteriologist, Ottawa.

11 a.m. to 11.45 a.m.—Paper, Dr. Revell, Provincial Board of Health, Edmonton, Alta.

11.45 a.m. to 12.30 p.m.—Paper, G. G. Nasmith, city of Toronto.

12.30 p.m. to 1 p.m.—Election of convener of section committee.

Second General Session, Room 43, 2.30 p.m. to 4.30 p.m.

2.30 p.m. to 3.00 p.m.—"Diet in Relation to Disease," Dr. H. B. Anderson, Toronto. Professor V. E. Henderson, Toronto, and Professor Fotheringham will open discussion.

3.30 p.m.—President's address, Chas. A. Hodgetts, M.D., Ottawa, Ont.

3.30 p.m. to 4.00 p.m.—Paper, Dr. W. T. Sherreff, medical officer of health, Ottawa.

4.00 p.m. to 4.30 p.m.—"A Threatened Outbreak of Typhoid Fever in Fort William and Means Taken to Avert it," Dr. R. E. Woodhouse, district officer of health.

Garden party—Sir Edmund B. Osler, 4.30 p.m. to 7.00 p.m.

Annual dinner—McConkey's, 8 p.m. Tickets at registration office, $2.

Wednesday, September 18th.

Third General Session, Room 43.

9.30 a.m. to 10.00 a.m.—Paper, Dr. H. W. Hill, director Institute of Public Health, London, Ont.

10.00 a.m. to 10.30 a.m.—"The Feeble Minded," Mr. J. P. Downey, superintendent, Asylum for Insane, Orillia.

10.30 to 11.00 a.m.—"Medical Inspection of Public Schools," Dr. A. P. Reid, provincial health officer of Nova Scotia.

11.00 a.m. to 11.30 a.m.—Symposium. "Communicable Diseases."

11.30 a.m. to 12 a.m.—Paper, Dr. H. G. Murray, Owen Sound.

12 a.m. to 12.30 p.m.—"The Value of a Public Health Laboratory to a Municipality," G. G. Nasmith, city bacteriologist, Toronto.

12.30 p.m. to 1.00 p.m.—"Of What Value are Sanatoria as a Public Health Measure?" Dr. W. B. Kendall.

1.00 p.m. to 2.00 p.m.—Adjournment.

General Session (Continued)—2.00 p.m. to 2.30 p.m.—"The Effects of Immigration on the National Health," Will. W. Lee, secretary of immigration branch of Y.M.C.A., Quebec.

2.30 a.m. to 3.00 p.m.—"The Open Window," J. Flemming Goodchild.

3.00 p.m. to 3.30 p.m.—"A Federal Public Health Department," Dr. J. L. Chabot, M.P., Ottawa.

Business meeting, 3.30 p.m.

A musicale Wednesday evening, courtesy of Col. and Mrs. A. E. Gooderham.

Arrangements will be made by courtesy of R. Harris, commissioner of works, for the members to visit the Toronto city filtration plant and sewage dispasal works.

UNION OF CANADIAN MUNICIPALITIES.

At the final session of this organization held in Windsor, Ont., August 29th, the following were elected officers for the coming season:—Mayor Hopewell, of Ottawa, president; Mayor Lavallee, of Montreal, first vice-president; Mayor Waugh, of Winnipeg, 2nd vice-president, and Mayor Beckwith, of Victoria, 3rd vice-president; W. D. Lightall, of Montreal, honorary secretary-treasurer, and G. S. Wilson, assistant secretary. The next convention will be held in Saskatoon, Sask.

RAILWAY COLLISION IN ENGLAND.

A rear collision at the Vauxhall Station of the London & Southwestern Railway, in London, England, on August 29th, resulted in the death of two and the injury of forty persons. A crowded commuters' train from Aldershot was standing in the station, when a light passenger train, consisting of a locomotive and two coaches, crashed into the rear end of it. A defective switch is blamed for the accident.

PERSONAL.

MR. J. G. MILL, until recently employed in the main drainage department of the City Engineer's office of Toronto, has been appointed resident engineer on the sewage disposal works of North Toronto.

MR. R. O. WYNNE-ROBERTS, consulting engineer, of Regina, called at the office of *The Canadian Engineer* in Toronto this week. Mr. Wynne-Roberts is on a tour of inspection of gas-works in Eastern Canada and the United States.

MR. R. H. MURRAY, A.M.I.C.E., who has been resident engineer for Mr. T. Aird Murray on the installation of sewers and sewage disposal plant for North Toronto, has been appointed resident sanitary engineer for the Province of Saskatchewan, with headquarters at Regina.

MR. R. F. PACK has been appointed general manager of the Minneapolis General Electric Company. Mr. Pack has been for several years general manager of the Toronto Electric Light Company, and has just recently resigned to accept the new position. He was elected president of the Canadian Electrical Association at the last annual meeting held in Ottawa.

MR. C. W. WARD, of Messrs. Reavell & Co., Limited, of Ipswich, Eng., returned to London this week after having been in Canada in connection with air compressors supplied to the Water Commissioners of London, Ont. The machines had been rejected by the commission because of low volumetric efficiency. Messrs. Reavell & Co., Limited, being of the opinion that a mistake had been made in testing the plant, sent Mr. Ward out to locate the trouble. The results of further tests demonstrated the efficiency of the plant, and it has been accepted without any alteration being made.

MR. JOSEPH RACE, F.I.C., has been appointed director of Laboratories for Ottawa at a salary of $2,400 per annum. Mr. Race, who has been analyst at the Toronto Filtration Plant, is well known to readers of *The Canadian Engineer*, as he has been a frequent contributor on sanitary subjects.

◆

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer, John Keillor, Hamilton, Ont.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912 Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

[illegible] ASSOCIATION.—President, Mayor [illegible], Hamilton [illegible] St. Thomas, Ontario.

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, [illegible]

THE ALBERTA [illegible] ASSOCIATION.—President, [illegible]

[illegible] OF CANADIAN MUNICIPALITIES.—President, [illegible]

[illegible] MUNICIPALITIES.—President, [illegible] Secretary-Treasurer, J. W. McCready, City [illegible]

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. [illegible] Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible]

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor [illegible] Mr. H. Bose, Surrey [illegible]

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor [illegible]

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, [illegible], Man.; Secy-Treasurer, Reeve [illegible], Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer [illegible], Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. [illegible], No. 5 Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box [illegible], Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. [illegible], P.O. Box [illegible], Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Bassano, Alta., waterworks and sewers	Sept. 30.	Sept. 5.	80
Brandon, Man., two tubular boilers and stokers	Sept. 27.	Sept. 5.	67
Bell Ewart, Ont., wharf and stone approach	Sept. 17.	Aug. 29.	68
Big Bay Point, Ont., wharf with stone approach	Sept. 17.	Aug. 28.	68
Dauphin, Man., superstructures of four bridges		Aug. 22.	80
Dewdrop, Sask., schoolhouse and barn	Sept. 21.	Aug. 29.	67
Kingston, Ont., model and gun shed	Sept. 16.	Sept. 5.	80
Minnedosa, Man., public building	Sept. 12.	Sept. 5.	67
Moncton, N.B., freight car repair shop	Sept. 12.	Aug. 29.	67
North Head, N.B., extension to breakwater	Sept. 12.	Aug. 29.	67
Northern Ont., right to cut pine.	Oct. 1.	July 25.	68
Oakville, Ont., extension of water towers	Sept. 12.	Sept. 5.	67
Oshawa, Ont., drill hall	Sept. 17.	Sept. 5.	82
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., Hudson Bay Railway	Sept. 12.	Aug. 22.	78
Ottawa, Ont., iron posts	Sept. 25.	Aug. 22.	78
Ottawa, Ont., piping systems, etc.	Sept. 16.	Aug. 29.	80
Ottawa, Ont., timber for dredge and scows	Sept. 12.	Aug. 29.	68
Owen Sound, Ont., retaining wall	Sept. 28.	Aug. 29.	68
Port Colborne, Ont., elevator	Sept. 20.	Sept. 5.	78
Port Stanley, Ont., dredging	Sept. 13.	Sept. 5.	68
Souris, P.E.I., breakwater	Sept. 11	Aug. 22.	68
Smith's Falls, Ont., wall	Sept. 14.	Aug. 22.	68
Toronto, Ont., sale of Normal School property	Sept. 30.	Aug. 15.	68
Toronto, Ont., purchase of sheet steel mills and equipment	Sept. 11.	Aug. 29.	68
Township of York, Ont., sewer, Frederica St.	Sept. 16.	Sept. 5.	80
Timiskaming, Ont., purchase of plant	Sept. 19.	Aug. 29.	68
Tracadie, N.B., residence of Medical Superintendent	Sept. 11.	Aug. 29.	68
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78

◆

TENDERS.

Brandon, Man. Tenders for the delivery of two return boilers and stokers, will be received by Harry Brown, City Clerk, City Hall, until noon of September 27th, 1912. Specifications, etc., may be obtained from A. W. Shaw, Engineer, Brandon. (See advt. in The Canadian Engineer).

Cobourg, Ont.—Tenders addressed to N. F. MacNachtan, county clerk, Cobourg, will be received until September 20th, 1912, for the several trades works required in the erection and completion of a hospital. Plans and specifications at the clerk's office. Messrs. Power and Son, architects, Kingston, Ont.

Franklyn Point, P.E.I.—Tenders will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 8, 1912, for the construction of a wharf at Franklyn Point, North River, Queen's County, P.E.I. Plans, etc., can be seen at the department and at the offices of J. B. Hegan, Esq., district engineer, Charlottetown, P.E.I., and on application to the postmaster at North River, P.E.I.

Guelph, Ont.—Tenders addressed to H. F. McNaughten, secretary, Department of Public Works, Toronto, Ontario, will be received until September 23rd, 1912, for all trades (excepting heating, plumbing and lighting) for the erection of Field Husbandry Building on the grounds of the Ontario Agricultural College, Guelph, Ont. Plans and specifications can be seen at this department and at the office of the superintendent at the College, Guelph.

L'Assomption, Que.—Tenders for the construction of an iron and concrete bridge over River L'Achigan, will be received until September 15th, 1913, by J. E. Duhamel, secretary-treasurer, municipal corporation of L'Assomption.

New Liskeard, Ont.—Tenders for the construction of a sewer on Broadwood Avenue and Dymond Crescent, will be received until September 16, 1912. Plans, etc., at the office of C. H. Fullerton, town engineer; J. I. Dixon, clerk.

North Vancouver, B.C.—The city council awarded the contract for the grading of Fourth Street from Mahon to St. Andrew's Avenue, to Messrs. Hall & Bowyer for $8,002.

Ottawa, Ont.—The Canadian Government has awarded to the Dublin Shipbuildinng Company, Dublin, Ireland, a contract for the construction of two fisheries protection vessels to be used in preventing United States fishermen from poaching in the waters off the west coast of Vancouver Island.

Ottawa, Ont.—Sealed tenders, addressed to L. K. Jones, Assistant Deputy-Minister and Secretary, Department of Railways and Canals, will be received up to 4 p.m. September 20th next for the supply and erection of a steel superstructure of an addition to the grain elevator at Port Colborne, Welland Canal, Ont.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrocher, Secretary, Department of Public Works, will be received up to 4 p.m., on Wednesday, October 2nd next, for the construction of a timber superstructure of a wharf on part of the Tunnel Bay dock at Brockville, Leeds County, Ont. Plans, etc., may be obtained at this Department and at the offices of S. J. Chapleau, Esq., District Engineer, Corry Building, Ottawa, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; and on application to the Postmaster at Brockville, Ont.

Ottawa, Ont.—Sealed tenders, addresses to Eugene Fiset, Colonel, Deputy-Minister, Department of Militia and Defence, will be received up to noon, September 18th, 1912, for the construction of a new drill hall at Lindsay, Ont. Specifications may be seen and full particulars obtained at the offices of the Officer Commanding the 3rd Division, Kingston, Ont.; Officer Commanding the 45th Victoria Regiment, the Town Clerk, Lindsay, Ont., and the Director of Engineer Services, Headquarters, Ottawa.

Penetanguishene, Ont.—Tenders for dredging required here will be received until September 13, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Specifications, etc., may be obtained on application to the secretary of Public Works, Ottawa.

Powell River, B.C.—Tenders for the erection and completion of a school house at Powell River, in the Comox district, B.C., will be received until September 18, 1912, plans and specifications of which may be seen at the offices of the secretary of the School Board, Powell River, B.C.; the Government agents, Vancouver, Nanaimo and Cumberland, and the Department of Public Works, Parliament Buildings, Victoria.

Regina, Sask.—Sealed tenders, endorsed "Tender for Construction of Powerhouse, Laundry and Refrigerating Plant, Regina General Hospital," and addressed to the City Commissioners, Regina, will be received until noon, Saturday, September 17th, 1912. Full particulars may be obtained upon application to Edgar I. Wenger, Consulting Engineer, Whitmore Building, Regina.

Sutherland, Sask.—Tenders for the erection and installation of a plumbing, heating and ventilating system to be installed in the public school at Sutherland, will be received until September 16, 1912, by the secretary of the Saskatoon School Board. Plans and specifications can be seen at the office of the architect, and at the Builders' Exchange, Winnipeg.

Toronto, Ont.—Tenders for plastering at the building of the Main Drainage Pumping Station will be received by registered post addressed to G. R. Geary, (Mayor), Chairman Board of Control, City Hall, Toronto, up to noon on September 11th next. Plans may be seen and full information secured at the offices of the Municipal Architect, City Hall.

Wallaceburg, Ont.—Tenders for all trades required in the erection of a bank building to be erected at Wallaceburg, will be received until September 14, 1912. Merchants Bank of Canada, proprietors. Drawings, etc., at the offices of J. L. Wilson and Son, architects, Market Building, Chatham, Ont.

◆

CONTRACTS AWARDED.

Boswell, B.C.—Pile bent wharf; H. Perry Leak, of Nelson, B.C.

Carr's Brook, N.S.—Breakwater wharf; Messrs. Halle Bigelow, of Canning, N.S.

Fairville, N.B.—Postoffice fittings; the J. T. Schell Company, of Alexandria, Ont.

Lethbridge, Alta.—Public building; contractors, Navin Brothers, of Moose Jaw, Sask.

Moose Jaw, Sask.—The contract for the construction of a bridge and dam to cost $75,000, has been awarded to Messrs. W. M. Newman and Co., 410 Ashdown Block, Winnipeg. The steel work will be done by the C. A. P. Turner Co., of Winnipeg.

Montreal.—The Grand Trunk Railway have placed a contract with John S. Metcalf Company, Limited, Montreal and Chicago, for a freight warehouse at Point St. Charles, Montreal, Quebec, 1,200 feet long and 60 feet wide; concrete foundations, brick walls and steel posts with wooden doors and [illegible]

Murray Bay, Que.—Wharf; general contractor, Nap Trudel, Ste. Irene, county of Charlevoix; estimated cost, [illegible]

Saanich, B.C. The tender of Messrs. Brown and Sim- [illegible] council.

St. Catharines, Ont. [illegible]

Victoria, B.C. [illegible]

Victoria, B.C. [illegible]

[illegible], B.C. [illegible]

for use in connecting the fire alarm signal boxes at a price of $12.28 per hundredweight.

Welland, Ont.—Mr. John Thew has been awarded a contract to erect an extension to the building of Trinity Church. This work is to cost about $8,200.

Winnipeg, Man.—Cedar for block paving; Mahoney Brothers, Winnipeg, at $10.50 per cord.

◆

RAILWAYS—STEAM AND ELECTRIC.

Kingston, Ont.—The management of the Canadian Locomotive Company have recently received an order for the construction of the following locomotives: Twenty-five heavy consolidated superheater locomotives for the Canadian Northern Railway; twenty switching locomotives for the same concern and twenty-five simple ten-wheeled locomotives for use on the lines of the Canadian Pacific Railway.

Montreal, P.Q.—A report states that the Canadian Pacific Railway engineers are preparing to construct a double track tunnel through the Selkirk Mountains at a high altitude in order that certain dangerous grades may be eliminated over Rogers pass, the scene of many serious snow slides. This tunnel, according to the report, is to be eight miles in length.

Northern Ontario.—A report states that the Commissioners of the Toronto and Northern Ontario Railway are about to electrify one of the double tracks of the line between North Cobalt and Cobalt.

Regina, Sask.—It is reported that the street railway committee of the municipal council are planning to spend the sum of $600,000 on improvements to the system during the next few months.

◆

LIGHT, HEAT AND POWER.

Berlin, Ont.—The ratepayers residing on Heinz Avenue are making enquiries regarding the cost of an ornamental lighting standard installation. They state that they desire the system installed by the coming winter.

Humboldt, Sask.—The ratepayers recently endorsed a by-law calling for the expenditure of $30,000 on an electric light plant for the municipality. Tungsten standards are to be used for the street lighting.

Montreal, P.Q.—The municipal council will consider a by-law which, if passed, will allow electric signs to project over the sidewalk for a space of six feet. The present allowance is restricted to four feet.

Ottawa, Ont.—Messrs. Harty and O'Connor have filed a claim against the Hydro-Electric Commission for a sum approximately $3,000,000 for damages arising out of the expropriation of the Chats Falls Property. In 1883 and 1911 two pieces of property which monopolize the power producing facilities of the falls were granted by the Government and the cost to the owners mentioned above is stated to be less than $2,000.

Richmond Hill, Ont.—The management of the Metropolitan Railway has made an offer to supply this municipality with electrical energy for the operation of their street lighting system, etc., at a price reported to be $25.50 per h.p.

Vancouver, B.C. -- The British Columbia Telephone Company will soon be in receipt of a shipment from Great Britain in the form of what is stated to be the heaviest telephone cable in the Dominion of Canada. It will contain [illegible] The cable is to be laid across the floor of the ocean and connect this city and North Vancouver.

◆

GARBAGE, SEWAGE AND WATER.

Calgary, Alta. [illegible]

Barrett Specification Roofs

On Four Great Granaries

To cover the four huge granaries illustrated herewith the Canadian Pacific R. R. engineers chose Barrett Specification Roofs for good and sufficient reasons.

These practical men know that these roofs will last *20 years or more.*

They further know that they will need no painting or maintenance expense of any kind and that the net cost per year of service will be infinitely lower than could be shown by any other type of roofing.

It is for these very reasons that Barrett Specification Roofs are used on more first-class buildings in the United States and Canada than any other kind

A big roof generally means a Barrett Specification Roof, for the reason that the cost of big roofs is carefully scrutinized and ultimate economy carefully considered. Small roof areas ought also to have Barrett Specification Roofs, because they are just as economical and satisfactory there.

Copy of The Barrett Specification with tracings ready for incorporation into building plans free on request. Address nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., Limited
MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Kenora, Ont.—The town of Kenora have authorized Mr. T. Aird Murray, Consulting Engineer, Toronto, to proceed with the preparation of plans and specifications for a municipal sewer system and sewage disposal plant, and have named his fee for this work as $3,000.

McLeod, Alta.—Plans and specifications for sewage disposal, prepared by T. Aird Murray, of Toronto, have been passed by the Alberta Provincial Board of Health. The works are to be for complete purification at an estimated cost of $40,000.

Moose Jaw, Sask.—The recent action on the part of the contractors laying the water mains for the Caron water scheme in throwing up their contract will, in all probability, prove of serious consequence to the ratepayers and citizens. An engineer on the ground has advocated that a temporary line of pipe be laid at an estimated cost of $10,000. It is estimated that the permanent acqueduct cannot be finished [illegible] in.

Niagara Falls, Ont.—The by-law calling for the expenditure of $7,500 on pumping equipment was carried by the ratepayers.

Sarnia, Ont.—A report states that the intake pipe of the waterworks system is again broken in two places about 200 feet from the shore. Chlorination has been adopted, and by this means it is hoped to secure freedom from an out-break of water-borne diseases.

St. Catharines, Ont.—According to recent compilations the cost of water in this city is the third lowest of any municipality in the province possessing a waterworks system. The town of Cornwall has a supply at the lowest rate; there the cost of 1,000 gallons is 1.07 cents. Niagara Falls occupies second place with a slightly higher cost of 2.03 cents for 1,000 gallons. Then ranks St. Catharines where the cost is 2.40 cents for 1,000 gallons. In Gravenhurst the cost is 17 cents for 1,000 gallons. This is the highest price of any municipality in the province.

Yorkton, Sask.—The town engineer, Mr. Talbot-Crosbie, has under preparation a set of plans showing a method of securing a suitable supply of water for this municipality. Test wells are being sunk and should these be inefficient the supply will be secured from York Lake. If the lake is resorted to it is proposed to take the water from a ravine by gravitation or pumping, through a filtration system into a storage reservoir with a capacity of at least 100,000 gallons.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Aurora, Ont.—[illegible] Cockerill Company, office furniture manufacturers, have been granted assistance from the ratepayers of this municipality and will [illegible]. The present [illegible].

Edmonton, Alta.—[illegible] the city by the Grand Trunk Pacific Railway will be a seven story structure with full basement, 185 by 250 feet, of steel, concrete re-[illegible]

Fort William, Ont.—[illegible]

Galt, Ont.—[illegible]

Montreal, P.Q.—[illegible]

Saskatoon, Sask.—The management of the Metal Shingle and Siding Company, of Preston, Ont., will erect a branch factory in this city. It is reported that the cost of this factory will be $100,000.

St. Thomas, Ont.—There is a probability of the E. T. Wright Shoe Company, of Massachusetts, building a branch factory in this city. They have asked that the city provide them with a modern brick or concrete factory with basement, elevators, vaults, etc. A by-law will be submitted to the ratepayers.

Toronto, Ont.—A company has been formed with the object of opening steel works yards at the foot of Bathurst Street in the property formerly occupied by the Canadian Shipbuilding Company. It is the intention of the new company to reopen the works without delay. Several hundred men will be employed in the manufacture of structural steel. The company will also engage in tank and kindred work at first, but they will eventually branch out into marine work on a large scale. Mr. J. E. Russell, of Toronto, is interested in this new company.

Toronto, Ont.—The management of the Methodist Book Room have recently purchased a block of property on the corner of John and Richmond Streets and will erect a modern publishing house. Dr. Briggs is an official of this business.

Toronto, Ont.—As a result of a visit paid by Ald. O'Neill, chairman of the Civic Property Committee, to the industrial farm at Long Island, N.Y., buildings to cost about $70,000 are advocated for the industrial prison farms of this city on North Yonge Street.

Vancouver, B.C.—The management of the Dominion Safe Works Company recently awarded a contract for the construction of a building for the manufacture of their products. The building will be 200-ft. x 150-ft.

Victoria, B.C.—The management of the British America Trust Company will erect a two-story office building on Fort Street. Mr. Arthur E. Haynes is an official of this company.

◆

BRIDGES, ROADS AND PAVEMENTS.

Kingston, Ont.—The management of the Ontario Asphalt Block Paving Company will give a bond of guarantee and accept the contract for municipal pavements which was recently awarded them under this condition.

Toronto, Ont.—Commissioner of Works R. C. Harris has recommended that Crawford Street be paved with asphalt from College to Bloor Street. The estimated cost of this work will be $21,000.

◆

CURRENT NEWS.

Eastern Canada.—A number of tenders for the construction of a car ferry to operate between Cape Tormentine, New Brunswick and Charlottetown, Prince Edward Island, have been received by the government officials at Ottawa. The contract will be awarded with all possible dispatch as it desired to have the ferry in operation within the next few months.

Kingston, Ont.—The ratepayers of this city have been requested to subscribe the sum of $50,000 toward a fund for the erection of 100 houses to be rented to employees of the locomotive works. A company has been incorporated under the name of the Kingston Realties, Limited, with a capital of [illegible]

Kingston, Ont.—Owing to recent heavy orders being placed for completion in the shops of the Canadian Locomotive Works, [illegible], of the syndicate recently formed to build working men's houses, will call ten-[illegible] the construction of these buildings with all possible [illegible]

New Westminster, B.C.—Mr. W. J. [illegible] and Mr. [illegible] of the Progressive Association, are taking [illegible] steps to secure grain elevators in this city.

Regina, Sask.—Word has been received from Mr. [illegible] Carnegie to the effect that he will forward a cheque for [illegible] to cover the restoration work now under [illegible] of the public library.

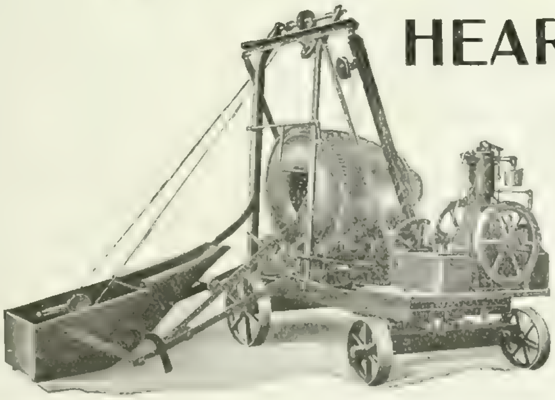
48 in. CONTINUOUS STAVE LINE.

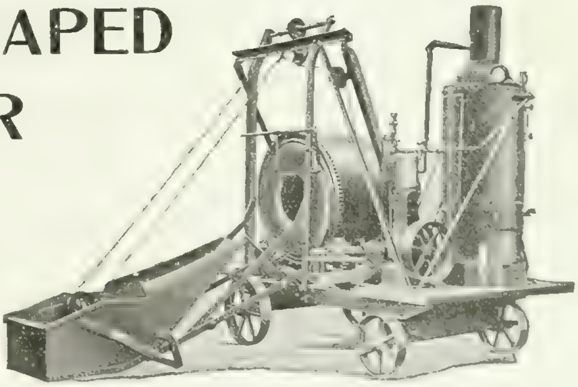
Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.





WETTLAUFER
HEART-SHAPED
MIXER

Write for 1912 Catalogues.

The famous heart-shaped drum turns the batch end for end very quickly; this ensures positive mixture.

A MIXER is not COMPLETE unless it is equipped with AUTOMATIC HOPPER, AUTOMATIC POWER DUMPING DEVICES, and built of STEEL and SEMI-STEEL as used in the entire construction of our mixers throughout.

HOOTON & MOORE,
613 Ashdown Block,
Winnipeg.

LAVALLE-ROSS,
Alexander Block,
Edmonton, Alta.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
TORONTO.
WORKS AT MITCHELL, ONT.
DETROIT, MICH
BUFFALO, N.Y.

A. R. WILLIAMS MACHY. CO.,
15 Dock Street,
St. John, N.B.

WETTLAUFER BROS.,
316 Lagauchetiere St., W.,
Montreal, Que.

Regina, Sask.—Dr. M. B. Bow, municipal medical health officer, has prepared a report on a revision of this branch of the civic administration. Under the scheme of reorganization which the council will be asked to consider the department is divided into branches as follows:—Dairies; foods, fruits, etc.; plumbing and property; nuisances, infectious and contagious diseases; scavenging. For each of these departments an inspector is proposed.

St. Catharines, Ont.—The total value of the building permits for the first eight months of this year amounts to $502,810.

St. Thomas, Ont.—The ratepayers will be asked to vote and authorize the municipal council to ratify a by-law calling for the granting of a loan and other concessions to the management of the St. Thomas Biscuit Company; also a by-law calling for a loan to the management of the Erie Iron Works, [illegible]

Tofield, Alta.—The ratepayers endorsed the expenditure of the following moneys for public utilities:—Waterworks, $25,000; gas distribution, $43,000; industrial site, $20,000; hospital, $4,200; drainage, $1,000. All the by-laws carried unanimously.

Victoria, B.C.—The municipal council have received the following offers to erect two garbage collection stations. Mr. Edward Logan, $7,478 for the Queen's Avenue station, and $7,698 for Woodland Street station; Mr. John Robert, $12,568 for both stations; Mr. W. C. Stedham, $14,686 for both; Parfitt Brothers, $6,485 for the Queen's Avenue station and $6,095 for the Woodland Street station. The health committee will report upon these offers.

Welland, Ont.—The following is a tabulation of recent building statistics:—

Building permits for month of August this year....	$ 20,550
Building (including new school) for August last year	38,743
[illegible]	10[illegible]157
Total for year to date last year	no record

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week [illegible]

A firm in South Wales who are about to commence the development of a mica property in India, are open either to do business with Canadian importers, or to dispose of the pro[illegible]

Inquiry is made by a correspondent in Northumberland for [illegible] of Canadian manufacturers of navvy wheelbarrows.

A German firm desire the addresses of Canadian importers of enamelled steel hollow-ware.

◆

NEW MEANS OF DETECTING UNDERGROUND WATER.

[illegible] of the Ontario [illegible] College, Guelph, Ont., has recently been experimenting with a device [illegible] is a long, slender, exceedingly light magnetic needle. [illegible]

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured

Each week on this page may be found summaries of

17155—July [illegible]—Authorizing [illegible] & [illegible] Ry. to construct bridge No. 5.2 over Burnside Road, near Victoria, B.C.

17156—June 24—Authorizing C.P.R. to construct spur for Jamieson Lime Co., village of Sand Point, Ontario.

17157—July 27—Authorizing Kettle Valley Ry. to construct bridge over Okanagan River, B.C., at Penticton.

17158—Aug. 1—Authorizing C.N.R. to cross with its Goose Lake Extension Alberta, 68 highways.

17159—July 31—Authorizing Campbellford, Lake Ont. & W. Ry. to cross 5 highways between mileage 126.60 and 155.70, Ont.

17160—July 31—Authorizing G.T.R. to construct spur for Dominion Canners, Limited, town of Aylmer, Ontario.

17161—August 1—Authorizing C.L.O. & W. Ry. (C.P.R.) to cross 9 highways between mileage 177.86 and 183.45.

17162—August 1—Authorizing C.P.R. to construct spur for Golden West Brewing Company, Ltd., at Titian, Alberta.

17163—August 1—Authorizing C.L.O. & W. Ry. (C.P.R.) to cross 4 highways between mileage 121.87 and 124.83, Ontario.

17164-65—August 1—Authorizing C.P.R. to construct spur for Stag Creek Lumber Company on its Maniwaki Subdivision, Quebec, and for Carter Mather Lumber & Supply Co., Calgary, Alberta.

[illegible]—August 1—Approving C.N.O. Ry. station site at Torbolton, Twp. of Torbolton, County of Carleton, Ontario.

17167—August 2—Authorizing Twp. of Medonte, Ct. Simcoe, Ontario, to construct highway crossing over C.P.R. Sudbury-Kleinburg Branch.

[illegible]—August [illegible]—Approving drain plans for [illegible] Award Drain under G.T.R. in Twp. of Malahide, Ct. Elgin, Ontario.

17169—August 2—Authorizing C.N. Branch Lines Company to connect with its Canora-Sturgis Branch main line of C.N.R. at Canora, Sask.

[illegible]—August [illegible]—Authorizing C.N.Q. Ry. to construct across public road in Parish of St. Augustin, Ct. Two Mountains, Que.

17171—August 7—Approving location of C.N.R. through Twps. 19-15, Rges. 29-26, west 4 M., Alberta, mileage 31.40 to 65.05.

17172—August 6—Authorizing C.N.O. Ry. to cross 2 highways on its Ottawa-Capreol Line, Twp. Field, Dist. Nipissing, Ontario.

17173—August 3—Authorizing C.P.R. to construct spur to its freight sheds at New Westminster, B.C.

17174-5—August 6—Authorizing C.L.O. & W. Ry. (C.P.R.) to cross forced road from Crow Lake to Sharbot Lake, Ont., and highway in Twp. of Hamilton, Ct. Northumberland, Ontario.

17176—August 6—Authorizing G.T.P. B.L. Co. to construct spur for Pacific Pass Coal Fields, Ltd., Dist. North Alberta, Alta.

17177-78—August 3—Authorizing G.T.R. to construct siding into premises of W. S. Cook and Son, city of Belleville, Ont., and for Canadian Northern Montreal Land Co., Ltd., Parish of St. Laurent, Ct. Jacques Cartier, Que.

[illegible]—August [illegible]—Approving plans of Dominion Atlantic Ry. Co. for additional wing walls for bridge at Bridgetown, N.S., and for bridge over Avon River, at Windsor, N.S.

17181—August 6—Authorizing Kettle Valley Ry. to cross highway northwest of Penticton, B.C.

17182—August 3—Authorizing Essex Terminal Ry. and Michigan Central Ry. [illegible] Windsor, Ontario. [illegible] Order [illegible]

17183—August 6—Authorizing G.T.P. B.L. Co. to cross 12 highways on its Cutknife Branch, Saskatchewan.

17184—August 7—Authorizing G.T.P. to carry traffic from mileage 100 to 164 east of Prince Rupert, B.C.

[illegible]—August [illegible]—Authorizing C.P.R. to construct spur for G. F. Stephens & Co., Ltd., Calgary, Alberta.

[illegible]—August [illegible]—Approving plan of Michigan Central Ry. for new bridge over London Street, Windsor, Ontario.

17187—August 7—Authorizing Dominion Atlantic Ry. Company to recon[illegible] from Halifax.

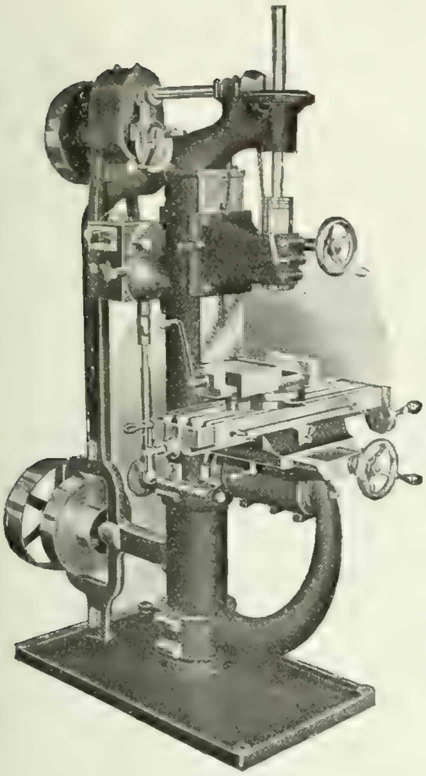
[illegible]

[illegible] Park, Elizabeth and James St., St. Mary's, Ont.

[illegible]

[illegible] subway.

[illegible]



You Need a Machine Like This on a Dozen Different Jobs

It's a No. 2 Knight Milling and Drilling Machine

This machine is very rigid, powerful and accurate, so that close work may be turned out with a high degree of satisfaction, and in the shortest possible time. The adjustments are quickly and easily made. On a large variety of work it is possible to make a saving of from 20 to 50 per cent. in time, as compared with other machines.

The fact that hundreds of Knight Machines are now in use in this and foreign countries proves that they are not experiments.

These machines are made in three sizes.

Briefly, the construction of the No. 2 Knight Miller is as follows:—Spindle of crucible steel, ground bearings; working surface of table, 29 × 8½ inches; feed, longitudinal and transverse; floor space, 60 × 68 inches; weight, crated for shipment, about 2,500 lbs.

WRITE US ABOUT IT TO-DAY.

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

[illegible] C.P.R. (B.C. [illegible]

[illegible] C.P.R. [illegible]

[illegible] C.P.R. [illegible]

[illegible] C.P.R. [illegible] at Thunder Creek, Sask., 20 per cent. from Railway Grade Crossing Fund, $5,000 by city of Moose Jaw, remainder by C.P.R. City to maintain road [illegible]

[illegible] Lumber & Shingle Co., Vancouver, B.C., re overcharges on lumber alleged against C.P.R. and G.N.R.

17208—July 30—Directing that Wellington St. Crossing, Hamilton, be pro- [illegible] by G.T.R.

[illegible] Vancouver, Westminster & Yukon Ry. to construct siding for Bradford & Taylor, Vancouver, B.C.

[illegible] owners of other warehouses at Brandon, Man., to unload cars from spur line of C.N.R. one lane between Lorne and Princess Avenues, Electric Light [illegible]

17211—July 24—General Order putting into force Rules entitled "Uniform [illegible]"

[illegible]

[illegible]

[illegible]

[illegible] Corporation, Ltd., near Longford Station, Ontario.

17216—August 15—Authorizing G.T.P. B.L. Co. to cross C.P.R. main line with its Harte Brandon Branch.

[illegible] plan of C.P.R. for signals at Atherley Swing Bridge, Ont.

[illegible] C.P.R. [illegible] for Joseph Pepin, Parish of St. Therese de Balinville, Ct. Terrebonne, Que., and for Harris Tie & Timber Co., District of Algoma, Ontario, mileage [illegible]

[illegible]

[illegible] C.N.R. [illegible]

[illegible] Andrews St., in village of Tisdale, Saskatchewan.

[illegible]

[illegible] C.N.O.R. [illegible]

[illegible] C.P.R. [illegible]

[illegible] C.P.R. of branch line authorized by Order 15768, Jan. 11, 1912.

[illegible]

17251—August 19—Extending until 15 Sept., 1912, time for completion by Hamilton Electric Radial Ry. [illegible] by Order 17132, July [illegible], 1912.

[illegible] August [illegible]—Amending Order [illegible], Dec. [illegible], 1911, by clause that G.T.R. continue and maintain switch to elevator of Hay Bros.; Police Trustees of village to pay to G.T.R. $200 towards cost of maintaining switch.

[illegible] August [illegible]—Directing that G.T.P. Ry. furnish at Haysport, B.C., adequate and suitable accommodation for receiving and loading of all traffic offered, etc.

[illegible] August [illegible]—Authorizing Central Ry. Co. of Canada to cross 11 highways [illegible] Caledonia and South Plantagenet, Ontario.

[illegible] August [illegible]—Amending Order [illegible], May 31st, 1912, re Birch Avenue, across G.T.R. tracks, Hamilton, Ont.

17256—August 22—Authorizing G.T.R. to cross road allowance between [illegible] June [illegible], 1912.

[illegible] August [illegible]—Approving Supp. No. 11, to Express Classification for Canada No. 2.

17258—August 16—Authorizing Hydro-Electric Power Commission of Ontario [illegible] G.T.R. [illegible] at Lots 5 and 6, Concession [illegible], in Township of Yarmouth, Ont.

17259—August 21—Authorizing C.P.R. to construct spur for General Fire Extinguisher Co., Dundas Street, Toronto, Ont.

[illegible] August [illegible]—Approving proposed location of C.P.R. station at [illegible], Ontario.

17261-62—August 20—Relieving C.P.R. from further protecting crossings at Dundas St., Cooksville Station, Ont., and at mileage 79, Windsor S.D., near Tilbury Station, Ont.

[illegible] August [illegible]—Rescinding Order [illegible], Nov. [illegible], [illegible]. Atl., Que. & W. Ry.

[illegible] August [illegible]—Authorizing C.P.R. to construct spur into [illegible] Ballast Pit, Sask., and for Price Bros., Parish of St. Francois Xavier de Batiscan, Que.

17266—August 21—Authorizing C.P.R. (St. Mary's and Western Ont. Ry. Co.) to cross 14 highways near St. Mary's, Ont.

[illegible] August [illegible]—Authorizing C.P.R. to construct spur [illegible] Iron [illegible], Ltd., Joliette, Que., and for extension [illegible] spur for A. B. [illegible] Lumber Co., Ltd., Calgary, Alta.

[illegible] August [illegible]—Directing C.P.R. to operate its trains over Main St., [illegible], Man., not exceeding [illegible] miles per hour.

[illegible] August [illegible]—Temporarily approving C.P.R. Std. Freight Mileage [illegible] C.R.C. No. [illegible] W. [illegible]

[illegible] August [illegible]—[illegible] C.N.O.R. to construct bridge across Main Channel of Riviere des Prairies, mileage 40, from Hawkesbury, Que.

[illegible] August [illegible]—Authorizing C.N.R. to operate spur to property [illegible] Gervais Coal Mine, Alberta.

17273—August 23—Approving plans of C.N.R. Standard No. 7 station for [illegible]

17274—August 21—Approving revised location G.T.P. B.L. Co. station [illegible] Regina-Boundary Branch.

[illegible] August [illegible]—Approving location of G.T.P. B.L. Co., mileage [illegible] to 21.86, Brandon Branch.

17276—August 20—Authorizing G.T.P. B.L. Co. to carry traffic over its Young to Prince Albert Branch, between mile 45.5 and Wakaw (mile post [illegible]). Rescinding Order [illegible], [illegible] Aug. [illegible]

[illegible] August [illegible]—Substituting [illegible] in Order [illegible], March [illegible], 1912, re G.T.R. crossings at Tavistock, Ontario.

17278—August 21—Relieving Windsor, Essex & Lake Shore Ry. from further protecting crossing 4½ miles south of Windsor, Ont.

[illegible] August [illegible]—Providing for branch [illegible] Canada Steel Co. and Brown Boggs Co., Hamilton, Ont., to be used jointly by T.H. & B. Ry. and G.T.R.

17280—August 21—Authorizing G.T.R. to reconstruct draw span at bridge [illegible] Point, Ont.

17281—August 13—Authorizing C.P.R. to construct spur east of Neebing Avenue, Fort William, Ont., to serve industrial plants, also to cross C.N.R. [illegible]

17282—August 22—Authorizing C.P.R. to cross 34 highways on its Crow's Nest Pass Branch between Seven Persons and Grassy Lake, and approving revised location, etc.

17283—August 23—Authorizing C.P.R. to connect with G.T.R. spur which [illegible] St. Mary's, Ont.

[illegible] August [illegible]—Authorizing [illegible] & W. Ry. (C.P.R.) to cross and divert two highways, Twp. South Sherbrooke, Ont.

17285—August 23—Authorizing C.N.R. to cross 6 highways on Vonda Northerly Line.

[illegible] August [illegible]—Authorizing C.N.O.R. to construct bridge [illegible] Ontario.

17287—August 23—Authorizing G.N.R. to construct crossing over high [illegible] application, Fruitvale Trading Company.

[illegible] highway crossings across G.N.R. and Victoria Terminal and Ferry Co.'s tracks near Cloverdale, B.C.

[illegible] W. Ry. (C.P.R.) [illegible]

[illegible]

[illegible] C.P.R. [illegible]

[illegible] C.P.R. [illegible]

[illegible] C.N.O.R. [illegible]

[illegible] C.P.R. [illegible]

Volume 23. Toronto. Sept. 19, 1912 Contents of this issue on page 483

The Canadian Engineer

An Engineering Weekly

NEW BRIDGE AT TRAIL, B.C.

There was recently completed for the Province of British Columbia, at Trail, B.C., a four-span through riveted truss type bridge, which contains much of interest, both in design and construction. The bridge was erected by Armstrong, Morrison & Co., Limited, of Vancouver, and was opened for traffic on May 24th, 1912. It is designed for ordinary highway traffic with paved roadway, eighteen feet in the clear. The bridge is of the truss type supported on tubular steel piers filled with concrete. Each pair of piers is joined together by sheet steel reinforced bracing, which forms a wall with two feet thickness of concrete. There are three piers; piers Nos. 2 and 3 were sunk by the pneumatic process, while pier No. 1 was built in a cofferdam. The site of the bridge is at the east end of the city of Trail. The bank on the south or city side, is of a rocky formation. The first pier and abutment have, therefore, solid rock foundation. The north bank of the river is of a sand and gravel formation, and the general level is about fourteen feet above the bridge floor elevation. This necessitated a cut of about fourteen feet and a removal of sixty-five hundred yards of material to make the approaches. The base of the north abutment, on account of the nature of the bottom, is forty-two feet below the floor level. The ground near the north shore slopes from zero at low water to a depth of thirty feet between piers 1 and 2, which is the channel proper.

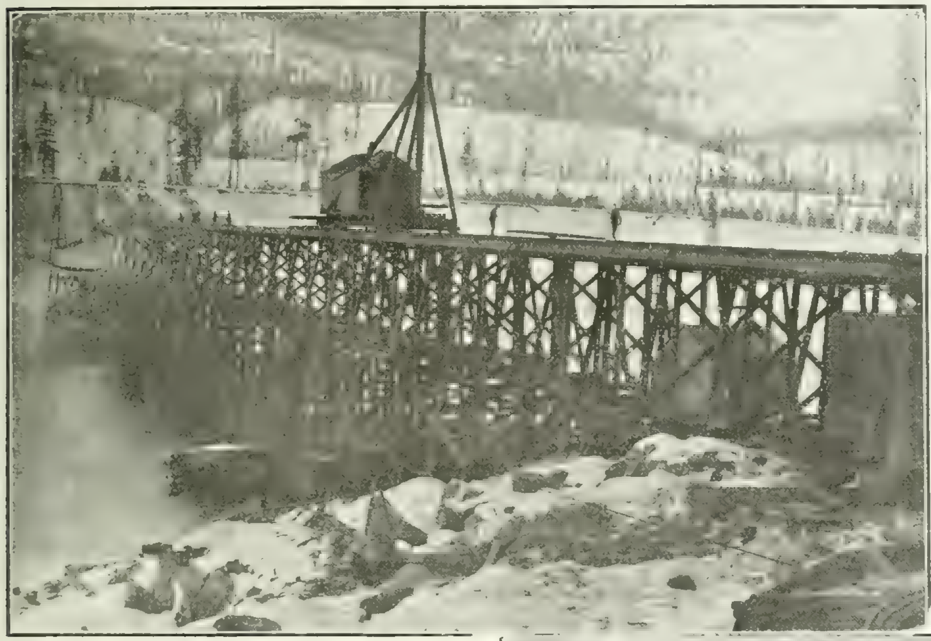


Fig. 1.—View Showing Falsework of the Bridge.

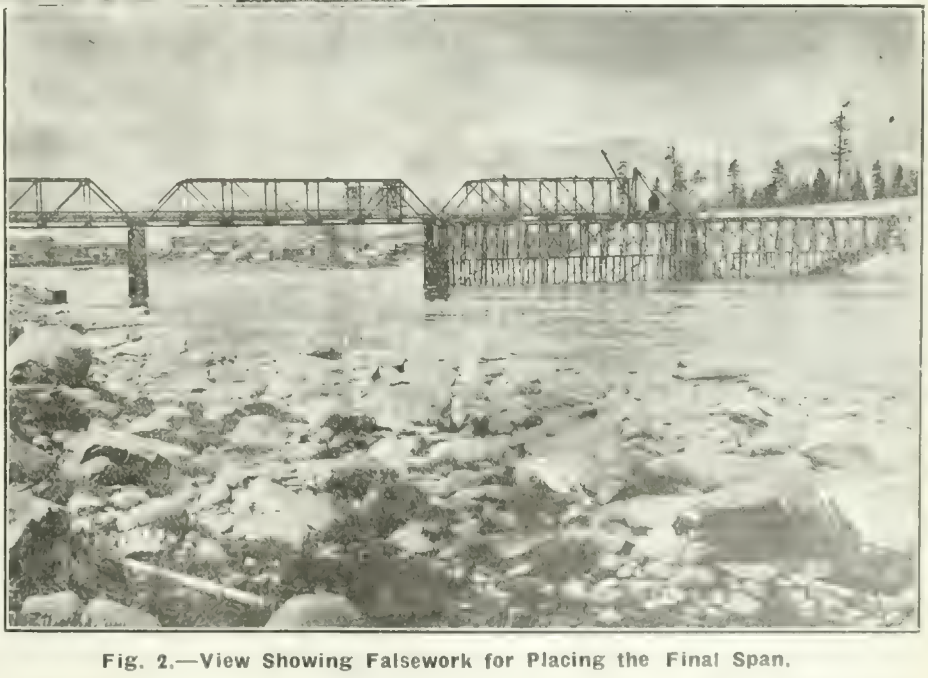


Fig. 2.—View Showing Falsework for Placing the Final Span.

Construction was commenced in November, 1911, and was completed on May 24th, 1912. Fourteen thousand lineal feet of piles were used in the falsework, and a hundred and thirty thousand feet of timber. The cement used in the construction of piers and abutments totalled about 7,500 sacks. The earth work necessitated for the approaches ran about 1,500 cubic yards. As has been noted, the bridge superstructure is made up of four spans. Each of these spans is 171 feet 6 inches in length, with seven panels to the span. The total length of the bridge is 691 feet 9 inches. The foundation of the deepest pier below low water necessitated by the nature of the ground, is 44 feet. The height of the pier over all is 86 feet. The height of the bridge from the floor to the top chord is

20 feet 6 inches, and the height from low water to top chord is 67 feet. Three hundred thousand pounds of steel were used in the piers and the weight of the steel in superstructure is 480,000 pounds. Eventually, the bridge will be provided with a lift span, but the provision of this span has been left to some future date. The lift span will be fully balanced by concrete counterweights when placed. The towers and machinery have been omitted until the river traffic requires the span to be made movable. The lift span will be operated by electric power and it will be possible to raise this to the full height of 55 feet above high water, in 60 seconds. The estimated complete cost [illegible]

The Province of British Columbia are the owners of the bridge. Waddell & Harrington, consulting engineers, Kansas City, Mo., designed the structure, while the Cleveland Bridge Company, of Darlington, Eng., were the contractors for the steel work. Armstrong, Morrison & Company, [illegible] B.C., were the [illegible] of the [illegible]

[illegible]

INTERESTING DRAINAGE SYSTEM OVER THREE THOUSAND YEARS OLD.

Dr. A. J. Evans, the chief of Cretan explorers, recently discovered the site of the Great Palace of Minos, at Knossos, near modern Candia, and the result of his explorations has brought to light the very high state of civilization enjoyed by the ancient Cretans, 3,500 years ago. The Rev. James Baikie, of Edinburg, has written a book summarizing the discoveries of Dr. Evans, entitled, "The Sea-Kings of Crete," Adams and Black, publishers (New York, The Macmillan Co.), from which the National Geographic Magazine has abstracted the following article which will be especially interesting to our readers:

Most surprising was the revelation of the amazingly complete system of drainage with which the palace was provided. The gradient of the hill which underlay the domestic quarter of the palace enabled the architect to arrange for a drainage system on a scale of completeness which is not only unparalleled in ancient times, but which it would be hard to match in Europe until a period as late as the middle of the nineteenth century of our era. A number of stone shafts, descending from the upper floors, lead to a well-built stone conduit, measuring one meter by one-half meter, whose inner surface is lined with smooth cement. These shafts serve the purpose of leading into the main con-

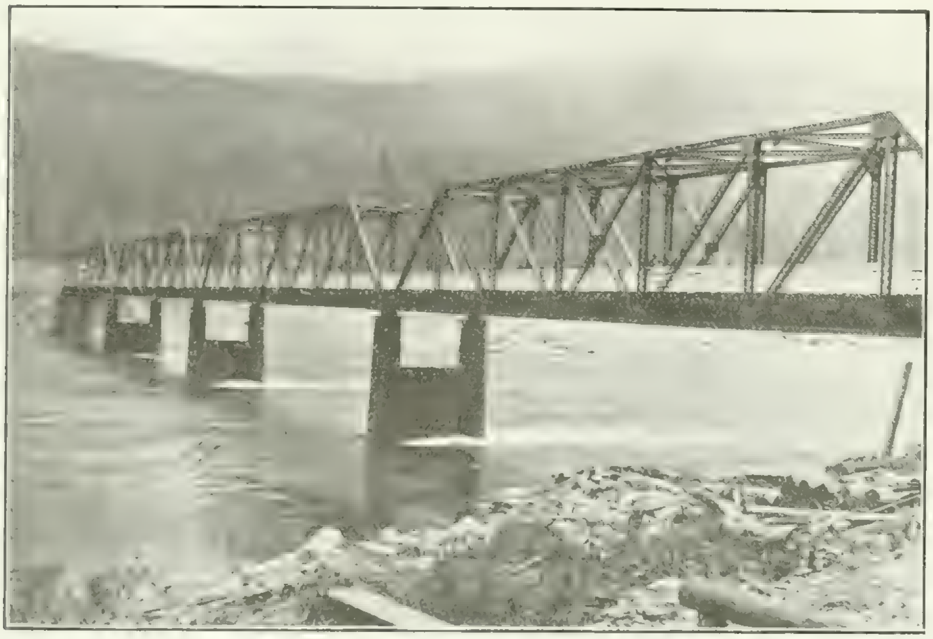
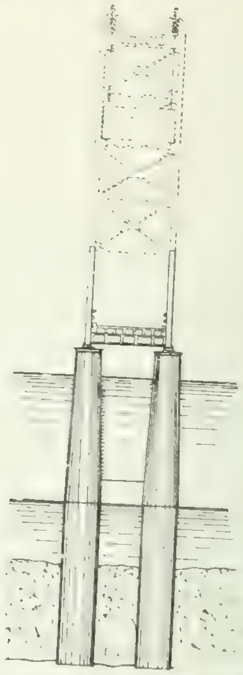
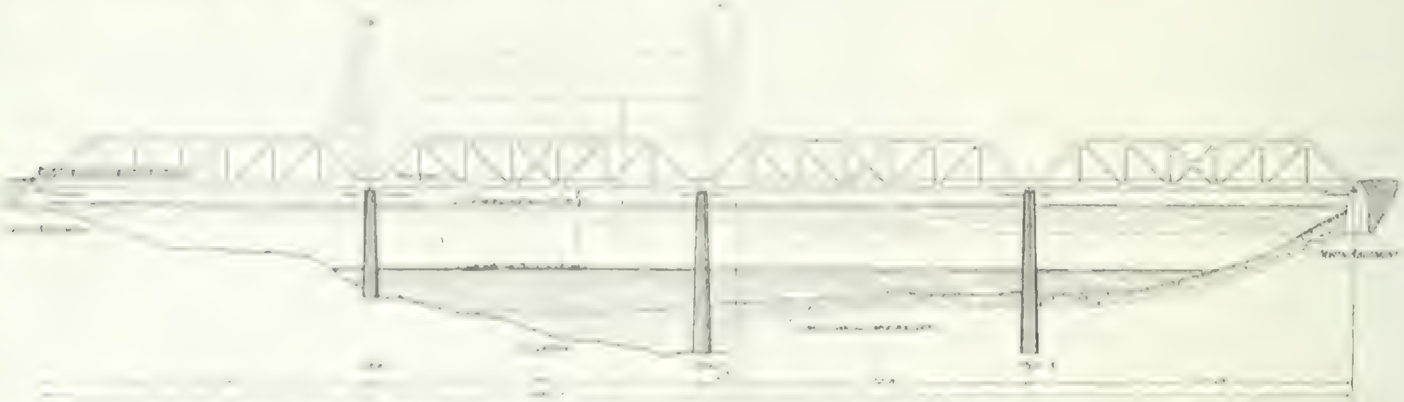


Fig. 3.—View Showing Completed Bridge.


Cross Section Through Bridge.


General View of Lift Bridge at Trail, B.C. Lift Span Towers, to be Installed Later are Shown Dotted.

duit the surface water from the roofs of the palace buildings, and thus securing a periodical flushing of the drains. In connection with this surface-water system there was elaborated a system of latrines and other contrivances of a sanitary nature, which are "staggeringly modern" in their appointments.

In the northeastern quarter, under the Corridor of the Game-Board, are still preserved some of the terra-cotta pipes which served as connections to the main drain. They are actually faucet-pointed pipes of quite modern type, each section two and one-half feet in length and six inches in diameter at the wide end, and narrowing to four inches at the smaller end. Dr. Evans states that jamming was carefully prevented by a stop-ridge that ran round the outside of each narrow end a few inches from the mouth, while the inside of the butt, or broader end, was provided with a raised collar that enabled it to bear the pressure of the next pipe's stop-ridge, and gave an extra hold for the cement that bound the two pipes together.

Indeed, the hydraulic science of the Minoan architects is altogether wonderful in the completeness with which it provided for even the smallest details. On a staircase near the east bastion, on the lower part of the slope, a stone runnel for carrying off the surface water follows the line of the steps. Lest the steepness of the gradient should allow the water to descend too rapidly and flood the pavement below, the runnel is so constructed that the water follows a series of parabolic curves, and the rapidity of its fall is thus checked by friction.

The main drains are duly provided with manholes for inspection, and are so roomy that two of the Cretan workmen spent days within them clearing out the accumulated earth and rubble without inconvenience. Those who remember the many extant descriptions of the sanitary arrangements, or rather the want of sanitary arrangements, in such a town as the Edinburg of the eighteenth century will best appreciate the care and forethought with which the Minoan architects, more than 3,000 years earlier, had provided for the sanitation of the great Palace of Minos.

PRODUCTION OF ELECTRIC-FURNACE STEEL.

According to Robert Pinot, secretary-general of the Comités des Forges de France, the production of steel in electric furnaces during the last three years was, in tons:—

	1909.	1910.	1911.
Germany	17,773	36,188	66,654
United States	13,762	52,141	29,105
Austria-Hungary	9,046	20,028	22,867
France	6,456	11,759	13,850
Total	47,030	120,116	120,476

The United Kingdom had hardly commenced to produce for the general market. The predominating lead of Germany and the drop in the electric steel production of the United States are notable features of last year's figures. Activity in France lies more in the field of ferro-alloys. Of these, France made altogether, in 1904, 34,200 tons, which amount had increased to 60,200 tons by 1910; the figures for ferro-alloys made in electric furnaces were respectively 5,756 and 23,800 tons; the electrically-produced alloys amounted in 1909 to 14,900 tons, and varied little in the years 1906 to 1909.

ALGAE AND THEIR RELATION TO PUBLIC WATER SUPPLIES.

In the monthly bulletin of the Ohio State Board of Health, there is a short discussion of algae and their relation to public water supplies, by Mr. L. H. Van Buskirk, assistant engineer of the State Board of Health. The discussion follows:

The State Board of Health receives frequent requests during the summer season from different municipalities of the State, for examinations of their public water supplies in which objectionable tastes and odors have developed. It has been observed by the residents of communities so affected, and also by the State Board of Health, that the tastes and odors occur sometimes as early as April, but generally not until the latter part of May or the first of June, and that they disappear as soon as cold weather is experienced in the fall. It has also been noted that the objectionable qualities are found in water that is stored in open basins or in impounding reservoirs in which there is an opportunity for stagnation due to the heat and light of the sun and the infrequent displacement of the water; and also that the peculiarities appear and disappear almost simultaneous with the occurrence of algae. It it an interesting fact that these features are not found to any extent in waters which are stored in reservoirs from which the sunlight is excluded. Algae do not develop in the dark. It is true, however, that certain other vegetable growths which give rise to the same unpleasant qualities thrive in waters which are protected from sunlight.

It must be understood that not all tastes and odors found in water are caused by algae, for there are a large number of other agencies which effect these qualities, among which are oil wastes, salt, sulphur, organic matter, iron, and bacteria. An example of bacterial growth is crenothrix which thrives in waters containing organic matter and iron. These bacteria when present in a water cause unpleasant tastes and odors. A water supply containing crenothrix is objectionable for laundry purposes due to the effects of the iron which collects in its cells upon linen. The growth develops rapidly in the dark and is found in covered reservoirs or storage basins and in distribution systems. In public water supplies containing large amounts of iron, the bacterial growth is often seen in the water as drawn from the hydrants in the form of small red filaments. It is difficult to destroy the bacteria unless the iron is removed from the water.

A further discussion of the causes of tastes and odors will be confined to purely algal growths concerning which the following facts are given.

The appearance of algae is familiar to practically all, as there are indeed few who have not seen the green scum floating upon the surface as well as the growths along the sides and bottoms of our lakes and ponds. These latter growths are not to be mistaken for the ordinary aquatic plants which are also abundant. Many people living or visiting in a community where the water supply is stored in open reservoirs know full well what the objectionable tastes and odors are like and many have noticed the green color of the water as drawn from the tap. The same qualities are frequently observed when fire hydrants on dead ends are opened for the purpose of cleansing the mains. The algal growth discharged from dead ends must not be confused with the red crenothrix which is found much more frequently.

The simplest forms of plant life are grouped under one general heading and are called thallophytes. Thallophytes may in general be separated into two divisions known as algae and fungi. Algae are thallophytes which contain chlorophyll, the green coloring matter found in plants, and are able to manufacture food from inorganic material. They are variable in size, ranging from forms visible only by means of the microscope to salt water forms with enormously bulky bodies.

Although all algae contain chlorophyll, some of them do not appear green owing to the fact that other coloring matter is present in the cells. It is easy, therefore, to subdivide algae into groups according to their color, which variation is accompanied by constant differences in habits and methods of growth. The constant termination phyceae which appears in the names is a Greek word meaning "sea-weed," which is a common name for algae; while the prefix in each case is the Greek name for the color which characterizes the group.

The four subdivisions are as follows:

(1) Cyanophyceae, or blue green algae.
(2) Chlorophyceae, or green algae.
(3) Phaeophyceae, or brown algae.
(4) Rhodophyceae, or red algae.

The phaeophyceae and rhodophyceae are found only in salt water. Therefore, they are eliminated from consideration as affecting the fresh waters of the State. While the cyanophyceae, owing to their methods of reproduction and growth, are in some classifications not included in the algae, they are important in connection with the study of the storage of water and are accordingly placed with the algae for convenience. The cyanophyceae and chlorophyceae are therefore the important forms of algae in which we are directly interested. Each of these groups includes numerous varieties, the identification of which is sometimes difficult. By observing the characteristic color of the growth it is easy to classify the same into either of the two main subdivisions which are found in fresh water. If it is desired to ascertain the particular variety, it is necessary to use a microscope by means of which the individual cells may be observed and recognized.

The cyanophyceae give rise to grassy or moldy odors, while the chlorophyceae are characterized by a fishy or oily smell. Some of the growths appearing early in the summer are aromatic or sweetish. These odors become intensified as the algae increase in numbers and as others decay. In order that those who are not familiar with the effects of algae upon public water supply may realize to a degree the seriousness of such a condition, the following facts are given relative to a particular supply in Ohio.

The water supply of the village is obtained by impounding [illegible] near the village. The algal growths develop in the impounding reservoir each summer and are carried through [illegible]

water is stored. The growths often appear on the surface of filters, and in such cases are very difficult to remove. When the temperature of the water is from 60 to 80 degrees Fahr., the algal growth is facilitated.

The prevention of algal growths in water to be used for drinking purposes is no small problem. It has been studied by many scientists who have practically decided that copper sulphate or blue vitriol is the best substance to use. Its use, however, is attended by many complications which require that it be applied only under expert supervision. Blue vitriol is known to be highly poisonous so that great care must be exercised in its use in order to prevent sickness. Another complication attending its use is the variable amount required to destroy the different species of algae. A careful microscopic analysis is therefore necessary in order to identify the growths. Even though the algae are destroyed, the tastes and odors will not disappear unless the decaying matter is removed. In many cases the growths soon reappear and it is necessary to repeat the treatment.

Probably the safest although not always the cheapest method of protecting water supplies against algae is to provide covers for the storage basins and at the same time keep the basins clean. The presence of organic matter and light, it will be remembered, are the two most important elements promoting the growth.

In one case the growth was prevented by pumping continuously to the reservoir, allowing it to overflow. This kept the temperature low and prevented the water from becoming stagnant. This, however, is a very expensive method as large quantities of water are thereby pumped to waste.

The removal of algae from filter beds is very difficult. In one instance, where tub filters are in use, much trouble has been experienced. The filters have been scraped and treated with copper sulphate, and several times the entire filtering material has been removed and washed. The treatment, however, was not successful though large quantities of algae growth were removed. The most successful method used at this particular plant was the sterilization of the filters by means of steam.

It will be readily seen, therefore, that the presence of algae in the water supplies of the State is a serious problem and one which requires careful and serious attention. No one method of protecting a water supply as outlined above will be successful in all cases, and it is evident that a careful study should be made of each particular problem. In order to do this a consulting engineer should be retained whose duty it should be to recommend possible changes in the method of handling the supply, or who should oversee the proper treatment of the water. This is the only logical and safe method to be used in preventing or destroying algal growths and in furnishing a water suitable for domestic and drinking purposes.

CANADIAN TIMBER.

[illegible] Ontario. Native hardwoods are more plentiful and varied in Ontario than in any other province, a consideration which is [illegible] in Nova Scotia.

DESIGN AND CONSTRUCTION OF SMOKESTACKS.

In a recent issue of Building Progress, a periodical published by the National Fire Proofing Company, of Pittsburg, there is published an article by Henry V. Feder, on "The Design and Construction of Smokestacks." A great part of the discussion deals with the use of hollow tile instead of brick for chimneys. We present herewith an abstract of the article.

To approach the problem properly, the first points to be considered are the maximum area of grate under the boilers on which coal will be burned at any time; the kind and quality of coal, and the greatest quantity of coal that will be consumed per hour per square foot of grate surface. Ordinarily twenty pounds of coal per square foot of grate surface will be the right allowance to make, although the rate of combustion will average from ten to twenty pounds per square foot of grate surface, with an average of about fifteen. The maximum, however, is what must be provided for, consequently the smokestack must be made large enough to take care of the gases of combustion during forced firing.

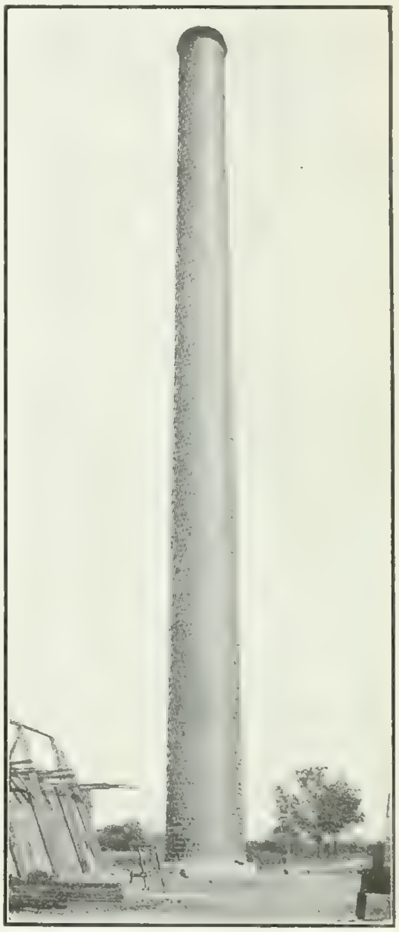
There are two—yes, three—important points outside of the stability of the smokestack to be carefully worked out by the designer. They are the height of the stack, its area and wall insulation. Taking up first the area of the stack brings us back to the combustion of coal on the grate. For the economical combustion of coal each pound must have from 143 to 169 cubic feet of free air to burn it, and this will necessitate an area capable of taking care of from 155 to 170 cubic feet of chimney gas per hour per square foot of grate surface on an average, and a much larger quantity than that when coal is first put on the fire.

If the chimney lacks either in area or in height to take care of this volume of gas, the effect will be much the same as though the air were not supplied to the coal, for a feeble fire will result, and there will be the additional annoyance of more smoke than when the stack is of sufficient size to furnish a supply of air for the combustion of the gases which cause the smoke.

Height of chimney comes next, for without height there will be insufficient draft, and the gases will not escape fast enough, even with a smokestack of enlarged area. The draft of a chimney, or the velocity of gases through it, depends entirely on the difference in weight between the column of gases in the smokestack and an equal column of air outside of the stack. The hotter the gases in the stack the greater the difference in weight between this column and a column of the air outside, and so long as the temperature of these two columns are different it stands to reason that the higher the stack the greater the total difference in weight will be. In engineering practice it is assumed that the hot gases from the boiler at the uptake where they enter the smokestack will have a temperature of 450 deg. Fahrenheit. Without this temperature the desired draft will not be attained, for, owing to the large area of exposed surface to the smokestack, loss of heat by radiation and conduction will lower the inside temperature of the stack to such an extent that the upward movement of gases will be sluggish.

This brings us naturally to the third consideration in smokestack design, the wall insulation. To keep down to the lowest possible limit the loss of heat through the walls of the stack, they should be made as heat retarding as possible, and, as nothing is quite so good as a practical insulator against loss of heat as air cells, hollow walls or compartments of some kind are commonly used for this purpose. The walls of the stack, however, have to do more with the structural design, which will be explained later.

In smokestack design the proportions of the stack must first be obtained. It might be well to explain here that chimney draft is affected by so many varying conditions that no absolutely reliable and infallible rule or formula has ever been devised for proportioning smokestacks for a certain desired draft pressure. The type of boiler, kind and size of grate, size and kind of coal to be used, frictional resistance of the smoke connections, number and size of boiler flues—these all have more or less effect on chimney draft. While absolutely accurate results cannot be obtained by rules and formula, approximate results, which, when interpreted in connection with all the modifying circumstances, will yield accurate results, can be obtained by rule, while for ready reference practice has established certain well-defined proportions for smokestacks to be used in connection with boilers of different-rated horsepowers. In the table appearing on the following page the heights of chimneys, their diameters and areas can be found for any size of boiler, or battery of boilers, from 23 horsepower to 5,031 horsepower. These proportions will be found safe for all ordinary conditions.



Hollow Tile Smokestack at the Plant of the National Fire Proofing Company of Canada, Limited, Near Hamilton Ontario.

When the height of smokestack and area of flue are known there still remain the structural features of design and construction to be worked out. For example, what should be the diameter of a smokestack at its base when it is 175 feet high?

There is a simple empirical rule that a smokestack in order to be stable must have a diameter at its base of from one-tenth to one-twelfth of its height. If in place, subject to an open, exposed strong winds, or on a floating foundation on poor soil, a diameter of one-tenth would be about right, while if the footings rested on bedrock, and the stack is partially sheltered from strong winds, the stack could be narrower at the base, perhaps one-twelfth the height of the stack being sufficient. Any proportion between these two extremes may be used, the designer being guided by judgment in assuming the proportions.

Applying this rule and assuming a height of 175 feet on a floating foundation of hard-packed sand or dry clay, the proportion of one-tenth the height may safely be taken as the diameter of the stack at the base. One-tenth the height is 17½ feet, which would be the proportion in such a case.

But smokestacks are not of uniform diameter throughout their entire heights, but grow smaller toward their tops. This batter gives them greater stability, while at the same time, by decreasing the amount of surface exposed to the strong winds, reduces the heat loss from the walls.

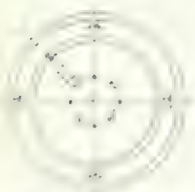
The batter of tall smokestacks is generally made .3 of an inch to the foot, which in a chimney 175 feet high would amount to 4 feet 4½ inches, making the chimney 8 feet 9 inches less in diameter at the top than at the bottom.

If a smokestack, rearing its top one hundred to two hundred feet in the air, is to maintain its stability, it must have walls of sufficient strength and thickness to bear the weight and resist any storms that blow. Naturally, the walls are not of uniform thickness, but increase in thickness at the base, according to the height. Common practice is to make the top 25 feet of smokestack less than 4½ feet in diameter at the top, 8 inches thick, and increase 4 inches in thickness for each 25 feet toward the base. Smokestacks over 4½ feet in diameter at the top are made 12 inches thick for the top 25 feet, and are increased in thickness 4 inches for every additional 25 feet toward the base. According to this pratice a stack 175 feet high and over 4½ feet in diameter at the top would have walls 12 inches thick for the top 25 feet, and by increasing 4 inches in each additional 25 feet would have walls 36 inches thick from the foundation to 25 feet above the ground level.

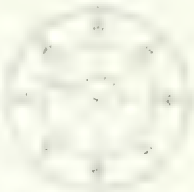
Table of Size of Chimneys for Power Plants.

Diameter Inches	Height of Chimneys and Commercial Horsepower											Side of Square Chimney Inches	Effective Area Square Feet	Actual Area Square Feet
	50 Feet	60 Feet	70 Feet	80 Feet	90 Feet	100 Feet	110 Feet	125 Feet	150 Feet	175 Feet	200 Feet			
18	23	25	27									16	.97	1.77
21	35	38	41									19	1.47	2.41
24	49	54	58	62								22	2.08	3.14
27	65	72	78	83								24	2.78	3.98
30	84	92	100	107	113							27	3.58	4.91
33		115	125	133	141							30	4.48	5.94
36		141	152	163	173	182						32	5.47	7.07
39			183	196	208	219						35	6.57	8.30
42			216	231	245	258	271					38	7.76	9.62
48				311	330	348	365	389				43	10.44	12.57
54				363	427	449	472	503	551			48	13.51	15.90
60				505	539	565	593	632	692	748		54	16.96	19.64
66					658	694	725	776	849	918	981	59	20.83	23.76
72					792	835	876	934	1,023	1,105	1,181	64	25.08	28.27
78						995	1,038	1,107	1,212	1,310	1,400	70	29.73	33.18
84						1,163	1,214	1,294	1,418	1,531	1,637	75	34.76	38.48
90						1,344	1,415	1,496	1,639	1,770	1,893	80	40.19	44.18
96						1,537	1,616	1,720	1,876	2,027	2,167	86	46.01	50.27
102								1,946	2,133	2,303	2,462	90	52.23	56.75
108								2,192	2,402	2,594	2,773	96	58.83	63.62
114								2,459	2,687	2,903	3,003	101	65.83	70.88
120									2,990	3,230	3,452	106	73.22	78.54
126									3,308	3,573	3,820	112	81.00	86.59
132									3,642	3,735	4,205	117	89.19	95.03
138									3,791	4,311	4,608	122	97.75	103.86
144									4,357	4,407	5,031	127	106.72	113.10

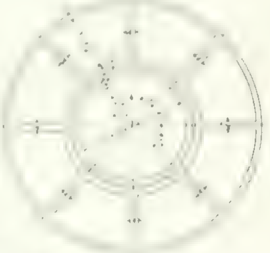
Owing to the stepping of the walls of the flue inside, and the batter given the walls of the smokestack, there would be a rough, uneven surface presented to the hot gases, and this rough interior would not be of uniform bore throughout its entire extent, a condition which would greatly [illegible] the draft of the flue [illegible] heat would be lost from the smokestack. To overcome all these objections, smokestacks are built with an interior lining of firebrick. This interior [illegible] built into the inner and outer shafts. From the middle of the stack to the top these brace walls are built into the outer shaft, but are sometimes free of the inner shaft by about one inch, like floating ribs.



Cross Section C.C.



Cross Section B.B.



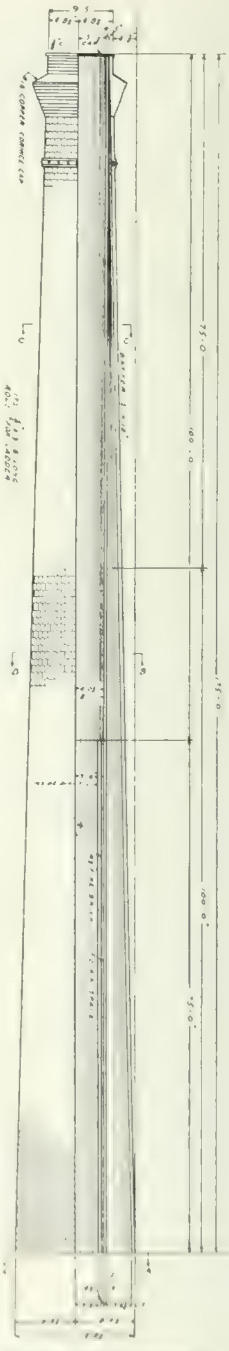
Cross Section A.A.

In the designing of the foundation or footing for a smokestack, particularly when the foundation is to be a floating one, is where great care must be exercised. The necessity for this great care will be realized when it is remembered that there are two distinct movements common to all tall, heavy structures, and that those two movements must be reduced to the lowest possible limits. Every heavy building erected on a footing other than bedrock settles into the ground from 3 to 5 inches, due to the compressibility of the soil. In Chicago, for instance, there are many prominent examples of such settlements, and provision is always made to guard against damage resulting therefrom. The Great Northern Hotel, for example, is partially carried on jacks and periodically leveled up as settlements occur.

The other movement of tall buildings erected on floating foundations, or, indeed, on any kind of footings, is found in the same city in the leaning of buildings out of plumb, the amount of the leaning in some cases amounting to a great many inches.

These two movements, then, can be considered as probable to a greater or less extent in smokestack construction, for the stacks are both tall and heavy, the extent of the movements depending to a great extent on the weight of the stack and the proportion of the footing supporting it. To reduce these movements to the minimum the footings must be liberally proportioned to the weight of the stack and the bearing capacity of the soil, so that the weight imposed on a unit area of the soil will be well within its safe limit. In compact sand and hard clay the footings or foundation at the base of the stack ought to have a diameter of about one-seventh the height of the stack, and a batter of about one inch in five from there to the bottom of the foundation.

In the illustrations are shown a photograph, plan, working drawings and details of a good example of smokestack construction and design. There were a number of problems of more than ordinary interest to work out in this particular case. In the first place, the stack, which is [illegible] feet high, was to be built on a footing of clay, in an exposed position swept by strong and cooling winds, and it was necessary to design a stack which would possess the maximum strength with the least possible weight, and at the same time of materials of such a character that but very little heat would be lost through the walls to the cooling winds. The problems were all satisfactorily solved by the simple expedient of using



HALF ELEVATION HALF SECTION

hollow tile instead of brick, as was formerly the practice, the foundation being built of concrete reinforced with steel.

The hollow tile were specially made for the purpose, were radial, 6 x 12 x 12 in size, hard burned, salt glazed, and laid with wire mesh in the joints, in cement mortar one to two. The finished stack is shown in Fig. 1, resting on its octagonal base, and extending to a height which makes a telegraph pole look like a toothpick. Owing to the numerous air cells formed in the walls of the stack by the countless dividing partitions of the hollow tile, there is no perceptible heat loss from the stack. This conservation of heat increases the draft of the chimney, so that the capacity is far beyond the ordinary rated capacity of a stack of this height and diameter. These air spaces further lessen the weight of the stack by many long tons, which in turn reduced the liability to lean or settle, over a stack of ordinary weight. At the same time the strength of the structure is increased by the less number of joints, and the radial shape of the blocks which makes them fit and interlock together. The cost of the stack was not considered, for efficiency and stability were the main requisites. Incidentally, though, the cost of the stack was much less than would be a like chimney built of bricks, and there was a further saving in time, the entire stack above the ground level having been built in about seven weeks.

RIVER IMPROVEMENT BY REGULATION AND DREDGING.*

By Major Wm. W. Harts.

In undertaking any river improvement for the benefit of navigation many considerations necessarily enter into the determination of the methods to be followed. It sometimes occurs that the solution is so obvious as to be self-determining, as at the Cascades of the Columbia River, where the advantages of a short lateral canal across a convex bank were so plain as to practically exclude other methods from consideration, but in the usual case there is a choice among several methods and usually considerable study is required to select the most suitable. This selection often depends more on the character of the river than it does on the nature of the use to which the work will be put.

For example, at Rock Island Rapids in the Mississippi River, where the channel has been successfully used for many years as the result of open river regulation, it was at first thought that a lateral canal would be necessary and such an improvement was proposed, even for the depth of 4½ ft. then needed. But a fuller study of the problem showed that the character of the river was such that the needs of navigation, as then existing, could be adequately met in an artificial open waterway supplemented by dikes and other contraction works.

The influences affecting the choice of a method of river improvement are changing, being constantly modified by later experience and by newer and better mechanical appliances. From present tendencies there seems small doubt but that in many instances lateral canals would probably no longer be so freely chosen at the present day as formerly, but that some type of canalization would be adopted instead if the project were up for determination anew.

The reasons which may incline the engineer to the selection of any particular type of improvement may be analyzed with advantage. The marked advance in recent years in the efficiency of machinery for excavation is one of these reasons which has more or less changed the economy of channel building and has had its effect on the choice of methods to be followed. Many harbor channels that originally could not be deepened owing to the high cost of effective improvement are now being dredged to depths suitable for deeper draft vessels. In New York harbor the Ambrose Channel, seven miles long, 2,000 ft. wide, and 40 ft. deep, is being dredged with sea-going hydraulic suction machines at the surprisingly low total cost of 5.4 to 5.7 cts. per cubic yard. (Professional Memoirs, Engineer Bureau, U.S. Army, January-March, 1909, pp. 61-62). Some years ago it was believed by many engineers that an effective entrance channel to this harbor could only be secured permanently by the adoption of protecting jetties of rip rap. The high cost of such work and its physical difficulties deterred engineers from undertaking it for a long time, and only within recent years has the construction of the entrance channel been considered economically possible, mainly through the greater perfection of dredging machinery.

This same tendency is felt to a certain degree on our rivers, and our ideas of improvement are likewise undergoing some readjustment, both as to practicability and as to choice of methods. Although this choice is often not as free as might be liked, since local conditions sometimes place narrow limits upon it, still, whenever one of several plans is to be selected for adoption the changing circumstances must be borne in mind.

For example, soft digging with a dipper dredge was done on the lower Tennessee River in 1910 for 3.6 cts. per yd., place measure, including all current field expenses, but excluding extensive repairs, plant cost and overhead charges. At Muscle Shoals Canal a record of 19 years shows that sediment has been removed from the canal at the same average cost, with a ladder of continuous bucket dredge. Including all charges the cost has been 5.16 cts. per yard at the latter place. In excavating through rock ledges exceptionally reasonable work has been done at Allens Bar, near Hobbs Island, where the entire cost, including blasting, dredging, loading on barges and dumping in dikes amounted to only 28.1 cts. per yard, including all current field expenses. These low prices are undoubtedly largely due to careful management, but improved machinery is nevertheless the important factor.

Before discussing the methods of river improvement, it may be desirable to enumerate the various classes of work used. The four principal divisions of river improvement methods are as follows:

(1) Contraction, including the use of spurs, sills, training walls and bank protection.

(2) Excavation, including dredging.

(3) Canalization, including locks and dams; and

(4) Lateral canals.

These methods are all well recognized and are in extensive practical use to-day. To these is sometimes added a fifth—reservoirs.

Engineers are ordinarily largely guided by their pre-preferences for certain classes of work, usually those met with in their own experience, and are often inclined to look with some disfavor on methods with which they are less familiar. But it would undoubtedly be best to recognize at once the good points of each tried method and combinations of two or more of them whenever found by experience to be advantageous. Untried theories and purely experimental modes of improvement will usually not receive extensive application at the hands of practical men.

On one point, however, most engineers will doubtless be agreed, i.e., that the navigable part of the river must be studied as a unit rather than piecemeal, and work must be done with some definite co-ordination so that a logical, systematic and connected improvement will result.

---

*Abstract of paper delivered before International Congress on Navigation.

No two rivers are just alike in slope, discharge, character of bed and banks, nature and size of drainage basin, or kind and amount of sediment carried, but in general it is observed that they are alike in some particulars; that they all have a more or less winding course with a constantly varying hydraulic radius, and consist of a succession of pools where depths are greater than the average, separated by bars where depths are less than the average. The fact is now no longer overlooked that these bars are like submerged weirs and have a decided effect on the elevation of the water surface. The danger of the early methods of improving the Rhone by deepening shoals separately, and cutting through bars independently of their relationship to the remainder of the river, has been repeatedly dwelt on by engineers. Unless contracted artificially, this invariably facilitates the outflow of the water of the pool above the site of the work, with a consequent lowering of the surface, and often causes an ultimate decrease instead of an increase of depths. On the Rhone at La Mulatiere the level of the low water surface was reduced to 4.66 ft. in 17 years by a deepening of the channels on the shoals below.

It seems plain that each separate work in a river should bear a similar relationship to the others as do the links of a chain. This need not prevent the gradual application of the methods selected, but would require that each work should form a part of a definite, comprehensive scheme.

The use of contraction works seems more particularly adapted to the portions of rivers where ample discharge, considerable width, small slope and gentle flow are met with. The Rhine below Strassburg, the Elbe from its entrance into Germany, the Niemen through Prussia, the Rhone below Lyons, are foreign examples of rivers that have been improved by these means. In this country the Mississippi above the mouth of the Missouri is an excellent example of this class of work, and instances of its successful application are found in the Columbia, Missouri and Tennessee Rivers, and on the French Broad and Hiawassee, tributaries of the Tennessee.

The amount of depth attainable by this method is ordinarily very limited. If the contraction is overdone, in rivers with movable beds an excess of scour may result, accompanied by a lowering of the water surface and perhaps a flattening of the slope in the lower reaches; or, if the beds are formed of resisting material, an excess of velocity may be [illegible]

It is an elementary principle that movable river beds must ordinarily be protected wherever contraction works are used, for otherwise the effect is sure to be largely local and the material scoured out by the currents is likely to be deposited elsewhere, frequently on other bars where depths were ample before. The protection of the banks in such cases is [illegible]

[illegible]

The navigability of unfinished rivers yet in a state of erosion can be improved with permanent results only by canalization.

(2) The most that can be accomplished by regulation is the desired adjustment of the slope of the low water line, and this only on reaches of uniform regimen and uniform characteristics.

(3) The feasible adjustment of the slope to be accomplished when the conditions are most favorable can only be established and brought about by constructive measures after the formation of that part of the channel which rises above low water is completed; after the conditions of the bed have adapted themselves to the change of energy caused by the formation of the mean and high water bed; in other words, after the erosion caused by this formation has come to rest.

(4) To secure the establishment and permanent preservation of the adjustment of slope, the irregularities of the bed in the longitudinal and transverse profiles are to be adjusted after reinforcing the low water shore, and the bed is to be strengthened where attacked by the water on account of the ground plan of the channel. Restriction of width alone will not bring about that degree of navigability which may be attained.

He also states that the depth attainable is expressed in the formula $d = \left(\frac{Q}{wk\sqrt{i}}\right)^{\frac{2}{3}}$ in which d is the depth; Q, the measured discharge; w, normal low water width; i, the adjusted slope, and k a constant corresponding to the constant of Chezy's formula. (Trans. Am. Soc. C. E., Vol, xxix, p. 220.)

If these views seem rather extreme as far as they bear on "unfinished" streams, the assumption that the gain is measured by the practicable amount of adjustment of the low water slope is open to much less question.

Dredging as an exclusive method of original improvement is seldom practised on interior rivers of the United States, except where the banks are comparatively low and unstable, the flow very gentle, and the discharge large. Navigable depths of 9 ft. in the Mississippi River below the mouth of the Ohio are now being supplemented by bank protection, the design being ultimately to protect the banks from caving by the use of brush mats and a rip-rap stone, and thus finally limit the bankfull channels to a predetermined width in order to accelerate the carrying velocity and insure regularity of regimen. This will also aid in maintaining depths and, perhaps, finally render much of the dredging unnecessary. Ten suction dredges of great capacity are employed in this work. It has been estimated from the surveys of 1908 that there were 749 miles of caving bank along the length of 790 miles of river between Cairo and the Red River, almost equivalent to one entire bank, and observations in 1892 indicated that 100,000 cu. yds. per mile fell into the river annually between Cairo and Donaldsville, La. It seems plain that until the banks can be protected nothing permanent or satisfactory can be expected. A recent plan for increasing this 9-ft. depth to 14 ft. proposes regulation of the low water slope by the addition of transverse sills combined with a revetment of the banks. Above the mouth of the Ohio and up to the mouth of the Missouri 8 ft. depths at low water are maintained by dredging, supplemented by the use of permeable dikes to restrict the river width at the bankfull stage [illegible] ft. These permeable dikes encourage the deposit of silt and the growth of new banks.

[illegible]

locks, and especially if funds are not sufficient for any other more radical improvement, resort is usually had to this kind of work. After a general scheme has been adopted work can be carried on at the difficult places first and in this way the most urgent needs of navigation met in order of importance.

Contraction works leave the greater part of the river open for boats, thus avoiding the delays at locks, are generally moderate in cost, can be changed if not entirely successful upon the first trial, may be applied gradually, do not flood the banks nor interfere much with high water flow, and ordinarily indicate the channel to pilots at low water. On the other hand, they require careful study for correct location, are not invariably successful, require considerable maintenance, and are usually limited in effect to a very few feet. They are not adapted to rivers of small discharge and steep slope.

Following European practice, the efforts to obtain 6 ft. navigation on the Ohio River above Cincinnati were directed during the early '80s toward improvement by dikes and training walls, of which many were built at the various shoals. In plan they left the bank in a long curve and followed down stream parallel to the channel, contracting the waterway without protecting the river bed. They were built to a height of 4 ft. above low water and their completion caused a disturbance in the equilibrium therefore existing and was usually followed by a local increase of depths, sometimes at the expense of decreased depths on bars lower down stream where the dislodged material was occasionally brought to rest. This method was only partly successful in the upper portions where the low water discharge was small and shoals frequent. When the 6-ft. project was abandoned and the 9-ft. project adopted for this river, the more radical method of locks and movable dams was selected and the use of training walls abandoned as insufficient.

Dredging in rivers, on the other hand, is immediate in its effect, the expenditure is applied directly to the seat of the trouble, and it is suitable for any type of stream. Dredged channels are usually not difficult to plan and their excavation is seldom accompanied by special engineering difficulties. When well located they are often fairly permanent. If the shoal is caused by a deposit of sediment it will sometimes reform, unless prevented by contraction works so designed as to remove the causes of the original deposit. On the Mississippi redredging each year is still necessary on some shoals, but in hard river beds, elsewhere the channels are often reasonably permanent. It is frequently the practice to use the excavated material in constructing dikes or training walls for a compensating contraction of the river in the neighborhood of the dredged cuts wherever the material is suitable, as is done on the lower Tennessee with good results.

If either dredging or contraction should be followed in river improvement to the exclusion of the other a considerable advantage would be lost, for it is by the combination of these two methods that the best open channels have been obtained in river work.

Regulation by spurs, sills and training walls, supplemented by dredging, merges without any sharp dividing line into dredging supplemented by contraction works, and the predominance of one method over the other will depend invariably on the character of the stream and the results to be achieved.

As a type of work where the contraction feature is the more predominant, the upper Tennessee is a fair example. There the present project is to obtain a 3-ft. depth at low water by open channel work. The methods followed to-day represent the outcome of many years' experience with dikes, bank protection, spurs and channel excavation and will be briefly described. The river has a normal width of about 600 ft., a discharge of about 2,500 second feet at low water, and 395,000 second feet at extreme high water. The bottom on nearly all shoals is either rock or hard gravel overlying rock at varying depths. The variation in bed and banks is so small from year to year that it may be justly described as of "fixed regimen."

The preliminary step is always a careful detailed survey showing the depths, nature of the bottom, low-water slope, and velocities at various places. A study of the physics of the locality is made and the action of the currents at varying stages observed.

The main steps in the work are then as follows:

First, the secondary channels back of islands are usually closed and the best location for the navigation channel selected. This location is almost invariably along one bank, the reasons for which are numerous, the following being the principal ones. It is more easily navigated, especially at night, more easily found by pilots, and more easily maintained, as it usually follows the convex bank where the tendency to re-fill is least. It is cheaper to construct, as the bank can be protected at less cost than a dike can be built; quicker, as the first cut of the dredge can be placed on the bank without using scows or barges for removing the excavated material; and better, as the channel can be straightened if needed and the minor irregularities in the bank corrected. Furthermore, spurs or training walls on both banks on opposite sides to contract the channel have been found difficult to navigate at intermediate stages of the river and often dangerous from the "draw" over them when submerged.

Second, the normal profile low-water width is calculated by the usual formulas involving the width, depth and character of bed, the discharge and slope of the river, and when obtained, is checked with actual conditions in normal reaches nearby. Formulas are never entirely reliable as no mathematical expression is equally applicable to the many varying cases met with, but they serve as a guide and when compared with the natural conditions are often useful.

Third, a combined system of bank protection, spurs and training walls, and sometimes sills when needed, are applied, so arranged as to hold up the water surface after the excavation is made, and so designed as to smooth out the inequalities in the low-water slope and distribute the fall over a longer stretch of river than before in order to reduce the extreme velocities.

Fourth, the bottom is drilled and blasted, if necessary, the material is dredged out and placed in the dikes, and after completion the shoal is re-surveyed to see whether further changes are necessary in adapting theory to the problem. Gages are placed before commencement along the site of the shoals, at the head and foot, and about a half mile above and a similar distance below, to ascertain the effect of the dikes. These gages are read daily. When finished, a survey of the work is made and the new slopes and velocities plotted. It sometimes happens that this survey will indicate that some dikes must be prolonged, or the channel narrowed, or perhaps a dike lowered in height to obtain the best results.

A very satisfactory example of this kind of work on the Tennessee River is at Little River Shoals. The maximum slope was originally 0.5 ft. per mile at low water and is now about 5.3 ft. The low water discharge is about 2,500 cu. ft. per second and high water discharge 395,000 cu. ft. per second. The maximum velocity at low water was over 8 ft. per second, and this has been so reduced that "warping" in passing up is no longer necessary.

On this work the rock excavation cost $1.92 per cu. yd., made up of drilling and blasting at $1 [illegible] per cu. yd. and rock dredging at $0.21 per cu. yd. Gravel cost $0.10 per cu. yd. to excavate. The dikes cost $1.74 per lin. ft, or $2.55 per cu. yd. Dikes were largely constructed of material excavated from the channel.

On the other hand, there are examples of a different kind of combination of dredging and contraction in the lower reach of the Tennessee River where the excavation is the predominating part and the contracting works are mainly for the purpose of compensating for the increased cross sectional area of the river, due to the newly dredged channel. In this section the distance from Riverton to Paducah is 266 miles; the total fall at low water 77 ft., or an average of 0.34 ft. per mile at low water. The low water discharge is about 10,000 cu. ft. per second. The project provides for a channel 150 ft. wide and 5 ft. deep at low water over all the shoals. Dredging has been very successful on this section, and the dredged cuts remain open in most cases without any later work. This is believed to be largely due to the contraction of the river opposite each cut by dikes which are composed of the dredged gravel and so placed as to hold the water surface without material change. It has not been found practicable to raise this surface to any important degree by these dikes, but their apparent usefulness in preventing any decrease of depth warrants some additional cost for construction.

Table I.—Cost of Regulation.

[illegible]	[illegible]	Miles	Cost	Av. cost per mile	Av. fall per mile in feet
[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	$[illegible]	0.44
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]					
[illegible]	[illegible]	[illegible]	$1[illegible] (abt.)	$[illegible]	[illegible]
[illegible] Waterways Commission					
[illegible]	[illegible]	[illegible]	$[illegible]	$[illegible]	1.14
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.29
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.81
[illegible]	[illegible]	[illegible]	24,729,000	[illegible]	[illegible]
Pregel	[illegible]	[illegible]	[illegible]	[illegible]	
Memel	[illegible]	[illegible]	[illegible]	[illegible]	0.48
	Average Germany			$41.69	

[illegible]

The various combinations of these two kinds of work, viz., contraction and dredging, represent one important method of improvement that has been extensively applied in cases where the river characteristics and required navigable depths permit, but their usefulness is by no means universal.

Canalization must be resorted to whenever the discharge of the stream is too small for open river work, or the slope [illegible] the depths permissible thereby insufficient, and will usually be considered when it has been found that the simpler and cheaper means before described are not applicable. Canalization costs more per mile, its maintenance is higher, and its delays to down-stream traffic are usually greater. But its results are positive and immediate; it renders up-stream navigation easier than before and affords greater safety to vessels than the other methods. Where [illegible] regulation and canalization is given in Tables I, II, and III

[illegible] capitalized maintenance charges, the disparity will really be [illegible]

But with the lateral canals the case is somewhat different. By means of a lateral canal with one or more locks the obstruction in the river at any particular locality may often be obviated, and some years ago this method of river improvement was widely advocated. Brindley, an English canal engineer, is said to have stated that "rivers were created for the purpose of feeding canals," and apparently acted on this belief.

Lateral canals are expensive to build and maintain, frequently cause undue delay to vessels in passing each other or in grounding, are easily blockaded through accident, and require constant expensive attention. They form pools of still water where sediment collects, requiring constant dredging. At Des Moines Canal on the Mississippi River there had been removed from the canal between 1878 and 1906, 2,181,743 cu. yds. of sediment, a volume larger than the original excavation.

At Cascades Canal, Columbia River, periodical dredging is necessary to keep the upper and lower entrances clear, and at the Muscle Shoals Canal, Tennessee River, one dredge is kept constantly busy through a large part of the year removing sediment brought in by the drainage of side creeks and the inflow at the head during times when the river carries silt. Since opening the canal (1892) over 1,300,000 cu. yds. have been removed.

The costs of various lateral canals in this country and abroad are given in Table IV.

The high first cost and later charges for maintenance make this method of improvement such a costly one that it would probably to-day be often supplanted by canalization. High speed cannot be allowed in canals owing to the wash caused along the banks, but in canalized rivers no such limiting condition exists. Colonel Wm. E. Merrill, Corps of Engineers, an eminent river engineer, stated in 1887, while commenting on the Muskingum River, as follows:

"The greatest obstruction to successful navigation on the Muskingum is caused by the lateral canals; they are expensive to keep up on account of the guard gates, the numerous draw-bridges, and the necessity of periodical dredging. Even when in perfect condition they must be navigated slowly, and it is with difficulty that boats can pass each other."

At Colbert Shoals on the Tennessee River the lateral canal now nearly completed provides a lift of 26 feet, which is overcome by a single lock. Before undertaking its construction it was several times proposed to build one or more dams across the river and canalize these shoals, but the possible use of the river at high stages, when fixed dams might interfere with the boats, decided the engineers to adhere to their first selection of a lateral canal.

At the Des Moines Canal a project is now on foot to build a power dam in the Mississippi which will "drown out" the present canal. Locks will be used in passing vessels from one pool to the other but the old canal will have to be abandoned should this plan be put into execution.

Similar plans for the Muscle Shoals Canal on the Tennessee River have been proposed, but no satisfactory agreement has ever been made between the power corporation having the work in view and the government as to the proportionate share each should pay toward the project. As a consequence, nothing has yet been accomplished.

[illegible] that the con[illegible] the selection of this type of work are chang[illegible] would probably not be selected in some of these instances.

[illegible] canalization is easily first among methods and is now being used more than all the others combined. But little new work of regulation is being under[illegible] new lateral canals are now being commenced in this country. Except the Rhone and the Loire, nearly all the improved rivers of France are canalized, about 970 miles in all; and in Germany, where there are nearly five times as many miles of open as canalized rivers and regulation finds its warmest advocates, but little new regulation work of importance has been done since 1875. In Belgium there are four times as many miles of canalized rivers as open rivers. (Royal Commission, Waterways and Canals—Lindley.)

A fair conclusion is that the present tendency is toward the selection of canalization whenever a new system is to be chosen, particularly if the examination of the natural and economic conditions shows regulation to be inapplicable. It also seems that lateral canals are not now being regarded favorably unless the local conditions unequivocally indicate the necessity of their adoption.

The theory of the use of reservoirs as an exclusive mode of improving rivers for navigation is an old one practically abandoned now in this country by river engineers but revived from time to time by its advocates and sometimes made the subject of an academic discussion of considerable seriousness. At first glance the theory is very engaging, but experience in its application has been in the main unsatisfactory and its applicability depends on many assumptions which are themselves of doubtful tenability.

Table II.—Cost of Canalization.

River.	Length canalized part.	No. of locks.	Depth, feet.	Total cost.	Cost per mile.	Average length of pool.	Cost per reach	Operation and Maintenance. Cost.	Cost per mile.	Cost per lock.	Fall per mile in feet.
				FRANCE (British Waterways Commission).							
Saone	232	30	8.2	$ 8,765,000	$ 37,750	7.7	$ 292,000	$ 60,500	$ 261	$ 2,017	0.85
Seine, Montereau to Paris	61	12		4,955,000	81,500	5.1	413,000	54,350	891	4,528	0.85
Seine, Paris to Rouen	145	9	10.5	17,500,000	121,000	16.6	1,945,000	92,250	636	10,250	
Seine, new works	140	-9	*	12,675,000	90,500	15.5	1,410,000	......	..	.....	
Yonne	67	26		5,590,000	83,500	2.6	215,000	33,650	502	1,294	2.43
Marne	113.5	19	7.25	5,235,000	46,250	6.0	275,000	39,900	352	2,100	1.16
Aisne	35.5	7		970,000	27,350	5.1	138,500	10,650	300	1,521	
Scarpe	5	2		775,000	155,000	2.5	387,500	5,000	1.000	2,500	
Average, France					$ 80,355		$ 634,500	$ 42,329	$ 563	$ 3,459	
				GERMANY (British Waterways Commission).							
Saar	19.5	6	4.25- 7.9	$ 1,772,000	$ 90,850	3.2	$ 295,300	$ 32,050	$1,650	$ 5,350	2.15
Main	23.5	5	5.9 - 8.9	2,241,000	95,350	4.7	448,200	40,050	1,700	8,000	1.40
Fulda	17.0	7	6.6 -11 9	785,000	46,200	2.4	112,150	21,925	1,300	3,125	3.30
Salle	89.5	15	4.4 - 8.8	1,917,000	21.400	6.0	127,800	45,400	500	3.025	1.27
Unstrut	40.5	12	2.5 - 8.5	528,000	13,000	3.4	44,000	14.200	350	1,175	1.72
Oder	53.2	14		6,059,000	113,900	3.8	432,800	217,100	4,075	17,000	1.90
Average, Germany					$ 63,350		$ 243,375	$ 61,787	$1,596	$ 6,279	

---

*Over 10.5 feet up to Paris.

The possibility of conserving the high water flow of rivers, thus reducing injurious floods and later using the stored supply during the low stages for the benefit of navigation, is fascinating alike to layman and theorist, and offers a wide field for speculation. But the attempt at practical application usually introduces virtually insurmountable difficulties.

The theory takes it for granted that sites for reservoirs, ample in number and capacity, can be obtained without greater injury to railroads, factories, towns and valuable private possessions than the benefits to be obtained for the public; that enough high dams can be safely built at reasonable cost free from danger of a breach operated intelligently and efficiently in order to create the necessary storage space for regulating the discharge. It assumes further that these reservoirs are not likely to be soon filled with silt but are practically of permanent usefulness. It assumes that increased discharge in the rivers means increased depths, and that precipitation may be foretold with sufficient accuracy to permit successful regulation. All of these assumptions are more or less debatable and some of them are plainly of doubtful reliability.

The reservoir theory has never been practically applied on a large scale as an aid to navigation except in two cases, and the results there have not been encouraging. It was early adopted on the headquarters of the Msta and Volga Rivers in Russia, where its use was the outgrowth of very favorable natural conditions. These rivers, flowing in opposite directions, take their source in a lake and swamp region at an elevation of 665 feet above sea level where land was cheap and unfit for agriculture. Here the construction of low, cheap dams was an easy task, resulting in increasing the reservoir effect very greatly without the necessity of obtaining new storage sites or going to much expense for dams and regulating works. A natural reservoir system was in fact already in operation, needing only a little artificial regulation. The capacity of this system is 35,000 cubic feet with dams only 17.5 feet high. (Reservoir sites in Wyoming and Colorado.—Chittenden.) It is usually considered a fairly efficient work in lengthening the season of navigability of the two streams.

Table III.—Cost of Canalization in the United States.

(U.S. Inland Waterways Commission, 1908.)

River	Length canalized part	No of locks	Depth ft	Total cost to U. S. up to 1907	Cost per mile.	Average length pool.	Cost per reach.	Operation and Maintenance* 1910: Cost	Cost per mile	Cost per lock	Fall per mile in ft
Black Warrior	41	7	6	$[illegible]	$[illegible]	13	$[illegible]	$12,[illegible]	$1,[illegible]	$[illegible]	[illegible]
Coosa	[illegible]	3	6	1,[illegible]	41,[illegible]	[illegible]	349,479	[illegible]	[illegible]	[illegible]	[illegible]
Allegheny	[illegible]	3		1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,865	15,546	[illegible]
Monongahela	131	15	7-8	6,845,857	[illegible]	[illegible]	[illegible]	[illegible]	1,323	11,557	[illegible]
Muskingum	[illegible]	10	6	[illegible]	[illegible]	8.4	[illegible]	50,130	597	[illegible]	[illegible]
Little Kanawha	[illegible]	[illegible]	[illegible]	388,020⁴		9.6	[illegible]	6,040	167	1,[illegible]	[illegible]
Great Kanawha	90	10	6	4,223,830	46,[illegible]	9.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Big Sandy	[illegible]	3	6	[illegible]	44,[illegible]	9.0	[illegible]	15,848	[illegible]	[illegible]	1.43
Kentucky	[illegible]	11	6	[illegible]	[illegible]	20.[illegible]	[illegible]	159,644	[illegible]	14,513	[illegible]
Green and Barren	[illegible]	7	[illegible]	1,638,410	[illegible]	27.1	[illegible]	75,854	[illegible]	[illegible]	[illegible]
Cumberland	[illegible]	8	6	[illegible]	[illegible]	18.5	[illegible]	33,055	[illegible]	[illegible]	0.67
Illinois	[illegible]	2	7	1,515,721	[illegible]	[illegible]	[illegible]	14,840	[illegible]	[illegible]	[illegible]
Average in United States				... ...	$30,762	....	$3[illegible]	...	$ 775	$ 8,149	

---

*Annual Report Chief of Engineers, U S A, 1910.
¹Repairs only. ²Operating cost only. ³Includes operation. ⁴Office records. ⁵In West Virginia. ⁶About.

The same favorable natural conditions were found on the upper Mississippi River and similar reservoirs were built by the government for improving navigation in the '70's. By constructing low dams across the outlet of an extensive lake area, a storage of 93,400 million cubic feet was accomplished at a total cost of only $678,300. (Reservoir Sites in Wyoming and Colorado.—Chittenden.)

Although the Russian reservoir system was in a measure successful, the effect of these reservoirs upon the Mississippi River at St. Paul, 357 miles below the dams was slight, being from 12 to 14 inches on an average, and 51 miles further down all trace of it disappeared altogether. But the dams were so beneficial for the production of power that when their abandonment by the government was being considered some years later such a course was vigorously opposed by the milling companies and other similar interests benefited, although they contributed practically nothing toward the expense of the work.

The system has never been extended in the United States although often studied. The slight assistance to navigation and the high comparative cost of construction and maintenance were reasons given for not applying this method of improvement to the St. Croix, Chippewa and Wisconsin Rivers, which were examined several times a few years later by engineers' boards. (Annual Report, Chief of Engineers, 1887, page 1692.)

It is stated that early in the last century the plan was adopted to some extent in France for the control of floods, and in 1856, after a flood of unusual destructiveness, it was thoroughly studied, more particularly with reference to its applicability to the Rhone, Seine, Garonne and Loire. As a result of this investigation it was decided not to construct the reservoirs proposed for these streams owing to the "uncertainty and doubtful efficacy of their action." In 1881 this system was definitely abandoned by the Corps de Ponts et Chaussées and its use for the control of rivers condemned in France. (Annales des Ponts et Chaussées, 6 sem., vol ii, [illegible])

The plan was proposed for the improvement of the Ohio in 1873 but was not favorably considered after careful investigation. The board in whose hands this investigation was placed stated "The first of these plans (viz., storage reservoirs) the board deems impracticable on account of the difficulty, if not impossibility, of finding locations for the necessary reservoirs, the immense cost of the system, its interference with navigation of the tributaries on which the dams are located, its injury to agricultural, mining, and railroad interests in the valleys of these rivers, the difficulties of regulating the supply from the reservoirs, and the terrible effects that could be caused by accidents." (Annual Report, Chief of Engineers, 1873, p. 541.)

Table IV.—Cost of Lateral Canals.

Location	Length (miles)	Locks	Cost	Cost per mile	Cost per lock	Operation and Care Cost	Operation and Care Cost per mile
			FRANCE				
[illegible]	[illegible]	[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$[illegible]
			UNITED STATES				
[illegible]	[illegible]	[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	2	[illegible]	[illegible]	1,910,162	[illegible]	[illegible]

In 1909 the plan was again suggested to a board of engineers having in their charge the project for the improvement of the Mississippi River, and again the plan was abandoned for lack of sufficient reservoir sites, high cost, and uncertainty of action. The board stated in its report that "In order to use this reservoir system for the benefit of the improvement of the river below St. Louis it would be necessary to commence the discharge at the reservoirs at least two months before it was needed at St. Louis, and a still greater interim would be necessary for the benefit of the improvement of the river below Cairo. Experience does not justify such long forecasts, and the service of the reservoirs would necessarily have to be based on general annual averages, an unreliable and unsatisfactory basis." The board also stated that [illegible] with the expense." ([illegible], p. [illegible])

[illegible] the Ohio River was being considered by a board of river engineers, [illegible] The estimated cost of the adopted plan for 6 ft depths by locks and movable dams is about 63¾ million dollars.

The general impression among river engineers in America seems to be that storage dams for the benefit of navigation alone will never be warranted. Similar dams have been constructed in many places for industrial purposes, such as power development and irrigation; but these purposes are not always in harmony with channel improvement, and the incidental benefits likely to be received on navigable streams from dams built for several combined purposes cannot always be determined in advance nor their value accurately estimated.

If an added flow at low water be furnished from such dams, the valuable scouring effect of low water may not be obtained without a supplemental series of contraction works at further additional cost, and the increased discharge may not mean increased depths on many sediment-bearing streams. For example, on the Mississippi, where much material is rolled along the bottom, bars often rise and fall with the gage heights, the low water being largely relied on to restore the channels in such cases.

Then, too, the location of the dams on the tributaries would usually be such as to intercept much of the flow of silt in suspension in the portion of the stream where the scour is greatest. In no other way could the water be clarified. This clarification is an assumed advantage of the reservoir system that has often been mentioned.

There is no known way of safety and easily removing silt from behind storage dams, more particularly if it is expected to do so without much injury to the river channels below. A constant diminution in storage capacity would be one of the inevitable results of the system, or an injurious deposit in the lower channels it is intended to benefit.

Notwithstanding these disadvantages, there may occur special cases where some incidental benefit may be derived, but experience seems to point out that such benefit will hardly ever be sufficient to very strongly influence the location of any storage dams or warrant any considerable portion of the cost being borne by the navigation interests.

As a summary of this discussion, the following conclusions are briefly stated:

1. Regulation in some suitable combination with channel excavation should always be first studied as a method of river improvement and adopted in all cases where economically applicable. It will be oftenest used wherever the funds available are small in amount, the increase of depth needed not great, the river flow comparatively large, the banks low and the width of the river considerable, velocities low and regimen more or less fixed.

2. Canalization with movable or fixed dams will be adopted wherever regulation with channel excavation is insufficient or unsuitable. It will usually be applied where the slope is steep, discharge small, and depths obtainable by regulation insufficient.

3. Lateral canals should never be selected for use unless imperatively demanded by the local conditions.

4. Reservoirs are too uncertain, too unsafe and too expensive for exclusive use in river improvement. They will seldom be relied on, except in special cases in connection with other enterprises where their use for industrial purposes warrants the cost and the water flow can be sufficiently controlled to operate beneficially on the channels.

◆

Messrs. [illegible] V. Kendall and Leonard Martin, F.R.I.B.A., architects, of London, England, have won the award in the competition conducted by the Toronto Housing Company for plans of houses for the development of the company's land in the east end of Toronto.

LARGE SUBMERGED SEWER OUTLET.

The city of Rochester, N.Y., is installing a sewage disposal system, some of the work of which is very interesting, particularly that of laying the effluent pipe in Lake Ontario. In a recent issue of the Municipal Journal, of New York, Mr. John F. Skinner, principal assistant to the city engineer of Rochester, describes the method of laying this pipe. The following abstract is made from the article:

The city up to the present time, has been drained by a combined system into the Genesee River through eight main outlet sewers, which serve territories having areas varying from 187 acres to over 5,000 acres. An interceptor is being constructed to receive the dry weather flow and two and one-half additional volumes of storm water from these outlets, which sewage and storm water will be conducted to disposal works near the lake, and the effluent discharged at a point 7,065 feet from shore in about 50 feet of water.

The effluent conduit will be a 66-inch lock-bar pipe, made up of ½-inch steel plates dipped in "Pioneer Mineral Pipe Coating." Proposals for this portion of the work were received March 13, 1912, and on the following day the contract was awarded to the T. A. Gillespie Co. A summary of the bids is given on the next page.

It will be noted that tenders were also invited for "Ingot Iron" from "Cast-Iron" pipe. It was not thought, however, that the existing conditions warranted the greater expense for material other than steel. The high cost of the cast-iron pipe is, in a measure, due to the requirement which specified that it be laid on pile bents.

Borings made in the lake bottom indicate fine sand and some clay with but little gravel.

The crib, which is 46 feet square and 24 feet high, is constructed of 170,000 board feet of 12 x 12-inch hemlock timber. It contains a steel special to which is bolted the last length of the pipe. The special has a 6-inch outlet in line with the pipe and two 38-inch outlets, one on each side. These three openings are provided with flanges so that they may be extended, if necessary, and the side openings are closed with steel covers.

The crib has pockets loaded with 1,075 cubic yards of stone. It was constructed at a dock two miles up the river from its mouth, and was towed to its site, two miles east of the river's mouth, where it was sunk, guided by piles driven on two sides of its position.

The lake bed was dredged so that the bottom of the crib is 3 feet below lake bottom, the mouth of the discharge pipe is 10 feet below lake bottom, and the top of the crib will be 26 feet below low water.

The contractor's plant consists of a 12-inch hydraulic dredge with 90-foot ladder; a pile driver scow 32 feet 6 inches x 80 feet; two derrick boats, the smaller one 21 x 50 feet, and the larger 34 feet 6 inches x 95 feet; two tugs, and a diver's boat with two complete equipments.

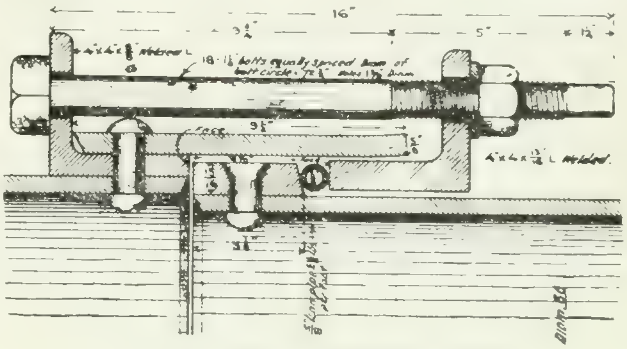


Fig. 1.—Detail of Submarine Joint.

The pipe leaves the crib a little above lake bottom, curves downward and then horizontally so that the remainder of the pipe can be laid in a trench and backfilled about 2½ feet deep. The curved pipe will be covered with a mound of sand, and 400 cu. yds. of rip-rap will surround the crib.

The plan is to dredge a short portion of the trench, drive four piles at each end of a pipe length, lower a section of pipe into position and while it is supported from the pile clusters make the joint and backfill the trench before moving to the next length.

The submarine joint used consists of a socket on one pipe into which the spigot end of another pipe is inserted. A gasket or ring of 1-inch heavy lead pipe is forced into the base of the socket by a follower which is drawn up by bolts manipulated by a diver. The city also has a diver who inspects the work.

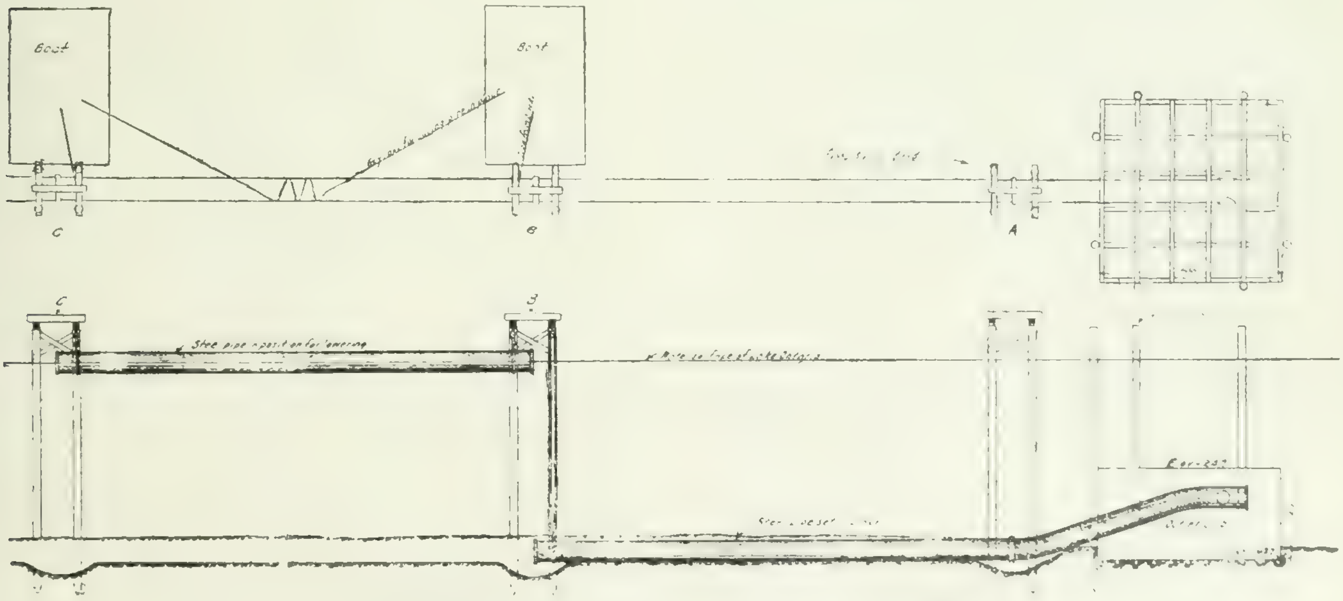


Fig. 2.—Proposed Method of Laying Outlet Pipe from Crib to Shore.

The pipe, which is received in 30-foot tapered sections, is riveted into 120 and 150-foot lengths. The 150-foot lengths will be laid in the trench from the disposal plant to the shore and in shallow water, while the 120-foot lengths will be laid in the deeper water. The crib was satisfactorily sunk on Friday, July 26, reaching the bottom at 6 P.M.

The accompanying sketch shows the relative position of the crib and derrick boats and the method of mooring. By manipulating the mooring lines, the crib was held snugly against the guide piles during the lowering. But little more stone was put into the crip than was required to sink it; the remainder of the pockets will be filled later.

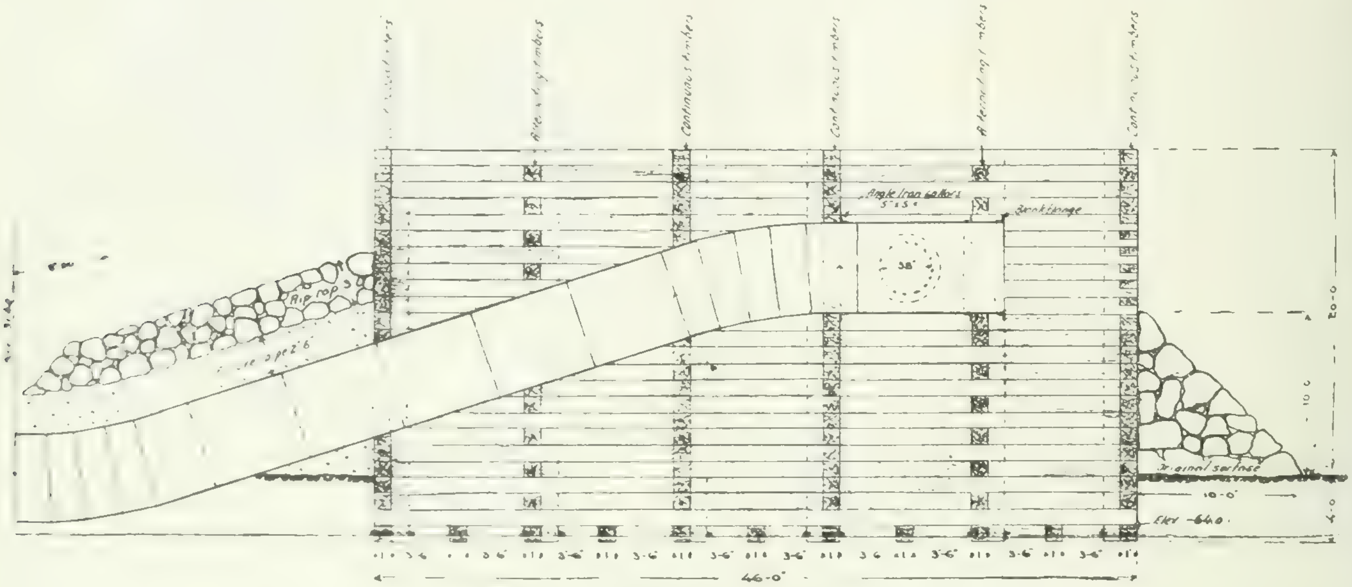


Fig. 3.—Section Through Centre of Crib and Pipe.

The pipe will be laid from the crib toward the shore, where a slip joint will be made with the shore pipe.

The work is in charge of Frank Wilcox, M.Am.Soc.C.E., engineer, and E. S. Williamson, superintendent for the contractor, and is being directed by C. Arthur Poole, Assoc. M. Am. Soc. C.E., general assistant on sewage disposal for Edwin A. Fisher, M. Am. Soc. C.E., city engineer.

In addition to the above, the following details may be of interest:

The [illegible] outlet pipe is to be [illegible] in lengths [illegible]

The joint at the shore end of the outlet pipe is a slip joint, consisting of two cylindrical sections of ½-inch pipe, one 66 inches inside diameter and 4 ft. 9 in. long, the other slightly greater than 67 inches inside diameter, so that the two may telescope one within the other. At the end of the outside section a ring of angle iron is fastened with its face flush with the end of the section and entirely surrounding the outside of the pipe, bolted to which and 2 inches from it is another ring of angle iron of similar diameter, so that the two give between them an annular space of 2 inches. In this space is placed a ring of 2-inch rubber, the diameter of the ring being 6 inches less than that of the outside of the smaller telescoping section. This will provide a water tight joint between the rubber ring and the latter section, and by screwing up the bolts connecting the two angle iron rings a water tight joint is made between the outer section and the rubber ring. This joint provides for a lateral movement of 36 inches to allow for expansion or contraction in the length of the pipe line.

The outlet crib is 46 ft. square on the outside and is divided into 25 pockets, which extend from the top to the floor at the bottom. The crib is constructed of 12 x 12 timber fastened together with [illegible]-inch by [illegible]-inch drift bolts and one-inch bolts with head and nut. A 12 x 12 post was placed at each corner, two posts on each side at the corners of the pocket on the middle of that side, four posts at the

Bids Received for Outlet Pipe and Crib.

[illegible]	[illegible]	Steel outlet [illegible]	Steel outlet pipe furnished and laid [illegible] 7,054 lin. ft.	Timber and plank in place [illegible] per M. B.M.	Concrete masonry 100 cu. yds.	Outlet crib in place, complete.	Additional rip-rap in place 1000 cu. yds.	Amount of proposal.
[illegible]	[illegible]	[illegible]	[illegible]	$60.00	$ 7.50	$20,000	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	50.00	[illegible]	[illegible]	3.25	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	60.00	[illegible]	20,000	2.50	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	50.00	[illegible]	20,000	4.50	[illegible]
[illegible]		Ingot iron 2,200 lin. ft.	Ingot iron 7,054 lin. ft.					
[illegible]	[illegible]	[illegible]	[illegible]	$60.00	[illegible]	$20,000	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	50.00	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		Cast iron 2,200 lin. ft.	Cast iron 7,054 lin. ft.					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$2.25	$405,164
[illegible]	[illegible]	[illegible]	[illegible]	60.00	[illegible]	[illegible]	2.50	[illegible]

[illegible]

corners of the central pocket, and four other posts on the diagonals between these latter and the corners of the crib. These pockets are 8 ft. square inside dimensions and the entire crib is 23 ft. high. Thirteen of the horizontal timbers are bolted to each vertical post. A drift bolt was used at each intersection of horizontal timbers. In walls of continuous timbers, butt joints were permitted, with a drift bolt in each timber. In the walls having alternate timbers, half-lap joints were required, giving a 12-inch lap, and fastened together with two 12 x 6 x 24-inch fish plates fastened with three one-inch bolts; the splices breaking joints at least 4 feet. It is provided that ultimately all the compartments be filled to the top with loose stone, excepting those through the centre of the crib (through which the outlet pipe passes), these being filled only to the bottom of the pipe; and excepting those at right angles to the outlet pipe and in line with the two T outlets at the end of the pipe, these compartments being filled up to the level of these outlets, at which level the compartments were floored over with 3-inch plank from the outlet pipe to the sides of the crib, thus providing a channel through the crib connecting the side outlets with the surrounding water. When finally in position, the crib is to be surrounded with rip-rap, as shown in the illustration.

◆

WINNIPEG AND ITS WATER SUPPLY.

For some time the municipal authorities and certain ratepayers have been facing a problem which they felt must be solved with all possible speed and expediency or the industrial future of this city would be marred. This problem was the same as has been faced, and will be faced, by many cities in Western Canada; that is the supplying of the citizens with a water supply that is beyond question as to its quantity and quality. To this end and for a conclusive movement in the matter the authorities engaged the services of Professor C. S. Slichter, of Madison, Wis., to prepare a report.

The chief available sources of supply are the Winnipeg River, the Poplar Springs, the Crystal Springs, artesian wells and Shoal Lake; the last named is the source recommended in the report, and is about ninety miles distant from the eastern extremities of the city as defined at present.

According to Professor Slichter, the water of this lake would require no treatment before being delivered to the taps of the consumers. No fear need be felt that the sanitary qualities of the water would be poor at any time in the future. The shores of the lake are hard rocks of the Laurentian series, entirely unfitted for agriculture, and the country thereabouts must remain in its present wild state indefinitely. There need be no fear of the growth of cities or towns upon the shore of Shoal Lake. The Lake of the Woods constitutes an enormous reservoir of clear, pure and soft water, situated 300 feet above the city of Winnipeg.

The well system of Winnipeg covers a north and south range of about five miles, and the amount of water intercepted is less than 2,000,000 gallons per day per mile. In several of the river valleys of the plains, similarly situated, it is possible to withdraw over 10,000,000 gallons per day from each mile of section. The mutual interference of the wells has been considerable. Well 5 has been especially active in cutting down the supply of wells 2, 3 and 4, but well 5 has, of course, greatly increased the yield of the group..

The above average yield of 2,000,000 gallons daily per mile can be materially increased by deepening existing wells 1 and 2, by the distribution of a more uniform draw-down or draft throughout the cross-section.

The amount of ground water pumped at Winnipeg in the past ten years is not large. The total pumped since the installation of the well system would cover a township of land with about two feet of water, an amount of water that the city of Winnipeg will require in a single year in the not distant future.

It must be borne in mind that a part, at least, of the water taken from the ground in the last ten years represents water that was merely stored there, and not flowing on. The static head has materially dropped. Some of the water used represents actual depletion, just as there is depletion when one draws upon a deposit of oil or of coal.

The group of springs known as Poplar and Crystal Springs seems to have a combined flow of between ten and fifteen million gallons per day. From measurements submitted by Col. Ruttan it seems that the flow is increased within less than a mile to 5,800,000 gallons per day. Prof. Slichter's own measurement of Poplar Springs, at the outlet to the same, was 1,190,000 gallons per day. The measurement made by J. F. Henson in August, 1910, at practically the same point, was only 894,000 gallons per day.

In spite of more or less discrepancy in the various gaugings, and notwithstanding the lack of sufficient number of weir readings, the natural available flow of the Springs is possibly more than 10,000,000, and probably less than 15,000,000 gallons per day.

There can be no question of the sanitary purity of the Spring water. It is amply protected from surface contamination by the impervious surface deposits. There need be no fear that any portion of the water naturally flowing from the Springs is bog water. The temperature of the bog just above the water plane on August 25th, 1912, was 51 degrees Fahrenheit. The temperature of the Spring water is about nine degrees lower.

A visit was made to the proposed intake at the Seven Portages of the Winnipeg River. The quality of the water at this point, it is assumed, was settled by the report of the commission of 1907. Rough tests were made of its turbidity and color by means of a white disk. The water, in the condition found on August 25th, 1912, would require the treatment recommended in the report of 1907. The suspended matter and color were both high on the date seen. In addition to the spores of water plants, algæ and minute particles common in nearly all river waters, there were numerous small bits of moss, etc., in suspension, which seemed to have been dislodged by the rapid current. The color and all of the suspended matter would be removed by the treatment proposed in the report of 1907, and the sanitary character of the water after proper treatment would be satisfactory.

The estimates of the cost of the supply from the Winnipeg River are printed on page 88 of the report of the commission of 1907. The proposed pipe line was to be 58.3 miles in length, about seven miles of which is in rock, and to consist of 35,000 feet of 45-inch pipe, 26,400 feet of 54-inch pipe, and 229,700 feet of 48-inch pipe. For a daily capacity of 23,000,000 gallons the estimates were:—

1—Land and right-of-way	$ [illegible]
2—Intake works	[illegible]
3—Pumping station at Winnipeg River	325,000
4—Pipe lines	1,737,000
5—Coagulating basins	65,000
6—Filters	250,000
7—Filtered water reservoir	270,000
8—Winnipeg pumping station	370,000
9—Keepers' houses	[illegible]
10—Telephone lines	[illegible]
11—Tramway	[illegible]
	$[illegible]
Add 15 per cent.	[illegible]
Total	$[illegible]

The present water supply of the city of Winnipeg from the well system is so highly undesirable and expensive on account of its high mineral content that it should be abandoned at the earliest possible date. The water is excessively hard and incrusting, and is corrosive and destructive to an unusual degree. The expense that this water now causes the citizens of Winnipeg by its destructive influences on plumbing, boilers, heating plants, etc., and increased cost of fuel, soap, compounds, and the destruction of woolens and other laundered articles, would well pay the interest on $15,000 to $20,000. As the city engineer has tersely remarked in his printed report: "The water in its natural condition is much too hard for general domestic and boiler use." The water is expensive to soften, and after treatment it is still hard water, and, more than that, still retains all of its corrosive qualities. The water is not only destructive of health; it is a handicap to and a serious drawback to the proper operation of many industries and a hindrance to the introduction of new industries. The following typical industries would be seriously handicapped by the present supply: Meat-packing industries, canning industries, woolen mills, starch and kindred potato product industries, any industry, of which there are many, that requires the use of live steam, or drying processes, or distillation, or kiln-dried material, or the application of heat for digesting or liquifying or combining a variety of commercial substances. There is no industry that would not be favorably affected by an abundance of pure, soft water, and to many it is an absolute essential.

It will be readily seen why the council are asked to abandon the present sources of supply and look toward Shoal Lake for the future.

Shoal Lake lies almost exactly 300 feet above the city of Winnipeg. It is a large, irregular body of water, of extreme dimensions 13 by 14 miles. The commission of 1907 proposed in their estimate, Number 9, page 95, 22.6 miles of 64-inch pipe, 27 miles of 54-inch pipe, 43.0 miles of 48-inch pipe, with intake laid in about 20 feet of water, extending about six miles through Indian Bay to an intake crib in Shoal Lake. The estimates submitted on page 95 of the report of 1907 give, for a daily capacity of 23,000,000 gallons:—

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

[illegible] at the station, 22.6 miles from Shoal Lake. This plan, if [illegible]

[illegible]

[illegible]

ject, to provide for the construction of the first conduit. A like expenditure should be contemplated for construction of a second conduit later on.

3. That the construction of the first line be begun at the earliest possible moment, and that every effort be made to finish the line by July 1st, 1916.

3. That an additional storage reservoir of 18,000,000 to 20,000,000 gallons capacity be immediately constructed within the city of Winnipeg. Such reservoir was duly included in the estimates of the Shoal Lake project.

4. That additional 18-inch wells be drilled in continuation of the present system, in and near the city, to furnish additional water until the Shoal Lake project is in readiness. An 18-inch hole should be drilled at once, both in Wells 1 and 2, and Well 7 should be tunnelled in search of shattered or cavernous rock. A number (at least 15) of 18-inch wells, in addition to the number thirteen now being sunk, should be drilled at once, about one-quarter mile apart, in lines north, and also west of the present wells. Each satisfactory 18-inch well should be equipped with direct-driven, multiple stage, centrifugal, deep well pumps.

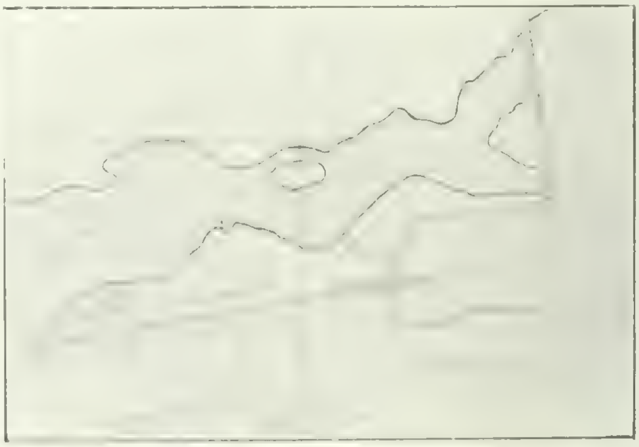
5. Before an intake pipe for Winnipeg water supply is finally laid out in Shoal Lake, observations, during the entire summer season, should be made by a competent person, in order to locate the best point of diversion.

◆

THE PORCUPINE POWER COMPANY PLANT.

At Sandy Falls, six miles north-west of the Hollinger Mine, or eight miles from Timmins Landing down the Mattagami River, the Porcupine Power Company has installed a hydro-electric power plant for the purpose of supplying power to the Porcupine District. The accompanying cut is taken from the last report of the Timiskaming and Northern Ontario Railway Commission. The installation consists of two pairs of 43 inch turbines, rates at 1,700 horse power with a 34 foot head, and two generators of 1,500 horse power each, 25 cycle, 3 phase, 12,500 volt, 214 r.p.m. Foundations for a [illegible] power have been prepared and [illegible] additions to the plant can be made whenever required. [illegible] light and power to the [illegible] of Porcupine and South Porcupine, and to the following [illegible] Hollinger, [illegible], [illegible] and Dome.

[illegible] in advance of the time that they are ready to utilize it.



Layout of Power Plant of Porcupine Power Co., Porcupine, Ont.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 19, 1912. No. 12

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Great Lakes and Typhoid 483
The Hudson Bay Route 483
The Medical Health Officer and The Engineer 484

Leading Articles:

New Bridge at Trail, B.C. 467
Interesting Drainage System over Three Hundred Years Old 468
Algae and Their Relation to Public Water Supplies . 469
Design and Construction of Smokestacks 471
River Improvement by Regulation and Dredging .. 473
Large Submerged Sewer Outlet 479
Winnipeg and its Water Supply 481
Information Regarding Water Powers 486
Rail Plateway 488
The Value of Sawmill Refuse as Fuel in Gas Producing 490
New Technical School in Winnipeg, Man. 492
A Complete Sewage Disposal Plant for a Public Institution 493
Presidential Address to the 6th Congress of the International Association for Testing Material . 496
Storm and Surface Water Drainage in Relation to Sewage Disposal 498
Quebec Railway, Light, Heat and Power Company. 499
American Road-Builders' Association Convention.. 500
Personal 501
Coming Meetings 502
Engineering Societies 502
Market Conditions 24-26
Construction News 71
Railway Orders 78

THE GREAT LAKES AND TYPHOID.

The boundary waters between the United States and Canada are rapidly becoming polluted, as is evidenced by the typhoid death rate of some of the cities located on them. We are glad to note, therefore, that the International Joint Commission has been instructed by the governments of both countries to investigate the question of pollution of boundary water. The questions laid before the Commission are as follows:—

> "1. To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?
>
> "2. In what way or manner, whether by the construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventive works, or a system or method of rendering these waters sanitary and suitable for domestic and other uses, be best secured and maintained in order to insure the adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations undertaken in Article IV. of the Waterways Treaty of January 11th, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other?"

The Secretaries of the International Joint Commission have, by the direction of Chairman Tawney in the United States and Chairman Casgrain in this country, sent requests to the mayors of all the cities along the international water boundary for data regarding their water supply and sewerage systems, with the expectation that much of this information will be ready to submit to the Commission when it meets in Ottawa the first Tuesday in October.

A great deal of valuable information, no doubt, will be received. The result of the investigation will be awaited with interest. One result, no doubt, will be the co-operation of the two countries in forcing cities and municipalities to purify their sewage before allowing it to be discharged into the Great Lakes.

◆

THE HUDSON BAY ROUTE.

Preliminary reports from the Hudson Bay survey parties on board the Government steamers which are investigating ice and navigation conditions in Hudson Bay and the Straits this summer in connection with the proposed Hudson Bay Railway are not very encouraging as to the safety and feasibility of the route, so it is reported. The ice conditions, especially in the Straits, have been found to be unusually bad, exposing vessels to both serious danger and delay. While the desire for another outlet for Western wheat and another ocean route to Europe, is natural, surveys and investigations prove that the Hudson Bay route is entirely impracticable. Navigation would be hazardous, and for only a short period of the year. Even the St. Lawrence route, with all its recent improvements, cannot obtain sufficiently low insurance rates. What rates could be obtained, then, on the Hudson Bay route?

Would it not be better for the Dominion government to concentrate its efforts upon the development of ports and routes which have already proved their merits? Montreal, for instance, cannot cope with the enormous business going that way. The present facilities there are not equal to the business offering, despite the energy and enterprise of the Harbor Commission. Montreal has every right to be considered one of, if not the leading of our national ports. If immediate steps are not taken to keep pace with the business, it will drift to foreign channels. The fact that many large grain boats were kept waiting there so long, that the owners were compelled to take their vessels off that route, is a serious matter, and but an indication of the more serious consequences which might easily follow. Our winter ports, too, should be improved materially.

Little has been done to make Vancouver the great ocean port it should, and must be, if it is to gain materially from the opening of the Panama Canal. Mr. Monk, the Minister of Public Works, was, unfortunately, correct when he stated that we are a quarter of a century behind in our port development. This is a matter for earnest consideration. The Hudson Bay scheme should be abandoned by the Government, with a frank statement that the proposed route is too hazardous and quite impracticable.

◆

THE MEDICAL HEALTH OFFICER AND THE ENGINEER.

The duties of the medical health officer and his general relationship to the public are too well known to warrant comment. His manifold activities may be noted by a glance over the programme of the second annual congress of the Canadian Public Health Association, which was published in last week's issue. The work of the engineer, which is peculiarly his own, is also well known. The lack of a clear definition of the relations of the engineer and the health officer has, however, led in the past to an enlargement of the power and duties of the latter beyond, in some respects, what is to the best interest of the public.

The engineer as a sanitarian comes into close touch with the medical health officer. To-day the lines along which the activities of municipal sanitary engineers are being directed are the problems of water supply development, the consideration of sewerage and sewage disposal, the matter of city waste disposal and street cleaning, the proper conduct of construction camps, and the supervision of general health conditions in mining districts and other engineering work.

Quoting Section 93 of the Public Health Act of Ontario, the Act states:—

> "Whenever the Council of any Municipality or any municipal board or commission or any company or person contemplates the establishment of or the extension of or any change in an existing water-works system, they shall submit the plans, specifications, and an engineer's report of the water supply and the works proposed to be undertaken, together with such other information as may be deemed necessary to the Provincial Board, and no such works shall be undertaken or proceeded with until the source of supply and the proposed works have been approved by the Board.
>
> "The Board upon the application for such approval may direct such changes to be made in the source of supply or in the plans submitted as it may deem necessary in the public interest."

Section 94 of the same Act states:—

> "Whenever the construction of a common sewer or of a system of sewerage or an extension of the same is contemplated by the council of any municipality, the council shall first submit the plans and specifications of the work together with such other information as may be deemed necessary by the Provincial Board, for its approval.
>
> "The Board shall inquire into and report upon such sewer or system of sewerage, as to whether the same is calculated to meet the sanitary requirements of the inhabitants of the municipality; and as to whether such sewer or system of sewerage is likely to prove prejudicial to the health of the inhabitants of the municipality, or of any other municipality, liable to be affected thereby.
>
> "The Board may make any suggestion or amendment of the plans and specifications or may impose any condition with regard to the construction of such sewer or system of sewerage or the disposal of sewage therefrom as may be deemed necessary or advisable in the public interest."

We have the greatest of confidence in the Ontario Provincial Board of Health. The work of the Board has been eminently satisfactory in the past, particularly since the present medical health officer, Dr. McCullough, has been installed. In many ways, however, the engineer, from the nature of his education and professional training and experience, is the best person to pass final judgment on questions of engineering practice. It will be agreed that there is a necessity for a central organization to pass on the plans for water supply and sewerage systems throughout the provinces, and it will be conceded that the provincial Boards of Health are the proper bodies for this work, as by this means centralization of authority and responsibility is fixed.

We believe that some means should be taken for having engineering advice given to the Board of Health regarding plans submitted to them for their approval and for advice regarding all the purely engineering details which inevitably arise when questions of water supply and sewage disposal are considered. Some of the provinces have already made provision for such advice by the appointment of a resident sanitary engineer under the direction of the Provincial Board of Health, and with the additional safeguard of employing consulting engineers. We do not offer any suggestion as to the method to be employed in securing this advice, but we must emphasize strongly the necessity for the securing of the assistance of expert sanitary engineering experience to co-operate with the Provincial Boards of Health.

EDITORIAL COMMENT.

The daily press notes another failure of a water turbine, with one man killed and nine others having narrow escapes. We have commented several times before in *The Canadian Engineer* on the fact of so many failures of water-wheel casings. It is a matter purely of hydraulic design, and there is little excuse for these repeated failures.

* * * *

An advance copy of the "Proposed Rules and Regulations for Inside Work" has just come to hand. These rules and regulations have been framed by the Hydro-Electric Power Commission of Ontario with the object of insuring that the design, materials, construction, equipment, workmanship and maintenance of electrical work or installations throughout Ontario, as well as of repairs, alterations or extensions thereto, shall be in accordance with the best current commercial practice, and that the interests of the public, workmen and others, shall be duly guarded, both with regard to safety (to life, limb and property), and convenience. These proposed regulations are being sent out to the different individuals and companies who are directly interested or affected by their enforcement, with a request that they express their criticisms and suggestions for changes and forward to the Commission by the 15th of October. As noted above, this is merely the advance copy, and the final publication will be proceeded with after that date. We would suggest that those interested in the regulations should communicate with the Secretary of the Hydro-Electric Power Commission and secure a copy. This week we are unable to make any comments on the regulations, but next week we hope to draw attention to some of the features where noteworthy change has been made from the old Underwriters' rules.

* * * *

To the looker-on of building operations it appears that there must be a clever organization with special knowledge at hand, and with trained mechanics working under careful supervision in order to successfully handle the building of even a fair-sized structure. But oftentimes, if one examines, he will find the methods crude and extravagant, and that much of the knowledge employed is the result of tradition and custom, and not of keen, original study. The sight of hod-carriers carrying brick to the upper story of a good-sized building is very common, and yet it is a shrewd guess that a hoisting engine, with a proper elevator and stages arranged so that brick could be delivered on wheelbarrows would pay.

GENERAL NOTES.

Cold weather prevailed throughout Canada during the greater part of the month, with a resultant mean temperature below the normal in most districts. The average was slightly exceeded in southwestern parts of British Columbia, and also locally in Alberta and Saskatchewan, but elsewhere in Canada the mean value was in defect by about three degrees.

Precipitation was excessive throughout Canada except in Nova Scotia, Prince Edward Island, and very locally in Ontario where the average amount was not recorded. Exceptionally heavy rainfalls occurred in Quebec and New Brunswick, and also more locally in Ontario. In the Irrigation Belt of British Columbia the rainfall was almost sufficient to supply the crops with moisture. The pronounced feature of the precipitation of August was the large number of days on which it occurred, being in most localities more than fifteen.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for August, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	2.7	+0.18
Edmonton, Alta.	4.4	+2.08
Swift Current, Sask.	2.5	+0.61
Winnipeg, Man.	1.6	—0.74
Port Stanley, Ont.	6.6	+4.07
Toronto, Ont.	3.98	+1.32
Parry Sound, Ont.	2.2	—0.80
Ottawa, Ont.	5.1	+1.90
Kingston, Ont.	5.7	+2.96
Montreal, Que.	3.9	— 0.11
Quebec, Que.	9.6	+5.66
Chatham, N.B.	6.4	+2.40
Halifax, N.S.	3.7	—0.80
Victoria, B.C.	2.26	+1.67
Kamloops, B.C.	2.1	+1.07

IRON AND STEEL TARIFF.

Speaking of further extensions of the iron and steel plant of the Lake Superior Corporation, Mr. T. J. Drummond says that the company has decided to postpone definite action pending possible consideration and action by the Dominion Government in regard to the iron and steel tariff.

"The existing tariff in iron and steel," he says, "is so torn up by special dispensations, exemptions and rebates, that the progress of the industry is retarded, and in many cases made absolutely impossible. Under the existing tariff we are encouraged to manufacture in small lines, giving small tonnage, and then discouraged in progression into the manufacture of heavier sections, which give larger tonnage. In other cases industries are practically bonused to purchase their pig iron, merchant steel, etc., abroad, and so in one way and another the industry is hampered, and the tariff is in many cases by these exemptions made absolutely illogical and inconsistent.

"If the iron and steel industry is to go forward this tariff must be overhauled, and such matters as I have referred to must be dealt with in a commonsense manner, and especially in connection with pig iron, merchant mill products and structural steel. At present practically one million tons of iron and steel are annually being brought into the country, and the bulk of this tonnage could and should be made in Canada. We placed our case before the Government during the last session of parliament, and we are hoping that something may be done this session, but pending the outcome of what consideration the Government is giving to our case, we can only mark time, and hope that such action will be taken as will warrant us in going ahead with the extensions we have in view."

◆

A new $5,000,000 steel plant for the manufacture of steel barrels and commercial packages has just been organized at Montreal. A group of influential Canadians, including Sir William Van Horne, Sir William Mackenzie and Messrs. George F. Johnston, C. W. McLean and J. Wesley Allison, have secured from the Steel Package Company of New York the letters patent to manufacture steel barrels and commercial packages of all descriptions. The new concern, it is said, is capitalized at $5,000,000, the financing having been done in New York, and will erect a plant in the vicinity of Montreal. The new concern is to be known as "The Canadian Steel Package Company," and it is probable that Sir William Van Horne will be the first president.

INFORMATION REGARDING WATER-POWERS.

We have just received an advance copy of a pamphlet, entitled "Instructions Relating to the Gathering of Certain Preliminary Information Respecting Water-Powers," to be issued shortly by the Commission of Conservation. The pamphlet has been prepared by Mr. A. V. White, M.E., and copies may be obtained from the secretary of the Commission of Conservation, Ottawa, or from the Department of Lands, Victoria, B.C. As there are only a few hundred available for distribution, those desiring copies should apply at once. An abstract of the introduction to the pamphlet is given herewith.

The inland water resources of the Dominion of Canada are of unique and exceptional value, and exist as a widely-distributed national asset.

During the last few years great attention has been given to the utilization of inland waters. The ability to transmit electrical energy long distances has resulted in an enhancement in the values of water-power sites, which, in turn, has caused persons interested in water-power developments to use, or seek to use, large quantities of water in special ways and for special purposes. Since it is necessary to conserve the common interests of the people in these waters, it is the desire and intention of the Federal and Provincial Governments of Canada, as quickly as possible, to obtain, so to speak, a preliminary inventory of the possible water-powers and other water resources of the country. In pursuing this work, it is very desirable to have the sympathetic and practical co-operation of surveyors, engineers, fire wardens, game wardens, road superintendents, timber cruisers, and others, in assisting to assemble reliable preliminary data relating to the inland waters of Canada. The data thus obtained will greatly assist the various Governments in administering and conserving, in the general public interest, the water resources of Canada; and further, the publication of information relating to our water-powers will, no doubt, materially contribute to the commercial opening up and development of the country.

It may be remarked that the commercial opening up and development of Canada's resources—and to which power is so necessary—will greatly improve the field of engineering activity. This remark is made in order to suggest the fact that hydrographic information gathered by engineers and others, when collectively published, will result in attracting the attention of capital to these water-powers and other resources; and one of the first classes in the community to feel the benefit of such new development is the engineer. Engineers who may be able to assist upon the gathering of the data desired may, therefore, find additional incentive in knowing that their pioneer work will, later on, result in the expansion of the sphere of their operations.

One of the chief objects in acquiring data respecting water-powers is, first, to enable the owners of the rights to know the possibilities and limitations of their powers, [illegible] respecting their possible uses and value; and, second, to enable prospective promoters of water-power development to learn the general [illegible] without the necessity of costly, independent, preliminary surveys. Certainly, if the [illegible]

The natural resources of Canada are being investigated by the Federal Government through the Commission of Conservation, Ottawa. This Commission has recently [illegible] an extensive report entitled "The Water-Powers of Canada." [illegible] the water-powers of Western Canada—British Columbia, Alberta, Saskatchewan, and Manitoba. The Commission, therefore, decided to prepare and issue, as soon as practicable, a report dealing with the water-powers of Western Canada. Work incident to this report has already been commenced.

Guiding Principles.—Speaking broadly, of the annual precipitation upon the earth, about one-half is evaporated; about one-third is "run-off"—that is, it runs off over or through the ground, and eventually reaches the sea; and about one-sixth either joins the ground water, or is taken up in plant structure, or is otherwise absorbed in processes incident to the ground. The natural and cultivated properties of the land on which the rain and snow fall largely determine the efficient uses to which precipitation is applied. It is in this connection that forests are so indispensably associated with the precipitation, and hence with water as a natural resource. Whatever opinion may be entertained respecting the effect of forests in influencing the amount of precipitation, the burden of opinion is that no feature of the topography of the country ministers more efficiently to the gradual and economical run-off from the precipitation than do forest areas. Thus it is that failure to intelligently conserve forest areas has wrought havoc by causing a great destruction of forest floors and agricultural lands, which, humanly speaking, can never be restored, to say nothing of the annual destruction to property by flood run-off, which seems yearly to increase rather than diminish. The run-off is the chief factor entering into water-flow problems as they relate to power development.

A deforested, eroded, and scoured territory, which has lost the humus of the soil, cannot retain the beneficent rains which, instead of being retained in the ground and transmuted into plants by the various processes of growth, carry destruction in the pathways of their torrential run-off. The water is necessary to the soil, and the soil, with its plant growth, is necessary to an economical disposition of the water. The interests of municipal and domestic water supply, water for manufacturing and industrial purposes, irrigation, navigation, and water-power are all interrelated and interdependent. They all depend on the same natural resource—**precipitation.**

In the case of water-power developments, therefore, it would be well to consider whether or not the industries which might use the water-powers would prove to be a menace to the district of their proposed location, and thereby spoil the watershed or waters for other necessary uses. Thus, wood-pulp mills, for example, which might completely denude the timber lands of trees at or near the headwaters of important waterways had better not be established at all; or, if established, then only under the strictest regulation and supervision designed to conserve the forest growth.

Along this line, therefore, in some instances, it may be possible for the engineer, or observer, when making his observations, to indicate what he thinks this or that particular water-power might be used for; whether, we shall suppose, for municipal purposes to serve a neighboring town or settlement, for mining, for manufacturing wood pulp, or, etc. Sometimes some such remarks prove to be suggestive to persons seeking opportunities for industrial development.

Pollution by Factory Wastes.—The effects likely to result from the pollution of waterways by the waste products emitted from the industries utilizing power from these waterways are also very important factors for consideration. The requirement of a pure and sufficient domestic water supply is a vital consideration, and, hence, a class of industrial waste products that will destroy life in the waters into which they are turned must be regarded seriously in their probable influence on human life. If any special instances of stream pollution are observed, it would be well to make a memorandum of such fact. When one realizes how even a great waterway like the Great Lakes System has been polluted, too great caution can hardly be exercised to conserve the purity of our inland waters.

Water-Powers Require Classification.—The amount of water-power is determined by two factors: first, the hydrostatic head, or the vertical distance through which the water may fall; and, second, the amount of water which may be made to operate upon the water-wheels. There are, however, many characteristic features associated with water-powers, which differentiate one power from another, and which determine the commercial and economic values of the individual powers. It is as unreasonable not to differentiate between water-powers as it would be not to differentiate between timber tracts, mineral lands, or the items of any other natural resource varying in quantity, quality, and situation.

In presenting water-power information, effort should be made to make brief remarks upon features which may have special bearing upon any specific possible power sites.

Reservoir Sites.—In connection with the subject of uniformity of flow, one may be on the lookout either for natural reservoirs, súch as lakes, or river expansions, or for natural sites, where reservoirs may be created by means of dams. In such reservoirs the run-off from precipitation may be impounded, and subsequently discharged gradually throughout the year. Water-powers situated within the range of the direct influence of such natural storage reservoirs may be of incomparably greater value than other water-powers not so favored.

When the subject of storage reservoirs is under consideration, it should not be forgotten that Nature also stores her waters elsewhere than in lakes and rivers. Forest floors, extensive areas covered with plant growth, soils and subsoils, the gravel-bed of streams, and the great swamps of the country, each and all, constitute valuable water reservoirs. In such reservoirs there is a widespread and satisfactory distribution of waters, which enables Nature to yield her supplies gradually and as required. A discreet conservation and utilization of such reservoirs will, in general, be found to be much more desirable than some of the large artificially constructed reservoirs, where the liability of accidental destruction of large construction works is always more or less of a menace.

In passing, it may be noted that where an early selection of reservoir sites is made, and the same held under Government control, so that no settlement, railway construction, or other similar improvement, is allowed to take place upon such reservoir sites, the expense and trouble incident to future reimbursement for expropriated properties will be avoided. Hence the desirability of the Government having knowledge of the existence of such sites.

Actual Measurements Required.—When information regarding water-powers is to be gathered, it is extremely important that the data be sufficient, and of the class that will enable a sound opinion to be formed upon the general water interests involved.

But little confidence can be placed in any reports of water-powers not based upon actual measurements, for, without measurements, the best judgment of explorers, and even of engineers, as to the heights of falls and the amounts of water discharging over them, is frequently very wide of the results disclosed by actual measurements.

Reconnaissance Surveys.—When knowledge of the quantities of water-power that may be available in particular places is required on short notice, and when sufficient records of actual observations do not exist, it is possible to **estimate** the probable amounts of power available. For such preliminary estimates, data are secured by what may be termed a reconnaissance survey of the general situation; but it must be recognized that the conclusions reached by such methods are not comparable with the results deducible from actual observations of individual water-power conditions extending over a series of years.

It will be profitable to explain, very briefly, these reconnaissance methods for estimating water-power. First, the area of the watershed in question is ascertained by measurement from the best available maps; to this area is applied an **assumed** run-off coefficient such as would be suggested by a general knowledge of the precipitation, and of the topography, and other characteristics of the territories involved. The wise choice of the coefficient used will, of course, depend upon the good judgment and knowledge possessed by the engineer. This run-off coefficient, as it is termed, is a quantity which represents the amount of water that may be drained off any specified area during a stated period, and is usually expressed as so many cubic feet per second per square mile. Obviously, if the area of a watershed is known to be so many square miles, and each square mile, under specified conditions, will yield so much water, then the total yield of water from the whole watershed will be the product of the factors just mentioned.

When the discharge of a stream, or river, is actually measured, it is usually accomplished by means of floats, or by using a current-meter. The principles involved are very simple. They consist essentially of measuring the velocity of the flow of the stream by means of floats, or meter, and measuring also the area of the cross-section of the river at the place for which the velocity has been thus obtained. The volume of the water which passes a given point is the product of the area of the cross-section of the stream and the velocity of flow at that point.

AUTOMATIC-STOP AND CAB-SIGNAL SYSTEM.

An automatic-stop and cab-signal system for railway signaling, which is being brought to the attention of railway officers, is based on the closed-circuit principle, in which the track rails are utilized for the signal current and no separate contact rails or track devices are required. Adjacent to the end of each block are lengths of rails insulated from the main track circuit, but maintained as a closed circuit through relays at the end of each block. Any obstruction in the circuit of one block, such as a train, open switch, broken rail, etc., deënergizes the relay in the two adjacent blocks in front and rear, and isolates the insulated rail sections from the main track circuit. Attached to the engine is a contact brush or shoe which controls the relay in the cab, and this in turn controls a special valve in the train-line air pipe. The engineman gets a red signal in the cab at a point far enough in advance of the end of the block to give him ample time to bring his train to a stop. In fact, he can pass into the next block at slow speed without causing the automatic device to operate. This, of course, enables him to proceed under control without waiting indefinitely to ascertain how or why the track is obstructed, while at the same time it avoids the undesirability of applying the brakes to a train proceeding under proper control.

The contact brush passing over the insulated rail sections when track circuit is interrupted (by train or other obstruction) deënergizes the relay in the cab, which in turn releases a lock lever, permitting a weight attached to the valve to drop, thus applying the air automatically and bringing the train to a stop. The movement of the valve is automatically recorded, so that it cannot be concealed by an engineman who wishes to avoid knowledge of carelessness in obeying a stop signal. In order to proceed, he must break a seal, thus releasing a lever, which enables him to restore the valve to its normal position. The device mentioned is that of the Thompson Automatic Signal Company, People's Gas Building, Chicago. No installation has been made.

RAIL PLATEWAYS.*

By G. Noble Fell, A.M.Inst.C.E.

Some years ago, the late Mr. Alfred Holt, of Liverpool, and a number of gentlemen interested in the trade of Lancashire and Yorkshire, grasped the idea that if the raw material could be conveyed from the ship direct to the mill, and the manufactured article from the mill to the market, a large saving might be effected in the cost of production. These gentlemen applied themselves to the task of solving this problem, and devised a plan whereby road wagons and lorries could be run over a plateway worked by mechanical means. Unfortunately their efforts were not successful, owing to the heavy expenditure involved in the method devised, estimated at no less than £48,000 per mile of plateway. One can readily understand that at this figure no great saving could be effected over carriage by rail, seeing that the adjacent railways, the London & North-Western, and Lancashire and Yorkshire, had cost on an average £53,400 and £67,800 a mile, respectively. One further realizes another fact, which is that every ton of goods carried over these roads must, besides paying its way, be charged also with its proportion of interest on this heavy capital outlay.

A plateway, pure and simple, that is, a track laid along the public highway to facilitate the passage of ordinary vehicles, is a failure in this respect, and does not meet the requirements of the case. What is necessary is the application on such a track of the best means of propulsion (whether steam, petrol or electric) to work the traffic economically and expeditiously. To do this the track must first of all be removed from the public road, and placed on its own acquired ground. A public road is not the place for such a plateway or railway. There must be provided a suitable permanent way, that will carry a locomotive, a railway wagon and a road vehicle. This is quite practicable, as will be seen by reference to Fig. 1, which shows a special form of plateway rail, a being the space provided for the flanged wheels of the railway stock, and b the space on the same rail allotted to the wheels of the road vehicles. The gauge adopted is 4 ft. 8½ in., so as to allow of the circulation of ordinary railway wagons over the plateway, and it is proposed to carry road vehicles of a width not exceeding 5 ft. 6 in. over the wheel tracks (that is, the measurement from outside to outside of the wheels at ground level), the intention, however, being to construct suitable road wagons for working on the plateway and so to avoid the expense of altering existing wagons to suit railway traction, in such matters as couplings, drawbars, brakes, etc.

The [illegible] rails are laid on a longitudinal [illegible] of concrete or timber and concrete combined, to which they are securely [illegible] by means of [illegible] bolts. The [illegible] rail, [illegible] with the [illegible] ballast, and [illegible] a solid [illegible] footing, and enabling a lighter form of rail to be used than would otherwise be possible.

A further departure from the ordinary methods of railway construction is the [illegible] of a third or centre rail, [illegible] Fell [illegible] as follows. The [illegible] tie above-mentioned is so constructed as to form a chair, raised slightly above the carrying rails. The tie is secured to longitudinal beams, and supports the centre rail, upon which run horizontal wheels. These wheels on the locomotive are worked by a separate pair of cylinders, and are made to grip the rail by means of elliptic springs, thus giving the engine the additional adhesion necessary for overcoming steep gradients. Horizontal wheels with flanges running under the head of the centre rail may also be attached to the wagons and carriages, to guide them round sharp curves, and to make it impossible for a vehicle to leave the track when descending a hill.

Gradients up to 1 in 10 have been successfully worked for many years by this system, and there is no reason why steeper gradients than this should not be overcome, especially where electric traction is adopted. The centre rail is used also for brake purposes, the brake acting directly on the two faces of the rail, giving absolute safety on steep inclines. This brake is operated by a powerful screw working two parallel arms which carry the brake blocks, and practically constitutes a vice gripping the centre rail. It can be worked by hand, or automatically. In the latter case, should a coupling break, the train would be brought to an immediate standstill, even on the steepest incline. With the above system the author has traveled down gradients of 1 in 10, at a speed of 40 miles an hour, with perfect safety. Naturally, on level ground the centre rail is not required, and the engine is worked by the two outside cylinders and carrying wheels alone, and when an incline is reached the driver, by putting the horizontal wheels into motion, can take the train up the hill as easily as it travels on the level. No change of engine, nor even change of gear is necessary, the mere opening of a regulator giving the extra power required. These engines are working on the Rimutake incline in New Zealand, where the system was adopted by the Government for getting over the high ground separating Wellington and Masterton. The saving in cost as compared with a railway of ordinary construction, was estimated at over £100,000.

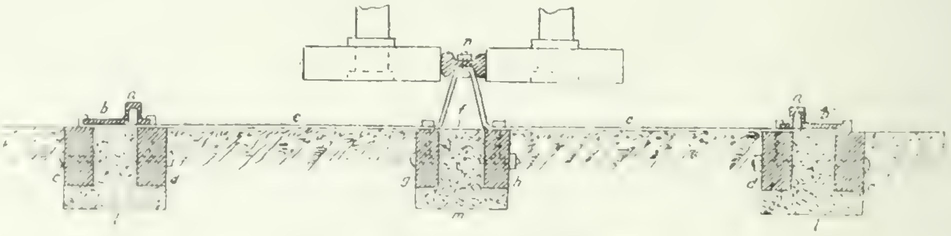


Fig. 1.—Section of Rail Plateway.

A special form of level crossing has been devised for roads, where the centre rail is laid, and means are provided whereby the road vehicles can be removed from the track when required to resume their journey by road, or vice versâ. This is done by tapering the longitudinal guard rails in the direction of the line, so as to form an incline, up which the wheels of the vehicles can be drawn to the level of the roadway. The same means will apply to stations, and to other points where it is desired to rail or derail road vehicles, thus giving agriculturists, manufacturers, mineowners and others, advantages such as are not and never have been possible with the present form of railway construction.

It may here be noted that plateways are not intended to and cannot compete with existing railways; they are to become feeders, and to constitute a means of bringing traffic to them and distributing traffic for them, in a more expeditious and economical manner than has hitherto been possible. They will form an intermediate means of transport, and will perform what neither the railway nor the highway is capable of doing, that is, they will combine the special functions of both.

---

*[illegible] read before the Society of Engineers, [illegible]

In order to keep the cost of construction as low as possible, and so to bring these plateways within the means of every district not possessing railway accommodation, the axle loads will be limited to 5 tons, that is to say, a 10-wheeled locomotive not exceeding 25 tons in weight, will be sufficiently powerful to deal with the class of traffic to be carried, and will be capable of working on the gradients above-mentioned. As the gauge of 4 ft. 8½ in. will be adopted, the ordinary light stock of the existing railways will be able to run over the plateways, and transhipment of freight will thus be avoided. There is no reason why road motors (steam, electric, or petrol) should not utilize the plateway.

Several types of plateway have been studied, that shown in Fig. 1 being designed to carry locomotives up to 25 tons weight, and ordinary railway trucks weighing 10 tons loaded, or bogie trucks weighing 6 tons each and carrying a load of 14 tons. This type is laid with two specially rolled-steel rails, weighing 50 lbs. per lineal yard, carried on the longitudinal timbers c d, to which they are spiked in the usual manner. These beams are in their turn carried on, and bolted to, concrete foundations, the upper surfaces of which correspond with the ground level. The two rails are braced together by the steel tie-bar e, whereby the gauge of the line is kept in proper adjustment. On steep inclines this tie-bar also serves the purpose of supporting the centre rail, as it forms a chair (shown at f), to which the rail is bolted and fish-plated in the usual manner. This chair is carried on, and secured to, two longitudinal beams g h, laid in concrete, and the whole permanent way is thus framed together in a very solid manner. This form of permanent way, including the centre rail and foundations, is estimated to cost £1,300 per mile, calculating labor and materials at average present-day prices.

Taking as an example a mile of plateway, carried along the side of a hill, with, say, an inclination of 1 in 10 (1 in 40 would represent the gradient upon which an ordinary railway would be constructed) over moderate ground, that is calculating upon an average depth of bank and cutting of 5 ft., and an average width of 24 ft. of land required or about 3 acres to the mile, we have the following cost:—

Cost of One Mile of Centre-Rail Plateway.

Single line.	Gauge. 4 ft. 8½ in.
1. Land: average price £50 per acre..............	£ 150
2. Earthwork; average cost 1s. 3d. per cubic yard	515
3. Bridges and culverts	500
4. Permanent way, Fig. 1, including sidings......	1,445
5. Stations	250
6. Fencing; double for the whole distance........	260
7. Level crossings	100
8. Telegraph	80
	£3,300
Contingencies, 10 per cent.	330
	£3,630
Rolling stock	750
Legal expenses, administration, engineering, and interest during construction	620
Total cost of construction and equipment.	£5,000

A plateway constructed on this system over a hilly country and capable of hauling traffic up inclines of 1 in 10, may therefore be built for £5,000 a mile. The cost of an ordinary railway, over similar ground, would be from £10,000 to £15,000 a mile, besides the cost of the extra length of line that would be required for reaching the same altitude with a 1 in 40 grade.

Having found the cost of the plateway, let us see what will be its carrying capacity. Take a line 20 miles in length, divided into three sections, and suppose that there is a length of 5 miles at each end with gradients of 1 in 10, and that the intervening portion is undulating country with normal grades, which would represent a line rising from sea-level to a plateau at an elevation of 2,640 ft., and falling again to sea level, that is, a line connecting two valleys separated by a broad range of hills. At speeds of 15 m.h. on the level, and only 8 m.h. up, and 15 m.h. down the inclines, the journey can be made in 1 hour and 35 minutes, and by running the engine a double trip on the first incline, so as to give a full load for the rest of the journey, the round trip can be made in 5 hours, allowing ample time for shunting, coaling, etc. A centre-rail engine of 25 tons weight will take behind it a gross load of 49 tons up a grade of 1 in 10, or a net paying load of 28 tons; the net double load will therefore be 56 tons, and one engine could make three round trips in 15 hours, carrying a total net load of 336 tons. With four engines running, therefore, 1,344 tons may be carried in a day, or a total paying load of 403,200 tons in 300 working days.

Instead of a double-headed rail, an H or channel bar may be used as a centre rail where the traffic is light. The carrying rails may also be formed of T bars. With this form, however, it will be necessary to provide a flange for keeping wheels of the road vehicles on the track where the centre rail is not laid. The cost per mile of this type of permanent-way, including the centre rail, is £920, and the estimated cost of one mile of plateway is £3,750 over a hilly country and £2,500 a mile on fairly level ground.

An example of a light railway of this description, where light timber viaducts were substituted for heavy banks and cuttings, is the Torrington and Marland Railway, in North Devon, mentioned in Mr. Vernon-Harcourt's work on "Railway Construction." It is eight miles in length, the gauge being 3 ft., and although there are many viaducts of from 20 to 25 ft. in height, and a bridge of three 45-ft. spans, and 40 ft. high, over the River Torridge, the total cost of construction was only £20,000, or at the rate of £2,500 a mile. It was opened in 1880, and is still carrying a heavy mineral traffic. It is intended to utilize similar light viaducts in timber or steel for the system of plateways now proposed, in order to secure economy and rapidity of construction, and this method, combined with plateways and the centre-rail system of traction, will be an entirely new departure in railway building.

The following table gives the cost of working the Torrington and Marland Light Railway, for the year ending December 31, 1911. The cost of management is not included in these figures.

Locomotive Account.

	£	s	d	£	s	d
Coal	300	13	8			
Oil, waste, packing, etc	120	[illegible]	6			
Repairs and renewals	[illegible]	15	10			
				£890	12	0

Track Account.

Rails	194	11	2			
Viaducts	61	3	11			
Sleepers	36	16	6			
				292	11	7

Wages Account.

Platelayers, drivers, stokers, etc..				1,231	4	11
				£2,423	8	6
Less cost of transfer to and from own trucks to L. & S.W. Railway at [illegible] Station	430	9	0			
Distributing and collecting trucks	234	18	0			
				665	7	0
Actual cost of working				£1,758	1	6

£1,758 1s. 6d. ÷ 35,326 tons = 11.97d. (say 1s.) per ton. One shilling per ton for 8 miles = 1½d. per ton-mile.

◆

THE VALUE OF SAWMILL REFUSE AS FUEL IN GAS PRODUCERS.*

By Chas. E. Snypp.

I will endeavor to state briefly my experience in the firing of the following fuels in gas producers, namely, bituminous coal, anthracite, coke and coke braize, and sawmill refuse.

Our producer plant was installed for the purpose of burning Pittsburg bituminous coal, guaranteed to furnish gas of about 125 B.t.u. to the engines. As a matter of fact, we operated the plant continuously for about four years on various kinds of coal.

The producer we used was a pressure type Wood producer. The capacity of the producer plant was 840 h.p., consisting of a combination of three units each having a producer shell 8 ft. in diameter by 12 ft. high with steam jacketed top; one wet scrubber 5 ft. by 18 ft. high; one dry scrubber 8 ft. in diameter by 3 ft. high; one pressure fan; one gas holder and one [illegible] mechanical tar extractor.

The coal was locked in through an air-tight hopper into each of the producer shells. When the workmen poked the fires, the gases under pressure from the blast escaped freely through the poke holes, causing great distress to the workmen. To overcome this difficulty we installed a fan between the dry scrubber and the tar extractor, intending to bring the producer shells under a slight vacuum. This relieved [illegible] though it did materially reduce [illegible] from the poke holes, thus re-[illegible]

[illegible]

then to a dry scrubber, which is a shell about 8 ft. in diameter and packed with excelsior in layers. The gases then pass through an exhaust fan to the holder and thence to the engines.

The first coal that we burned was Pittsburg bituminous coal, but we found that while this fuel filled the requirements as far as the richness of the gas was concerned, our plant went out of commission at regular intervals in consequence of tar congestion. These intervals came closer and closer together the longer we operated the plant on this coal, on account of greater and greater accumulation of its peculiar tar. In fact, the tar was too heavy for the centrifugal tar extractor, and breakdowns of this machine were frequent. This led us to try other bituminous coals with the idea of reducing the tar nuisance.

After four years of continuous service of the producer plant on various bituminous coals we found that in spite of our selection the whole system of pipes and engines was becoming congested with tar. We also found that it was quite an expensive repair to remove this tar from the engine cylinder rings. In fact, many of the rings had to be cut from the grooves with a cold chisel. We found that a gas plant could not be run for more than five hours on gases from Pittsburg bituminous coals without taking out these tars, as the valves and piston rings would stick. Alabama coals did not do much better.

These Alabama coals were analyzed particularly for fixed carbon and volatile matter in order to select those with a high fixed carbon and a low volatile matter. They gave greater satisfaction because of the reduced quantity of tar, and at the same time furnished a gas that was just as rich as the Pittsburg bituminous, namely, about 125 B.t.u. The Alabama coal, however, introduced a trouble peculiar to itself, which finally forced us to abandon it. The first trouble was that the fuel came to hand of irregular quality, even from the same mine, particularly as to volatile matter and ash. The content of ash was especially unsatisfactory and very irregular, varying from 6½ to 11 per cent. Not only was the content of ash high, but it had the peculiar property of fusing in the producer or forming a solid clinker, which was almost impossible to penetrate with poke bars, and even after penetration with bars and sledges was not brittle enough to break in pieces of a size that could be readily removed from the producer itself. Besides this, the act of fusing cuts off the air from the fuel beds, producing a lean gas, or one low in B.t.u., finally putting that particular producer out of business.

We next resorted to the experiment of burning anthracite coal. Our experiment was limited to a few tons, but the conclusion reached was that we could not produce a gas high enough in heat value. The best condition did not yield much more than 100 B.t.u. in the gas. Besides, this fuel was to expensive.

The next experiment was to substitute coke and coke braize for anthracite. This furnished a fair quality of about 100 B.t.u. gas in the beginning, but we experienced great difficulty in the producers filling up with ash, and the ash fusing, thus causing cavities which could not be poked out. The quality of the gas sometimes fell as low as 80 B.t.u., thus putting the plant out of commission. When this happened we would have to [illegible] down and sledge the clinker. I realized that when the gas became lean we could raise the heat value of the gas by feeding the producer with [illegible]

During this interval [illegible] improvements on the producer plant were made, as follows:

---

*[illegible]

First, the "Z" pipe which conducts the gases from the producer shell to the wet scrubber would frequently become clogged with dry soot, and we found that on account of the bends in the pipe this soot would bake in hard clinkers, thus reducing and eventually choking the pipe. This pipe was replaced by a horizontal pipe extending between the producer shells and the wet scrubber, and a partition was run vertically in the wet scrubber, thus making a downtake which opened directly into the bottom of the wet scrubber.

Second, we found that tar was accumulating in the bottom of the wet scrubber and was very difficult to remove. The metal bottom was replaced by a water seal, extending all over the bottom of the wet scrubber. All other pipes where the gases have a downward trend and a sharp bend were similarly provided with water seals, in order that the tar might readily drop out and wash out, thus facilitating the cleansing of the producer.

While these water seals or water bottoms are essential to the cleansing of the plant, the following little experience will show that they must be used with some judgment. The wet scrubber as installed by Woods & Co. in the ordinary sized machine is about 5 ft. in diameter. The metal bottom of this scrubber was removed, as I have just stated, and a water seal substituted, which proved to be just the thing for a pressure producer. However, I was called upon some months later to go to a plant in Mississippi where they were having trouble with their producer. Upon my arrival I was surprised to see how nicely the producer was working, and noticed that the installation consisted of 140 h.p. engine together with a corresponding size producer of the suction type. In spite of no apparent difficulty, everybody seemed to be afraid to approach this producer, and the superintendent told me to wait awhile and see what would happen. I did wait awhile and noticed that the engine was drawing gas under a head of about 3 in. of water and this was gradually increasing until some hours afterwards it reached 5 in., and then ran rapidly to 10 in. Then there was a terrific explosion which blew through the seal and blew the poke hole castings and the plugs from the top of the producer. The negro stoker happened to be on top handling a wheelbarrow of coal, and he must have been a new hand or a nervous one, as the last I saw of him was that he was tumbling toward the ground with the wheelbarrow of coal, a distance of about 15 ft., and I noted particularly that he landed on his feet and ran down the hill-side. The only reason that I did not leave was that I was penned in by a guard rail. The after-effect of this explosion was that the remaining water seal was alternately drawn in and expelled by numerous puffs that followed. It was apparent to me at once that what had really happened was that the engine had drawn up the water from the seal and admitted a large influx of air, which no doubt made the proper mixture for causing an explosion. The remedy applied was very simple. The opening on the water seal under the scrubber was restricted in size so that no great quantity of water could be drawn in suddenly. The plant ran along afterwards without any trouble whatever, with simply working the beds and removing the clinker when the draft became obstructed. You will pardon this digression.

On account of these various troubles and because of the increase in heating value of producing gases made with barrel staves referred to before, I was prompted to try sawmill refuse in the producers, and found very much to my satisfaction that we were able to operate the plant continuously on about 130 to 135 B.t.u. gas, and the plant was more reliable on account of the even quality of gas. After about a month of use of this refuse fuel our tar troubles began to disappear, and now after using this fuel for a couple of years it is a very rare occurrence to have an inlet valve or an exhaust valve stick in the engines on account of tar, or carbon deposits. In fact, we have discarded the dry scrubber altogether and we even operated one week without a tar extractor at all, on account of that machine needing repair. This illustrates how well the sawmill refuse has solved the problem in our case when it is recalled that we could not run even five hours on coal without removing the tar.

The refuse that we use is known as "cypress hog." It consists of about 50 per cent. of sawdust and 50 per cent. of chips, such as are discharged from the "hog," which is a machine used by sawmills to destroy their refuse. This material runs from 30 to 55 per cent. moisture, and this moisture seems to be necessary for best working conditions.

I will state that we have to guard against the sawdust blowing over into the pipes which conduct the gases to the wet scrubber. This is a probably local trouble, due, no doubt, to the strength of the blast that we use in order to get capacity. We have been able to realize full capacity using sawmill refuse, and our engines deliver a brake horse-power on about 4½ lb. of this fuel.

The changes necessary to fire sawmill refuse are merely the removing of the coal dump hoppers and substituting a hollow cylinder about 10 ft. high slightly tapered and made larger at the bottom and fitted with a slide gate at both top and bottom; these slides are worked with levers and the sawmill refuse is locked into the producers through these tubes.

To start firing a producer with sawmill refuse it is not necessary to have an underlying bed of cinders or ash to cover the blast pipe. The fuel can be dumped in on the water seal and fire can be started either on top or through the side poke holes. Aside from these conditions, the beds seem to be subject to all conditions prevalent in the firing of coal. A clinker is formed of a brittle nature and can be easily removed with the fine ash. The percentage of ash is so small that a producer can be operated about three weeks before removing the ash.

Cavities and chimneys will burn in the bed, and eternal vigilance and poking are necessary to produce a uniform quality of gas. In order to lessen the labor of poking it is good practice to feed occasionally, say, once a day or when the quality of the gas fluctuates, one or two charges of blocks ranging in size from stove lengths to 15 in. in diameter. These blocks will find their way into the cavities and stop the chimneys, and the producer will respond instantly. I have had cavities form low down in the beds and cause trouble, but we have always succeeded in poking down overlying fuel and closing this cavity.

We also experimented with "pine hog," and we find that it is more efficient fuel for producer gas than "cypress hog." An average of ten analyses made on gas produced from "pine hog" showed 161.4 effective B.t.u. against 130 to 135 for cypress. The reason for this is probably due to the greater heat value of pine itself as compared with cypress. The analyses of heating value of these two fuels showed that the cypress was 5 540 B.t.u., while pine was 7 605 B.t.u. These are on fuel as received, and, therefore, include moisture. The only reason that we do not use pine is that cypress is more available as far as our plant is concerned, which means that it is cheaper, comparatively speaking, although it is pound for pound a much richer fuel.

I have added below a number of analyses of gas produced from various kinds of fuel that it has been my lot to experiment with in solving our problem.

Kind of Fuel.	No. of Analyses.	Effective B.t.u.	CO.
Pittsburg bituminous	15	125.3	9.6
Pittsburg bituminous	6	119.0	9.5
Pittsburg bituminous	8	122.5	9.7
Alabama and Pittsburg bituminous	3	112.7	11.3
Alabama bituminous	9	140.9	9.3
Alabama bituminous	12	112.2	7.8
Alabama bituminous (Rock Castle)	13	104.4	11.4
Pocahontas coke	10	103.1	...
Pocahontas coke	8	97.8	7.2
Nut coal	3	100.4	10.5
Coke braize	2	[illegible]	10.1
Coke braize	4	113.8	...
Coke braize	4	108.0	6.4
Anthracite coal	39	91.2	12.4
Anthracite coal	11	101.2	9.1
Cypress hog	4	111.3	12.2
Cypress hog	12	134.2	10.3
Cypress hog and petroleum	5	135.0	...
Cypress hog and petroleum	5	135.0	..
Pine hog	11	161.4	9.9

To summarize; the advantages to be derived from burning sawmill refuse where it is available are as follows:

First, little ash, therefore little cleaning to be done.

Second, high grade gas, i.e., gas of higher heat value as compared with other fuels in our type producer.

Third, a lesser quantity of tar, and much more limpid in character.

Fourth, gas of constant quality with less labor.

Fifth, no deadly gases to overcome the workmen.

Sixth, and finally, the all-important factor of lower cost per h.p. hour must not be forgotten.

In conclusion, I wish to explain that there is no intention on my part of casting any reflection on the producer or the original installation that we had. I believe that we were among the first to burn bituminous coal in our section, and our work was of such character that the producer plant had to be operated twenty four hours a day and sometimes on Sundays.

Cost of cypress waste fuel (basis 4½ [illegible] per ton [illegible])	[illegible] per h.p. hour
Cost of [illegible]	[illegible]
Total cost per h.p. hour for cypress waste	[illegible]
Cost of Pittsburg bituminous coal [illegible] per h.p. hour [illegible] per ton [illegible]	[illegible] per h.p. hour
Cost of [illegible] Pittsburg bituminous coal	[illegible]
Total cost per h.p. hour for Pittsburg bituminous coal	[illegible]
Cost of Alabama bituminous coal [illegible] per h.p. hour [illegible] per ton [illegible]	[illegible] per h.p. hour
Cost of [illegible] Alabama bituminous coal	[illegible]
Total cost per h.p. hour for Alabama bituminous coal	[illegible]

NEW TECHNICAL SCHOOL IN WINNIPEG, MANITOBA.

The St. John Technical High School was recently opened for the admission of pupils. This high school has been established to provide a more complete and comprehensive scheme of scientific and technical education for students and the ordinary school age who are able to continue their education with a view to special preparation before entering the university or commencing a commercial or manufacturing career. Students may by arrangement take a mixed course slightly different from those laid out, with the object of training for definite occupations.

The first year's course consists of such subjects as English, commercial geography, elementary bookkeeping, practical arithmetic, simple algebra and mensuration, geometrical and mechanical drawing, general elementary science, and practical work in the laboratories and workshops.

In the second and third years the subjects are grouped into courses under: Architecture and building; electrical work; machine work; chemical industries, and commercial work. The courses have been carefully arranged by experienced practical teachers, fully acquainted with the requirements of various occupations and knowing well what subjects of study are necessary in the best interests of students who have the desire to achieve success in their chosen occupation.

In connection with the teaching of the mechanical work, the most complete arrangements have been made in the basement of the building. Here, where the noise will not disturb the other classes, are rooms fitted out with the very latest of mechanical appliances and various sorts of machinery from which the intending electrician or mechanic can learn at first hand. In the machine shop, for instance, there are no less than 11 lathes of the very latest pattern all driven by electricity. Besides the large and small lathes there are also to be found a large planing machine, two milling machines, a tool making machine and other fine pieces of machinery all with particular uses.

The cement floor is covered with a wooden flooring so that sharp instruments falling thereon will not be dulled or chipped.

Next to this room is the forge room where the art of the blacksmith and all appertaining to it is taught. The large room is a mass of anvils and blowers and the various instruments that go with the trade. The electrical laboratory is also fitted out with the very latest appliances.

There is a large room for mechanical drawing fitted with monster blackboards running to the full width and length of the walls. Pattern making, wood turning and forging, practical woodwork, all are prepared for in a manner that is excellent. The domestic section where the domestic science and art are taught are equally well equipped. A large power hammer has been installed in the forging and tempering room which will show interesting comparisons between hand and power work. The carpentering department is also most elaborately fitted out and it will need but a few days for the entire system to be running smoothly. At present workmen are fitting up the various machines and getting everything ready.

G. J. Price is in charge of the technical work and H. J. Russell will look after the commercial work. There is ample room in the building for a large number of pupils. A feature is the large lecture hall fitted out with a stage and with a large gallery, accommodating close upon [illegible] all told.

A COMPLETE SEWAGE DISPOSAL PLANT FOR A PUBLIC INSTITUTION.*

By T. Lowes, Chief Assistant to T. Aird Murray, Consulting Engineer, Toronto.

Of course it is impossible to bring before your notice any one complete system of sewage disposal for a large isolated building, and say that such is the best or only efficient system applicable to all such buildings. Just as with reference to towns and cities, it is foolish to assume that any one system of sewage disposal is always suitable. Local conditions must always govern the choice of any system. While the scientist may say and prove that such and such systems will produce effluents which cannot be objected to either from the nuisance or the health point of view, there are many local engineering factors which may decide the choice of a system apart from the theoretic suitability.

The chief engineering factor is, after all, the question of fall or level between the outlet drain and the point of main outfall. Given plenty of fall which will allow of complete processes of sedimentation and filtration, we have at once ideal conditions in which our choice of a system is hardly limited. With ten or twelve feet of fall between the point of drainage discharge and the effluent discharge almost anything can be done. Local conditions mean something more, however, than plenty of fall, and may be said to include as follows :—

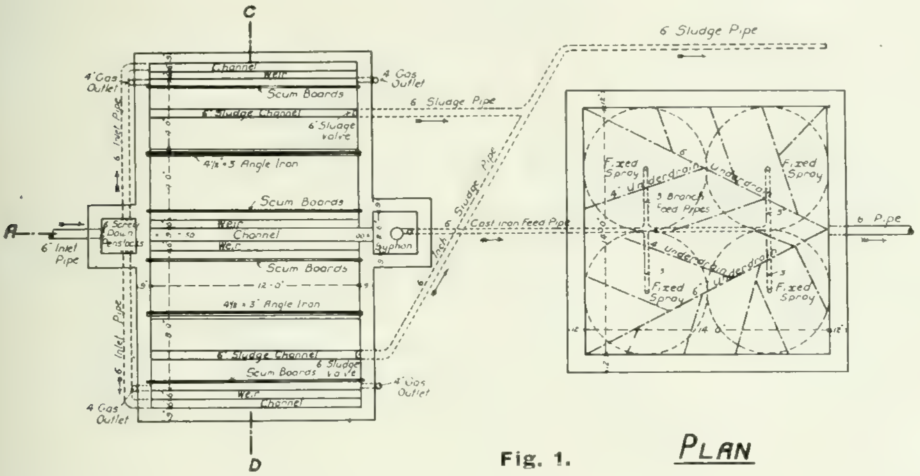


Fig. 1. PLAN

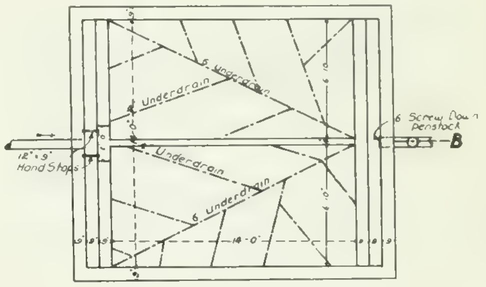


Fig. 4.

(a) The quality of final effluent demanded.

(b) The character of land and subsoil available for disposal works.

(c) The volume and character of stream, river or lake receiving the final effluent.

(d) The amount of surface of land available for works.

(e) The vicinity of any projected works to other buildings.

(f) The character of the building producing the sewage, whether used for domestic or trade purposes.

(g) The economic working of any plant with reference to the supply of labor for operating purposes.

The above and many other minor considerations all effect the final choice of a scheme of sewage disposal.

We are apt to hear too often that such or such a system has proved most successful in such or such a location, and that this is, therefore, practically "the system of sewage disposal" to be relied upon. The purely scientific mind too often sees only the scientific working and the results, without due consideration to particular adaptability, and when the engineer finds that he has to adapt this particular system of sewage to some particular location, he is, to use a slang term, "up against it."

In the above reference too much stress cannot be laid upon the absurdity of any tendency on the part of health authorities to dictate special systems of sewage disposal as being applicable without reference to local conditions. The medical officer or medical inspector may have in his own mind the fact that certain methods have, to his knowledge, given success; but, he has no justification for recommending such methods until he has become thoroughly familiar with the topographical and engineering factors which have particular application to the case in point.

This paper is not intended to be a treatise upon the various methods of sewage disposal which may be applied to isolated buildings, but merely a short description of a method which the author lately designed to suit certain conditions which came before him in connection with the Northumberland and Durham counties House of Refuge, at Cobourg, Ontario.

By an isolated building is meant a building producing sewage without the use of any common or public sewer, and where it is necessary that the sewage be so treated that it will not produce any nuisance to the occupants of the building or to others in the vicinity.

The House of Refuge is located some considerable distance from the town sewerage system, upon rising ground which gradually falls to a clear water stream which eventually discharges into Lake Ontario. The stream forms the natural surface drainage for the land and valley in which the House of Refuge is built, and has continued ever since there has been sewage from this building to take the discharge. The stream flows through part pasture land and part urban land to the lake. Complaints have been made from time to time of pollution of this stream.

A few years ago a sewage disposal system was installed in a field south of the "House." This system included a small receiving chamber, and a septic tank. At one time the discharge from the septic tank was conveyed direct to the stream, but an injunction was obtained by a land owner, for prevention of nuisance and pollution of the stream. This injunction was followed by cutting off the effluent drain, and substituting a system of sub-irrigation by discharging the septic discharge by means of a syphon below the surface of the land at depths ranging from 1 foot to 1 foot 6 inches. It was not long before the land showed signs of becoming sewage sick, until last year the local nuisance and sewage odors from the land became unbearable.

---

* Paper delivered at 2nd Congress of Canadian Public Health Association, Sept. 17th, 1912, Toronto.

In the first instance the system failed because the land was of stiff clay and entirely unsuitable for purposes of either surface or sub-irrigation.

In both cases the system failed because it did not meet local conditions.

The fact that a septic tank in some other locality discharging probably into a large volume of water where it may only have been necessary to remove grosser solids, had no application in this case. Again the fact that septic discharges may have been discharged with a certain amount of efficiency into friable sandy of gravel land and lost by evaporation, absorption and oxidation, did not apply in this case. The history of the sewage disposal of this House ol refuge was one of finding out by experiment what the local conditions were, instead of first examining the local conditions and designing a system to suit them.

The local conditions as summed up by the author may be stated as follows:—

(a) A House of Refuge providing accommodation for about 100 people, producing on the average about 3,000 gallons of sewage per day of 14 hours.

(b) Ample fall from the base of the building to the stream receiving the final effluent.

(c) A small field presenting about 15 feet of fall located about 60 yards south of the "House" and the property of the "Counties."

(d) A character of subsoil in the neighborhood entirely [illegible]

(e) A stream capable of receiving the volume of sewage discharge, if it was rendered (1st) non-putrescible, and (2nd) non-pathogenic.

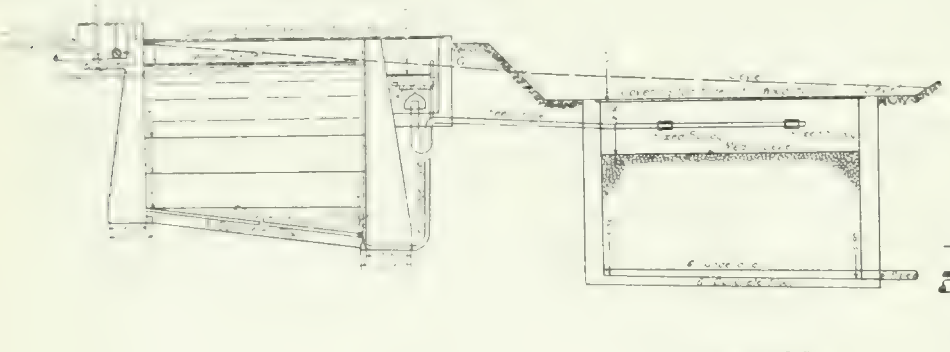
The particular field south of the "House" on which the [illegible] was selected for the new [illegible]. Owing to the [illegible] character of the land and its proximity to the main road, it was considered that [illegible] of the type which has been called "Biological," providing artificial filtration and ignoring [illegible]

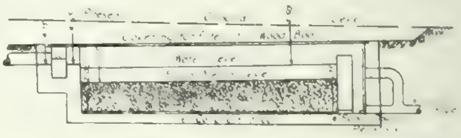
[illegible]

[illegible] percolating filters.

[illegible]

[illegible]





SECTION A-B

Fig. 2.

Fig. 5.

tion tank. The tanks are provided with scum boards to keep back floating matter, while the principle of immediate separation of the precipitated solids from the flowing sewage is adopted by provision of a wire reinforced glass apron covering the sludge storage area. The sedimented liquid is passed into a syphonic discharge dosing chamber, and then by means of 6-inch cast iron pipes to four fixed sprays, where it is distributed over the surface of a percolating filter consisting of coarse gravel from 1 inch to 1½-inch cubes in size. The percolating filter is never in a state of saturation but every drop of the liquid sewer is exposed to atmosphere during its downward course. The filter is well underdrained as shown. The oxidized liquid is then passed on to the final sand filter. Fig. 2 shows a section through the sedimentation tank and filters, while Fig. 3 shows a cross section of the sedimentation tank, location of the sludge apron, scum boards, and slopes for movement of the sedimented sludge to the storage area. At the apex of the sludge apron and under it, air pipes are fixed to take care of the gases produced by the decay of the stored sludge. The arrangement is intended to produce a sludge which is thoroughly septized and innocuous from a nuisance point of view.

Figs. 4 and 5 show respectively a plan and section of the sand filter treating the oxidized effluent from the percolating filters. These filters are in duplicate, so that either can be used independently to allow of cleaning and removal of sand. One foot three inches head of liquid is provided over the surface of the sand in order to overcome the friction of the sand particles, while a value and base outlet is used for emptying the filters at any time.

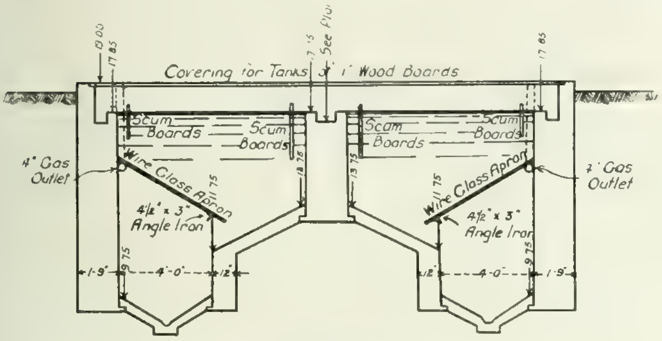
The system is, generally, based upon the following capacities and dimensions:—

Sedimentation tanks in duplicate 12 ft. 0 in. by 4 ft 0 in. by [illegible] at sludge outlet end, with a capacity of [illegible] gallons, or at 3,000 gallons per day of 14 hours equal to 21 hours' flow. At certain hours of the day the flow per hour will exceed the above ratio considerably. The average velocity flow through the tanks is approximately .3 feet per minute. The sludge storage area has a capacity of [illegible] cubic yards, and approximately a storage capacity of about from three to four months of 85 per cent. water and sludge residue, based upon [illegible] sludge of purely domestic sewage. It is [illegible] that the sludge will require removal after from [illegible] to 4 months' septic action to sludge drying area. [illegible] provided at a level to which the sludge can [illegible] from the base of the tanks.

The percolating filter is 14 ft. .0 in. by 14 ft. .0 in. by [illegible] cubic yards. [illegible] gallons per day the rate of filtration will, therefore, [illegible] This is a much less rate than [illegible] on account of the use of pebbles in lieu of clinker or broken stone. It is anticipated that this [illegible] to arrive at maturity, the [illegible] filters being from 1 to 2 months.

The sand filter is 14 ft. .0 in. by 14 ft. .0 in. by 2 ft. .6 in. in depth, well underdrained, as shown. The square surface is 196 feet, the rate being slightly over a half million gallons per acre of surface.

The work of construction was let by tender to Mr. Roland McLaren, of Oakville, Ontario. Work was commenced on or about the 1st of June this year, and finished, apart from the housing, in the middle of August. The whole system, together with effluent drain to stream and housing, including cost of a resident engineer, has totalled approximately $3,000.



SECTION C-D

Fig. 3.

The plant has not been sufficiently long in operation to allow of analysis of the effluents from the various parts to be made, but it may be said that the effluent at present is pure in appearance to sight and odor. Regular samples of the effluent will be taken from now on and the results published in the Canadian Public Health Journal.

TEMISKAMING RAILWAY FINANCES.

The following is the condensed statement of revenue account of the Temiskaming and Northern Ontario Railway for the year ended October 31st, 1911, compared with the year 1910:

	1911.	1910.
Revenue from transportation ..	$1,708,249.02	$1,522,020.05
Revenue other than transportation	72,715.81	69,831.97
Total operating revenue ..	$1,780,964.83	$1,591,852.02
Operating expenses	1,181,998.63	1,165,361.36
Net operating revenue	$ 598,966.20	$ 426,490.66
Ore royalties	17,060.56	31,762.92
	$ 616,026.76	$ 458,253.58
Hire of equipment, etc.	22,874.07	22,123.27
Total earnings	$ 593,152.69	$ 436,130.31
Paid Treasurer of Ontario	515,000.00	420,000.00

The operating expenses amount to 66.4 per cent. of the gross earnings, and the net earnings to 33.6 per cent., as compared with 73.2 per cent. and 26.8 per cent., respectively, for the twelve months ending October 31st, 1910.

The total mileage of the railway, including main and branch lines, yards and siding is 379.62.

CANADIAN CANAL TRAFFIC.

Canadian canal traffic from the opening of navigation until July 31 of this year has exceeded by approximately 3,000,000 tons the traffic for the corresponding period of last year, as shown by statistics just issued from the department of railways and canals. The increase is about 16 per cent. The total tonnage through Canadian canals for the period mentioned this year is 20,116,188 tons, as compared with 17,154,111 tons for a similar period last year. The increase in correct figures is 2,962,077 tons.

The Soo canal, leading all others in volume of traffic, shows the largest increase, being 2,793,682 tons, or almost equal to the total increase throughout all the canals, a decrease in the volume of tonnage through the Chambly, Rideau, St. Peters, Murray, and Trent considerably offsetting in the totals what would otherwise have been an enormous increase over last year.

As against the decrease in those above mentioned, large increases are shown in the volume passing through the Welland, St. Lawrence and Ottawa, while St. Andrews locks on the Red River above Winnipeg shows probably the highest proportionate increase of all, the volume having jumped from 11,241 tons last year to 50,063 this year, or an increase of 38,822 tons.

The statistics for the various canals are as follows:

Canal—	1911.	1912.	Increase.
Soo	14,028,453	16,823,135	2,794,682
Welland	1,138,284	1,201,588	03,304
St. Lawrence .	1,339,766	1,417,731	77,965
Chambly	273,356	257,374	*15,982
Ottawa	134,990	173,563	38,573
Rideau	80,439	76,243	*4,196
St. Peters ...	29,473	24,860	*4,613
Murray	86,206	68,475	*17,731
Trent	30,903	23,156	*7,747
St. Andrews .	11,241	50,063	38,822
Totals	17,153,111	20,116,188	2,963,077

---

*Decrease.

The large increase at the Soo is chiefly made up from the tremendous volume of iron ore passing through, this being partly American traffic handled by American vessels. There has also been a large increase in the volume of Canadian wheat conveyed.

Of the total traffic passing through the Soo, over **82 per** cent. was purely United States' traffic.

The statistical branch of the department of railways and canals is this year collecting figures showing comparative rates by water on the canals, as compared with those by rail and are requiring all shippers to supply a statement of rates. It is purposed that the scheme be elaborated next year so that these figures will be analyzed according to canals and also commodities.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended August 31st:—

	1911.	1912.	Increase.
C.P.R.	$3,329,000	$3,809,000	+ $480,000
G.T.R.	1,442,953	1,660,916	+ 217,963
C.N.R.	460,900	563,800	+ 102,900
T. & N.O.R.	58,451	58,451	— 13,205
Halifax Electric ...	8,532	7,699	— 833

The July statement of the Grand Trunk Railway system shows a total decrease of £14,450 sterling. The earnings of the Grand Trunk proper show an increase of £10,300, but the subsidiary companies show a substantial decrease: Grand Trunk Western Railway, net profit decreased £2,200; Grand Haven & Milwaukee Railway, net profit decreased £10,150; Canada Atlantic Railway, net profit decreased, £12,400.

The gross earnings of the C.P.R. for the month of August, as given in the weekly statements, show an increase of $1,813,000, or 18 per cent., over earnings in the same month last year. August earnings were $11,886,000 against $10,073,000 for August, 1911.

PRESIDENTIAL ADDRESS TO THE SIXTH CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.*

By Henry M. Howe.†

The purpose of this association is to serve humanity by enabling it to distinguish the fit from the unfit among the materials with which the world's work is done, the materials for its buildings, its bridges, its ships, its railroads, its machinery, and its constructions in general. This is the function of the testing engineer; he stands between the public and the manufacturer who would supply that public, to test the fitness of those supplies, to measure accurately their degree of fitness, and to reject unsparingly the unfit. He is a guardian of the lives of those who travel by land or sea, and of those who live or work in buildings of important size. He is a protector of the material interests of the public, because in the last analysis all structures and all materials of which they are made are for the use and benefit of the public individually or collectively, and are paid for directly or indirectly by that public; and it is to the interest of that public that the fitness of those materials for their various purposes shall be known quantitatively to those who select them.

It is to make this work of the testing engineer more effective, to guard the lives and the interests of the public the better that this association exists. It is an open court in which the public sits in judgment on the various methods of testing. Of that public certain parts are here represented directly by their own engineers. This is true of the great railroads, the great shipbuilding and bridge builders, and the great engineering houses. Other parts of the public are represented indirectly by the middlemen or by the public engineers of tests.

The results of experience in all lands, in all climates, and under all conditions, and the points of view of all races, are here focussed in the most searching criticism of the various methods of testing, to the end that the buyer may gage their fitness with full knowledge, and thus may select intelligently those which give the fullest protection first to himself and ultimately to the public. If one method is unduly favorable to one manufacturer or to the manufacturers of one region or of one country by tending to gloss over the shortcomings of their product and to give undue prominence to its special merits, the public is here warned of the deceptiveness of that test by the evidence offered by the competing manufacturers.

However far distant may be the political "Parliament of man," which is "coming yet for a' that," the industrial parliament of man is already here. The buyer in each country may well say "My country is the world, my countrymen are all mankind," for wherever his abode he selects the fittest goods, quality and cost considered, without regard to their origin. While he is selecting his purchases, friendship, patriotism, national boundaries, empires, and continents cease to exist. [illegible] [illegible] the business of testing, [illegible] in comparing the market-place's competing goods.

[illegible] methods of testing throughout the world, to the end that the [illegible]

lative merits of all competing materials of a given kind, from whatever country they may come. The day has passed when the buyer's ignorance, his inability to ascertain for himself the fitness of what is offered him, forced him to rely on the reputation and on the assurances of the manufacturer or exporter. To-day he relies not on the untested assertions of the seller, however creditable, but on his own tests, or on tests made by his own agents. Purchase is no longer a matter of faith but one of knowledge. It is our mission and privilege to carry this substitution of knowledge for faith ever farther and farther.

Turning our attention now in a different direction and asking what our attitude ought to be toward attempts to replace or supplement our present methods of testing with new methods, we find that, though we have good reason to be dissatisfied with out present methods, yet we should be extremely cautious in the industrial adoption of new ones. Let us consider these two aspects briefly.

For every structure there are certain conditions which are more trying to it than all other conditions, certain conditions which it fulfills with the greatest difficulty. Its ability to meet these most trying conditions is the measure of its industrial and commercial fitness, usefulness, and hence value. The fact that I cannot lay my hand with certainty on these conditions does not affect the truth of this proposition. We may not know these conditions to-day, but they are intrinsically discoverable. The supreme danger to the chimney may be the gale. The supreme danger to the rail may be the unduly rapid impact of an ill-balanced driving wheel when the ground is frozen hard, and after the head of the rail itself has been brought from its initial ductility to the vitreous state by the peening of the wheels. The supreme danger to the hull plate may be dynamic stress along the rivet holes in a collision. That which at last breaks down the well aligned factory shaft may be the inevitable slight variations of stress. In each case there are probably two or more supremely trying sets of conditions; but be they few or be they many, be they recognized or be they still undiscovered, there must in the nature of the case be such most trying conditions, the ability to endure which necessarily carries along with it the ability to endure all of the other conditions of use. It is to these most trying conditions that our tests should address themselves.

We assume reasonably that the ability to meet these most trying conditions will be measured most trustworthily by that test which reproduces these same conditions the most closely. For instance, in the many cases in which the most trying stresses are dynamic, it is reasonable to believe that a dynamic test is fitter than a static one. Of course we should not leap to the conclusion that any and every dynamic test is here fitter than any and every static test.

Here, then, is one direction in which most of our tests are very faulty. Their conditions are radically unlike the most trying ones of service. The light which they throw on the fitness of the object for its proposed service is most indirect. In that respect they are unfit tests.

An objection from a wholly different direction lies against most of our tests, the objection that, because they are tests to destruction, they cannot in their nature be applied directly to the object whose fitness they would gage, but instead they must be applied vicariously to small pieces assumed to represent those objects. We do not test the individual [illegible], boiler plate, shaft, bridge post, or [illegible] on whose fitness the lives of our fellows hang, but small pieces cut from them, or for some other reason assumed to represent them. In certain rare cases we do indeed test, not merely a small fragment, but a similar whole structure, a like beam or shaft or post. This is not as bad as measuring the endurance of your recruits by finding what forced march suffices to kill their brothers, but it is open to the same kind of objection, the objection that because it is destructive it must needs be vicarious.

---

*Abstract of address delivered in New York [illegible]

†Acting President International Association for Testing Materials; Professor of Metallurgy, Columbia University, New York City.

But a great range and variety of indestructive tests suggest themselves, tests which leave no more effect on the piece tested than seeing, tasting, or smelling it would. The presence of cavities may be detected through the density: and that of plastic deformation through the potential. Microscopic examination is already well advanced. Magnetic testing has received much attention; and the electrical disintegration is now pointed out as a means of test. The number of physical properties which offer themselves as possible means of testing is very great.

Here we note that Miers and Isaac determine the supersolubility curve of solutions by measuring their index of refraction of light, and that Hönigsberg and Coker study the lines of stress by the behavior of polarized light passed through transparent specimens. What do these things mean? They mean that light, a manifestation of energy, in crossing these bodies undergoes a change; and the nature of that change teaches us concerning properties in those crossed bodies little related to light; or in short the action of the body tested upon a form of energy passed through it or reflected from it may be made to disclose and to gage properties of that body but little related to that form of energy, and with no residual effect on the body itself.

But light is only one of a considerable number of forms of energy which seem open to such use. Sound, electricity, the divers kinds of radiations which only lately disclose themselves to our amazement, and the many yet undreamed ones awaiting discovery, these are forms of energy some of which may be harnessable to a like use.

Let us remember that later our analysis of these subtler manifestations of energy will be even fuller than our present analysis of the coarse radiations of sound. As to-day we know not only the pitch and volume, but the timbre, overtones, and harmonics of sound, so later shall we know corresponding characteristics and phenomena of these other kinds of radiation, so that we seem embarrassed by the riches of the variety of agencies from which the testing engineer of an age less crude than ours may choose.

Here lies the suggestion that we may learn the properties of the very rails and girders which we are to use, and later the properties of assembled structures themselves, such as boilers and bridge posts, and conceivably in the far, far future the assembled hull, by their action and re-action with some form of energy. Who shall say that the pitch or volume or timbre of sound emitted by a rail as the result of a given excitement may not be made to disclose pitilessly its hidden defects and to measure the fitness, not alone of the material of which it is composed, but of the rail as a whole structure? Or giving rein to our fancy we hear the inspector report, "This one-hundred story building indeed responds to G sharp, but its timbre has this abnormality and these harmonics are exaggerated."

These indestructive methods indeed have the defect of being indirect in one respect to weigh against their advantage of being direct in another; they are indirect in that they gage the properties actually needed in service by means of other properties; they are direct in that they may be applied to the very objects to be used, instead of vicariously to coupons or like objects to be destroyed in the test itself.

Their natural service seems to be to supplement the vicarious destructive tests. Thus the tester of the future may prove his material by the vicarious destructive tests of coupons, and prove his structures themselves by these indestructive tests.

Having thus considered the purposes of our society, let us turn to some tangible evidence of the progress made in accomplishing them since our last congress. First, four additional countries are represented in our Council—Japan, China, Canada and Brazil, by Messrs. Saito, Kwong, Hersey and di Paolo—bringing the number of countries represented on the Council up to 25. Second, our membership has increased from 2,160 to 2,680, or by 24%, and now represents 30 countries, and every continent. Adding the members for the present Congress year, our membership becomes about 3,700. Third, in addition to the existing national societies closely affiliated with us in Germany, America, Italy, Austria, and Hungary, two new national societies have arisen in Russia; and in addition to the existing organization of our own members into a racial group in France and Belgium, a like national Swiss group has formed. I appeal to the members of Council from other countries to institute like works. Perhaps by this means better than by any other can they discharge that solemn trust which they accepted in entering the Council.

That we are recognized not as a private club for our own benefit and enlightenment but primarily and essentially as a benevolent institution, successfully aiming to benefit mankind; an institution to which our contributions of time and thought are such as no sordid motive could evoke, is shown by the generous and widespread response to our appeal for aid in this work, and by the action of many governments and important public bodies in appointing representatives on our commissions.

Here it may be mentioned that the volume of papers for this congress is about twice as large as that of any previous congress.

The Council contemplates ways of lessening the impediments to the efficiency of our international committees, due both to the language difficulties and to the usual need of carrying on their deliberations by correspondence instead of face to face.

The immediate purpose before the founders of our society was to perfect and unify the methods of testing; the ultimate purpose was to enable the public to get fit goods. But if I am to learn whether my purchase is fit by testing it, I must know not only how to test it, i.e., how to measure its properties, but also how much of each property it ought to have. Of what use is a process for testing axles by impact or tension unless I know quantitatively what tensile properties they ought to have and what impact they ought to endure? Of what use are methods of testing without reception specifications? One is the necessary complement of the other.

It so happens that, in building a society fitted for the immediate end of improving methods of testing, we have simultaneously fitted it for the indispensible supplement, specification making. In bringing together those competent to improve methods of test we have also brought together those most competent to draw specifications. We have "builded better than we knew." We have unconsciously made an organization fitted for filling both needs of the public, for telling it both what properties, quantitatively, its purchases need and also how to measure those properties.

I am not unmindful of the obstacles and pitfalls in the way of specification making. I understand the gravity of the commercial questions involved. I see that commercial interests may readily be antagonized into the positon of resenting supposed interference. But let us look at obstacles as things primarily to be overcome and pitfalls as things primarily to be bridged, remembering that where there is a will there is a way; that the human beings with commercial interests on other continents do not differ in their innermost nature from the corresponding human beings on this continent; and that if it has proved possible to bring maker and user into harmonious and indeed enthusiastic coöperation here it ought to be possible there.

As men of your sagacity are ever anxious to profit by the experience of others, I commend most earnestly to your attention this opportunity which your American visit offers to profit by the special experience of the American Society for Testing Materials, which stands to you in a relation of filial affection and pride. The natural development of the American Society has happened to be in the direction of specification making. In our opinion, based on our now very considerable experience, this work has proved far more valuable, and of far greater profit to the public, than our simultaneous work of perfecting methods of measurement. Your visit here gives you an opportunity of judging the truth of this opinion, and, in case it shall seem to you true, the further opportunity of profiting by our experience in the methods to be followed and those to be avoided in this special work. Not less strongly do I commend to our American members this opportunity to learn from their foreign colleagues the work which they have found most useful, and the means which they have found most effective.

In closing this address I ask the members of the committee who have labored so zealously and so wisely to organize and carry out this congress and its excursions to rise and receive the thanks which, on behalf of the association, I give them from the bottom of my heart, and I ask their chairmen, Messrs. Clark, Holmes, Humphrey, Hunt, Marburg, Moldenke and Schmitt, and the officers of the subcommittees, Messrs. Chapman, Dunning, Hamburger, Kinkead, Kunz, Miller, Moisseiff, Stoughton and Wight, to express our gratitude to the absent members of their committees. Our warmest thanks are due also to our indefatigable secretaries, General Secretary Reitler and Secretary Porter, for their most zealous and efficient labors.

Ladies and gentlemen, I have sought to impress on you that we are among the guardians of mankind; that our services to humanity are of so high a nature as to stimulate us to seek earnestly how we may make them more effective and wider; that one means is to supplement and in time replace our present methods, which rightly viewed are but temporary expedients, with better ones; but that this replacement, much as it is needed, should be made with extreme caution. Classing the two kinds of testing into the vicarious tests to destruction on the one hand and on the other hand the indestructive tests applied directly to the objects which are to enter into service, I have pointed out that in the future these two classes of tests may well be used to supplement each other; that the vicarious tests should be made to reproduce as closely as possible the most trying conditions of service, and that the indestructive tests, with which we have hardly made even a beginning, hold out very [illegible] I have touched on our competence and our consequent duty to add specification making to our original plan and thereby to increase very greatly our services to our fellows, and through our fellows to our [illegible] Here are tasks which may well be [illegible] of the International Association for Testing Materials.

* * *

STORM AND SURFACE WATER DRAINAGE IN RELATION TO SEWAGE DISPOSAL.

The following is an extract of a paper read by Mr. [illegible] R. Knight, C.E., at the second annual Congress of the Canadian Public Health Association at Toronto.

Storm water, which is the subject [illegible] of the paper, is defined as that portion of the rainfall which finds its way into the sewers. It is described as [illegible] offensive and [illegible], carrying [illegible] of all kinds and street [illegible] and matters flushed out of the sewers. Storm water is to all intents and purposes diluted sewage.

Under the heading Rainfall, it is pointed out that extraordinary storms (those above one inch per hour) need only be considered in making calculations. Averages are not to be considered. A probable maximum rainfall should be decided upon.

The next consideration is that of the characteristics of the drainage areas. Some interesting figures are given, showing the proportions of impervious areas for different classes of property in Toronto. These proportions range from 0.19 to 0.75, and were arrived at in connection with the author's work on the design of the storm overflow sewers of Toronto.

The quantity of storm water from drainage areas receives attention, and an example giving an idea of the immense amount of storm water a heavy rainstorm will produce is given.

In dealing with the characteristics of storm or surface water, the report of the Royal Commission is quoted. The first flush of storm water is conceded to be of such a foul nature that it ought to be purified. As to what is to be considered the first flush, the author suggests that the first three minutes of a storm be so taken. The difficulty of selecting the first flush, due to the time occupied in the passage of the storm water from the surface and along the sewers to the outfall is pointed out. The engineer has, therefore, to provide for the treatment of what he considers would be classified as polluting liquid.

The choice of separate or combined system, with special reference to purification, is next treated with. From the point of view of purification of the storm water the separate system is favored. In this system the storm water, while being a polluting liquid, is not so much in the nature of a diluted sewage. The difficulties of our larger cities are mentioned, the combined systems in vogue hampering the sewage disposal question considerably.

In comparing the two systems in regard to disposal, the combined system is shown to require sedimentation tanks and filters for at least three times the dry weather flow, whereas in the separate system only one and a half times the dry weather flow need be settled and filtered in the sewage works as distinct from the storm water works.

The closing chapter on purification includes an extract from the report of the Royal Commission in support of the argument for the provision of stand-by tanks for storm water. The period of settling for storm water is suggested as from one to two hours, and provision should be made to accommodate all the storm water which would be brought down to the works by the sewers due to a heavy storm during the first three minutes of the storm, allowance being made for the time occupied in the conveyance of the storm water from outlying districts to the works.

Several stand-by tanks, located in suitable positions with respect to the natural drainage of the area, are recommended. All storm water should pass through the tanks; direct currents should be avoided, however, and to meet this the author suggests the provision of long overflow or discharge weirs at the inlet and outlet. Square tanks are also recommended.

After the period of settling is over, the storm water left in the tanks should be passed on to filter beds at a slow rate through sprinklers or other such method.

In conclusion, it is pointed out that the report of the Royal Commission cannot be applied strictly to Canadian needs. In the majority of cases we have to empty our sewage and storm water into rivers or lakes, which have to form our source for supply of drinking water. Not so in England. The aims of the Commission were directed towards the prevention of sludge deposits and nuisance in the rivers and lakes. With the question of pollution as it is presented in Canada, it is time that some steps were taken to prevent this form of contamination of our water supplies, in the manner pointed out by the author, in the provision of stand-by tanks and filters for the first flush due to heavy storms.

A few remarks in reference to the works at present being carried out in Regina and Toronto bring this paper to a close.

◆

QUEBEC RAILWAY, LIGHT, HEAT AND POWER COMPANY

The annual meeting of the Quebec Railway, Light, Heat and Power Company was held on Tuesday, and save for the presentation of the financial report showing the result of the year's operations, the street is but little wiser as to the many points of recent discussion.

It is satisfactory to note that the earnings of the company for the year ending June 30th, 1912, were equal to 2.11% on the common stock, after all charges, save dividends, had been provided for. This meant that had no dividends been paid, the surplus for the year would have amounted to $211,200. Inasmuch, however, as two quarterly dividends of 1% each, making a total of $199,990 were paid during the year, the total surplus brought forward from the year's operations was but $11,210.

This compared with the deficit of $37,381 the previous year. This comparison is a fair one, inasmuch as the dividends paid the previous year were exactly the same as those of the last year. The fixed charges of the past year, however, were $204,000 more than the previous year, while the amount written off to organizing expenses was $7,000 less this year than a year ago.

Those who attended the meeting in the hope that light would be shed upon the situation as respects the relationship between the Quebec Railway and the Quebec and Saguenay were disappointed. A representative of the Paris interests was present and asked certain questions with respect to expenditures on the Quebec and Saguenay which were refused, although Sir Rodolphe added that the affairs of the company would presently be straightened out. The following is a comparison between the profit and loss statements of the past two years:

	1911.	1912.
Gross	$1,280,127	$1,415,825
Operating expenses	661,907	734,925
Net earnings	$ 618,220	$ 680,900
Sundry interest earned	11,109	....
Miscellaneous earnings	....	194,584
Gross income	$ 629,319	$ 875,484
Fixed charges	456,329	660,364
Net income	$ 172,990	$ 215,120
Dividends 2 quarters	199,990	199,990
Org. expense	10,681	3,910
	$ 210,671	$ 203,900
Deficit on 1911 oper.	$ 37,681	....
Surplus on 1912	....	$ 11,211
Brought forward from previous year	100,000	62,328
Total surplus at June 30th	$ 63,319	$ 72,539

The accuracy of the statement was sufficiently vouched for by the auditors and the only criticisms that were heard among the shareholders were as to whether sufficient appropriations for various purposes had been made, and what effect would be on the percentage of surplus to capital, were it necessary to make allowance for depreciation, &c.

The statement of assets and liabilities and of the progress made by the company, in the matter of traffic, was as follows. The point in this which perhaps is of greatest interest is the excess of payments now due, or falling due, over available funds.

Assets.

Investments, stocks, bonds and interests in other corporations	$22,819,192.64	
Less bonds or subsidiary companies outstanding	3,659,000.00	
		$19,160,192.64
Treasury bonds		1,286,100.00
Advanced to controlled companies for construction		865,359.36
General construction		389,952.73
Underlying Securities Redemption Fund		40,169.75
Cash on hand and in banks		254,513.25
Accounts and bills receivable		241,643.01
Stores and supplies on hand		136,739.87
		$22,374,670.61

Liabilities.

Capital stock		$10,000,000.00	
Less unissued		500.00	
			$ 9,999,500.00
Bonds		$14,600,000.00	
Less in escrow to redeem bonds of subsidiary companies	$3,659,000		
Less unissued	220,600		
Less cancelled	114,000		
		$ 3,993,600.00	
			$10,606,400.00
Accounts payable			158,572.62
Sundry loans			1,171,968.01
Accrued interest			148,875.12
Unpaid interest and dividends			189,586.84
Accrued charges			8,154.10
Reserves			18,074.47
Surplus			73,539.45
			$22,374,670.61

Passengers carried in the city division: 1909, 6,859,679 includes tercentenary celebration); 1912, 8,785,995.

Passengers carried on the Montmorency division: 1909, 1,442,327 (including tercentenary celebration); 1912, 1,581,846.

Gross gas output from January, 1905, to September 1, 1912: 1909, 122,000,000 cubic feet 50 cent gas for 6 months; 1910, 98,000,000; 1911, 103,000,000; 1912, 74,000,000 (8 months).

The number of directors were reduced to nine from fifteen and the following were appointed:—Sir Rodolphe Forget, Hon. Senator J. P. B. Casgrain, Hon. Robert MacKay, Messrs. J. N. Greenshields, Lorne C. Webster, Paul Galibert, D. O. Lesperance, L. C. Marcoux and O. B. d'Aoust. Of these, the new names are the last three. The directors whose names are absent are as follows: Hon. C. E. Dubord, A. Haig Sims, W. G. Ross, Maxime Beauvisage, Anthony Thierree, Louis Galliard and Charles Michel.

Sir Rodolphe Forget suggested the appointment of a president who would reside in Quebec, who could give his whole time and attention to the affairs of the company, but he was appointed president at a meeting of the directors held after the shareholders' meeting, and it is thought will continue to occupy the office until other arrangements can be made.

AMERICAN ROAD-BUILDERS' ASSOCIATION CONVENTION.

Highway improvement, one of the most vital questions before the United States, will engage the attention of the foremost public officials and expert road builders in the country during the four days of the ninth annual convention of the American Road Builders' Association, at Music Hall, Cincinnati, Ohio, December 3 to 6. Those in charge of the arrangements have been busy with the plans for the meeting, and the exhibition of road building materials and machinery to be held in conjunction with the convention, for several months, and although there yet remains nearly three months before the first session will be opened, the number of official delegates already appointed and the amount of space taken by exhibitors make it beyond question that the convention will be not only the principal event of the year in road building circles, as it has been each year for nearly a decade, but will also surpass all previous meetings of the association.

Governor Judson Harmon, of Ohio, has evinced his interest and his sympathy with the efforts of the American Road Builders' Association to the extent of addressing letters to the governors of all of the other States, strongly endorsing the purposes for which the meeting has been called and requesting the appointment of official delegates. Although this letter was sent out only a short time ago, and although some of the chief executives to whom the letter was addressed were absent from their States, delegates have been appointed by Governor O'Neal, of Alabama; Governor Deneen, of Illinois; Governor Oddie, of Nevada; Governor McDonald, of New Mexico; Governor Burke, of North Dakota; Governor Colquitt, of Texas, and Governor Mann, of Virginia. Governor Brown, of Georgia, has signified his intention of complying with the request, and Governor Foss, of Massachusetts, Governor Cruse, of Oklahoma, and Governor Aldrich, of Nebraska, have taken steps to name delegates.

The American Road Builders' Association has held conventions of constantly increasing size and importance during the past nine years, and is composed chiefly of state, county, town and city officials; engineers engaged either as public officers or in private practice in the construction and maintenance of roads and streets; road and street contractors; consulting engineers and chemists, and others to whom the building and up-keep of country roads and city streets is of direct and vital interest. It is the only national organization of the United States which limits its annual convention to the consideration of the administrative and technical phases of road and street construction, and it numbers in [illegible] known among road builders and highway officials.

Although the formal sessions of the convention are limited to the consideration of the particular questions in which its members are interested, there is always much of popular interest at its meetings. This is especially true of [illegible] which are held in conjunction with the convention. This plan was inaugurated by the association at its sixth annual [illegible] r will include not only all the features [illegible] departure from the usual plan has been contemplated by the association since its 1911 convention, and the manner in which the States and cities have taken hold of the matter gives promise of a most interesting display. The commercial exhibits, as in former years, will include displays by the leading manufacturers of road machinery, manufacturers of and dealers in various materials, including oils, asphalts, tars, cements, etc., paving companies and others.

The meetings and the exhibits will all be held in Music Hall, which is conveniently situated, and provides ample accommodations. The city officials and citizens of Cincinnati, as well as the State officials of Ohio, are co-operating with the American Road Builders' Association and putting forth every effort to make the 1912 convention the most successful ever held.

Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York city, is the president of the American Road Builders' Association; Harold Parker, ex-chairman of the Massachusetts State Highway Commission, first vice-president; W. W. Crosby, consulting engineer of the Maryland State Highway Commission, treasurer, and E. L. Powers, editor of "Good Roads," secretary.

THE CANADIAN FORESTRY ASSOCIATION CONVENTION.

The Canadian Forestry Association held their annual convention in Victoria, B.C., September 4th to 6th, with Mr. John Hendry, of Vancouver, the president, in the chair.

In the course of his presidential address Mr. Hendry said:

"To keep 'fake' settlers out of areas suited principally for timber requires, first, a knowledge of the country, which will show where such areas are, and the power in the various governments to resist political pressure brought to bear upon them to allow pretended settlers to locate on what is chiefly valuable as timber land. Surveys should, therefore, be made as rapidly as possible to ascertain the areas of absolutely forest land, and the whole forest staff should be free from any partisan influence, so that it will not be silent when measures antagonistic to the good of the forest are proposed, or when parties endeavor wrongfully to enter upon forest lands. To obtain the best results, the forest service should be placed under civil service regulations, whereby appointments, promotions and dismissals will be made solely upon merit. It is gratifying to know that British Columbia is taking a forward stand in these matters and that a forest service is now being organized which bids fair to be the finest in the Dominion. This means the expenditure of a large amount of money, but, so long as the service carries out the idea of protecting our forests, with an eye single to the public interest, I am sure the government will be sustained by the people in this work."

The Minister of Lands, Hon. W. R. Ross, gave a paper on "The [illegible] of the Forest Wealth of British Columbia." Sir Richard McBride, the Premier, he said, had made it plain that this province, so far as the others are concerned, proposes to take the lead in matters affecting the modern policy of conservation of forests. It was particularly fitting that the present convention should be held in Victoria, as it gave British Columbia an opportunity to give firsthand notice to its friends from other provinces that [illegible] expect that for the latest word in forestry conservation all must come here.

Mr. Ross in his paper, traced briefly but concisely what has been done in British Columbia for the protection of the [illegible] and explained fully the composition and working of the [illegible] of his department, starting his review from the appointment of the forestry commission, the work of which he praised highly.

The resolutions committee named by the president is composed of Hon. W. R. Ross, Mr. R. H. Campbell, Dominion forester; Dr. Fernow, dean of the School of Forestry, of Toronto University; Mr. Aubrey White, Deputy Minister of Lands, Forests and Mines of Ontario; Mr. Wm. McNeill, Vancouver, and Mr. A. C. Flumerfelt, Victoria.

Resolutions were adopted without discussion congratulating the Government of British Columbia upon the excellent beginning it had made in forest conservation, endorsing a suggestion made by the British Columbia Lumber and Shingle Manufacturers' Association that a course in logging engineering should be established at the University of British Columbia; reiterating its former pronouncement that all appointments in the forest services of the Dominion and provinces should be based on ability and experience; that squatting or settlement should not be allowed on lands that are chiefly valuable for timber; that the fire acts of the three prairie provinces be revised so as to provide more efficiently for the prevention of fire; urging upon the Dominion and Provincial Governments the advisability of adopting measures as soon as practicable of disposing of logging debris; recognizing the work of the United States foresters and hoping for increasing co-operation between the two countries; besides the usual formal resolutions of thanks to Lieutenant-Governor Paterson, Sir Richard McBride and colleagues and others who have shown the visitors and members courtesies.

The fact was referred to several times that practically all the young men now engaged as trained foresters in Canada have been pupils of Dr. Fernow, dean of the School of Forestry in the University of Toronto.

A MUNICIPAL OPERA HOUSE.

A municipal opera house at San Francisco, California, is projected. The building will be erected from private funds raised by the Musical Association of San Francisco. The estimated cost is $650,000. The building will stand on land owned by the city and would form a part of the new civic centre, becoming the property of the city after its completion. The management of the building, it is stated, would be vested in 15 trustees, to be chosen by the city of San Francisco, the Musical Association, the University of California and Stanford University. It is stated that between $400,000 and $500,000 toward the cost of the building has already been pledged.

CANADIAN SOCIETY OF CIVIL ENGINEERS' (TORONTO BRANCH) EXCURSION.

The following arrangements have been made for the excursion of the Toronto branch of the Canadian Society of Civil Engineers:

Leaving Toronto on Friday, September 20th, at 5 p.m., in a special car on the regular train of the Canadian Pacific Railway, the party will arrive in Bobcaygeon about 8 p.m., where supper, sleeping accommodation and breakfast the next morning will be arranged for.

Early Saturday morning, by the courtesy of Mr. Jos. H. McClellan, superintendent of the Trent Canal, the party will proceed by boat up the Trent Canal to Lake Simcoe. On the way, some time will be spent examining the Kirkfield lift lock. Lunch will most likely be had at Beaverton.

The return journey will be made either by the Canadian Northern Railway from Beaverton of by the Toronto and York Radial from Jackson's Point.

PERSONAL.

MR. J. L. WOOD, formerly of Peterborough, and MR. GEORGE SERVICE, construction engineer, of Toronto, have entered into partnership in the city of Toronto as construction engineers.

MR. W. H. BELL, of the well-known English engineering firm, Sir W. G. Armstrong Whitworth & Company, Limited, is in Toronto for a few days conferring with the management of the Canadian British Engineering Company, Limited, who have been appointed Canadian agents for his firm.

MR. WALTER B. SNOW, publicity engineer, 170 Summer Street, Boston, Mass., has added to his staff Mr. Chester R. Ross, who will act as manager of the addressing and mailing department. Mr. Ross brings to this position an extended experience covering three years with the Griffin Wheel Company, four years with the Boston Transcript, and a considerable period as salesman in various lines of industry.

MR. ALMAN HARE, president and managing director of the Hare Engineering Company, Limited, 14-16 King Street East, Toronto, is arranging to begin immediate construction on their new works at Galt, Ontario. Mr. Hare has just returned from England where he has been for the last three months arranging for the financing of the company. The English syndicate have underwritten the unissued preference shares of the company amounting to $150,000, so that immediate construction of the work will be begun. The property at Galt is about six acres in extent and the company will manufacture power plant equipment and special machinery. Sir Ernest Shackleton, C.V.O. "late of the South Pole," has been elected as chairman of the London board and Mr. A. Cairn-Hodge, M.I.C.E., F.R.G.S., has also been placed on the board.

MR. ROBERT F. PACK, formerly general manager of the Toronto Electric Company, Toronto, Canada, has been appointed general manager of the Minneapolis General Electric Company. He assumed office Tuesday, September 10th. Since the resignation of Mr. A. W. Leonard early in August, the position has been temporarily filled by Mr. Samuel Kahn, who will resume his duties in the operating department of H. M. Byllesby & Company. General George H. Harries, vice-president of the Consumers Power Company, will continue to act in the supervisory capacity over all the properties of this corporation, Mr. Pack being in direct charge of the Minneapolis property. Mr. Pack was born in England in 1874. He was educated for the British navy, but came with his parents to Canada at an early age. Twenty-one years ago he entered the service of the Toronto Electric Light Company as an office boy. At that time the lighting supplied in Toronto consisted of open series arc lamps. Mr. Pack advanced steadily through the positions of accountant, comptroller, secretary and finally general manager of one of the largest of the Canadian electric companies, serving a population of about 450,000. He is ranked among the most progressive of utility managers. Mr. Pack is president of the Canadian Electrical Association and as such is also a member of the executive committee of the National Electric Light Association and has also served upon various committees. He is also a member of the American Institute of Electrical Engineers, and a member of the following clubs: Engineers' Club, of New York; Engineers' Club, of Toronto; Royal Canadian Yacht Club, Arts and Letters Club, and Albany Club, all of Toronto. He was a member of the Publicity Committee of the Toronto Board of Trade.

LESLIE R. THOMSON, B.A., Sc., lecturer in civil engineering at the University of Manitoba, has resigned to accept a position with the Dominion Bridge Company, at Montreal.

MR. W. T. BATHO, managing director of the Consolidated Diesel Engine Manufacturers, Limited, England, called at *The Canadian Engineer* office this week. Mr. Batho expects to go to the coast before returning to the Old Country.

COMING MEETINGS.

AMERICAN ROAD CONGRESS.—First Annual Session to be held in Atlantic City, N.J., at the Million Dollar Pier, September 30th to October 5th, 1912. Secretary, J. E. Pennybocker, Colorado Bldg., Washington, D.C.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE CANADIAN HIGHWAY ASSOCIATION.—Meeting will be held in Winnipeg, Man., October 9th to 12th. Secretary, P. W. Luce, Room 4, Cunningham Block, New Westminster, B.C.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the [illegible]

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

[illegible] BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack. Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, [illegible]

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon [illegible]

THE [illegible] OF CANADIAN MUNICIPALITIES.—President, [illegible] W. D. Lighthall, K.C. [illegible]

THE [illegible] OF NEW BRUNSWICK MUNICIPALITIES.—President, [illegible] J. W. McCready, City [illegible]

[illegible] MUNICIPALITIES.—President, Mr. A. S. [illegible] Secretary, A. Roberts, Bridgewater, N.S.

[illegible] MUNICIPALITIES.—President, Mayor [illegible] Moose Jaw [illegible]

[illegible] MUNICIPALITIES.—President, Mayor [illegible] Mr. H. Bose, Surrey [illegible]

[illegible] MUNICIPALITIES.—President, Mayor Mitchell, [illegible] Alta.

[illegible] MUNICIPALITIES.—President, Reeve Forke, [illegible] Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President E. T Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE. Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5 Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Bassano, Alta., waterworks and sewers	Sept. 30.	Sept. 5.	80
Brandon, Man., two tubular boilers and stokers	Sept. 27.	Sept. 5.	67
Bell Ewart, Ont., wharf and stone approach	Sept. 17.	Aug. 29.	68
Big Bay Point, Ont., wharf with stone approach	Sept. 17.	Aug. 28.	68
Brockville, Ont., wharf	Oct. 2.	Sept. 12.	67
Cobourg, Ont., hospital	Sept. 20	Sept. 12.	67
Dauphin, Man., superstructures of four bridges		Aug. 22.	80
Dewdrop, Sask., schoolhouse and barn	Sept. 21.	Aug. 29.	67
Franklyn Point, P.E.I., wharf	Oct. 8.	Sept. 12.	67
Guelph, Ont., Field Husbandry Building	Sept. 23.	Sept. 12.	67
Lindsay, Ont., drill hall	Sept. 18.	Sept. 12.	67
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
Oshawa, Ont., drill hall	Sept. 17.	Sept. 5.	82
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., iron posts	Sept. 25.	Aug. 22.	78
Owen Sound, Ont., retaining wall	Sept. 28.	Aug. 29.	68
Port Colborne, Ont., elevator	Sept. 20.	Sept. 5.	78
Powell River, B.C., schoolhouse	Sept. 18.	Sept. 12.	67
Toronto, Ont., sale of Normal School property	Sept. 30.	Aug. 15.	68
Timiskaming, Ont., purchase of plant	Sept. 19.	Aug. 29.	68
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78

TENDERS.

Fairhaven, N.B.—Tenders for the construction of a pierhead to the public wharf at Fairhaven, Deer Island, Charlotte County, N.B., will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 8th, 1912. Plans, etc., can be obtained at this department, and at the offices of F. G. Goodspeed, Esq., district engineer, St. John, N.B.; Geoffrey Stead, Esq., district engineer, Chatham, N.B., and on application to the postmaster at Fairhaven, N.B.

Fernie, B.C.—Tenders addressed to the director of contracts, Department of Militia and Defence, Ottawa, will be received until noon of Sept. 21st, 1912, for the construction of a new drill hall at Fernie, B.C. Specifications may be seen and full particulars obtained at the office of the district officer commanding military district No. 11, Victoria, B.C., the office of the town clerk, Fernie, B.C., officer commanding "A" Company, Kootenay Rifles, Fernie, B.C., and the director of engineer services, headquarters, Ottawa.

Holberg, B.C.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until Sept. 30, 1912, for the construction of a pile wharf and pile bent approach at Holberg district of Comox-Atlin, B.C. Plans, specifications and form of contract can be seen and forms of tender obtained at this department and at the offices of C. C. Worsfold, Esq., district engineer, New Westminster, B.C., and on application to the postmaster at Holberg, B.C.

Goderich, Ont.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until October 10, 1912, for the construction of part of the river breakwater at Goderich, Ont. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of H. J. Lamb, Esq., district engineer, Windsor, Ont.; J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto, Ont.; and on application to the postmaster at Goderich, Ont.

Kirkfield Park, Man.—Tenders for the construction of a sewer on Silver Street and Thompson Drive to the Assiniboine River in D.G.S. 12, St. James, will be received until Sept. 21st, 1912. Plans and specifications may be seen at the office of the engineer of the municipality, Municipal Hall, Kirkfield Park P.O., Man.

Lanoraie, P.Q.—Tenders for the partial reconstruction and extension to wharf at Lanoraie, Berthier County, P.Q., will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 10, 1912. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal, P.Q., and on application to the postmaster at Lanoraie, P.Q.

Massett, B.C.—Tenders sent to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until October 15, 1912, for the construction of a pile wharf at Massett (white settlement), Queen Charlotte Island, Comox, Atlin district, B.C. Plans, specifications, etc., at the department and at the offices of G. B. Hull, Esq., district engineer, Prince Rupert, B.C.; C. C. Worsfold, Esq., district engineer, New Westminster, B.C., and on application to the postmaster at Massett, B.C.

New Westminster, B.C.—Tenders will be received by A. O. Powell, harbor engineer, Room 22, 26 Lorne Street, New Westminster, until noon of October 8, 1912, for a ladder dredge having a capacity of 250 cubic yards per hour and excavating to a depth of 25 feet. (See advt. in Canadian Engineer.)

Niagara Falls, Ont.—Tenders are invited for the construction of approximately 2,930 square yards of vitrified brick pavement, with concrete curbs, on Jepson Street from Victoria Avenue to Fourth Avenue. Specifications may be seen and forms of tender obtained at the office of J. C. Gardner, city engineer. Tenders to be received by the city clerk up to noon on September 21, 1912.

Niagara Falls, Ont. — Sealed proposals addressed to Blanche Carr, secretary, Board of Water Commissioners, Niagara Falls, will be received until October 1st, for the installation of new centrifugal pump. Specifications furnished on application at water works office. (See advt. in Canadian Engineer.)

North Battleford, Sask.—Tenders will be received by the secretary of the North Battleford High School Board until noon of Sept. 19, 1912, for the erection and installation of a plumbing, heating and ventilating system to be installed in the North Battleford Collegiate. Plans and specifications can be seen at the office of the architect, and at North Battleford. Hugh Maher, North Battleford, Sask.; David Webster, Kempthorne Block, Saskatoon, Sask.

Penticton, B.C.—Tenders will be received until Sept. 25th, 1912, for the erection of a concrete power station, about 35 ft. square, including the furnishing of materials as specified. Plans and specifications may be seen at the office of F. H. Latimer, municipal engineer, Penticton; at the office of Mather, Yuill & Co., consulting electrical engineers, 429 Pender Street, Vancouver, B.C., or at the Municipal Offices, Penticton, to whom tenders should be sent.

Quebec, Que.—Tenders addressed to Raoul Renault, secretary-treasurer, will be received at the Quebec Harbor Commissioners' office up to noon of October 21st, 1912, for the construction and delivery in complete order of a 1,000,000 bushel capacity grain elevator, with marine tower and shipping apparatus. Full particulars of the requirements for the elevator, etc., may be obtained by applying to the harbor engineer's office, Quebec. (See advt. in Canadian En[illegible]

Seaforth, N.S.—Tenders will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 7th, 1912, for the construction of a breakwater at Seaforth, Halifax Co., N.S. Plans, specifications and form of contract can be seen and forms of tender obtained at this department and at the offices of H. A. Russell, Esq., district engineer, Halifax, N.S.; E. G. Millidge, Esq., district engineer, Antigonish, N.S., and on application to the postmaster at Seaforth, N.S.

Saltcoats, Sask.—Tenders sent to D. C. McNab, Deputy Minister, Department of Railways, Telegraphs and Telephones, Province of Saskatchewan, will be received until Sept. 19, 1912, for the erection of a one story brick veneer telephone exchange building in Saltcoats. Plans, specifications, and all information may be obtained on application to Mr. D. C. McNab, or to Ernest Brown, architect, 108 Donahue Block, Regina.

Shutty Bench, B.C.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until September 30th, 1912, for the construction of a pile bent and timber decking wharf at Shutty Bench, district of Kootenay, B.C. Plans, specifications and form of contract can be seen and forms of tender obtained at this department and at the offices of F. W. Aylmer, Esq., district engineer, Chase, B.C.; C. C. Worsfold, Esq., district engineer, New Westminster, B.C.; and on application to the postmaster at Kaslo, B.C.

St. Pierre les Becquets, P.Q.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until October 15th, 1912, for the construction of a wharf and approach, and dredging of berth for headblock at St. Pierre les Becquets, county of Nicolet, P.Q. Plans, specifications, etc., can be obtained at this department and at the offices of A. G. Sabourin, Esq., district engineer, Sherbrooke, P.Q.; A. R. Decary, Esq., district engineer, post office building, Quebec; F. X. Berlinquet, Esq., district engineer, Three Rivers, P.Q.; J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal, P.Q., and on application to the postmaster at St. Pierre les Becquets, P.Q.

Toronto, Ont.—Tenders will be received addressed to the Chairman of the Board of Control, City Hall, Toronto, [illegible] for the construction of the following works:

Asphalt pavements on St. Clair Avenue, Bathurst (east [illegible]

Brick block, St. Clair Avenue, Hendrick Avenue (west [illegible]

[illegible] ed at the office of the Commissioner of Works, Toronto. G. [illegible]

Welland, Ont. [illegible]

Winnipeg, Man. [illegible]

Winnipeg, Man. [illegible]

Willow Point, B.C.—Tenders for the construction of a pile bent and timber decking wharf at Willow Point, district of Kootenay, B.C., will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 11, 1912. Plans, etc, at this department and at the offices of F. W. Aylmer, district engineer, Chase, B.C.; C. C. Worsfold, Esq., district engineer, New Westminster, B.C., and on application to the postmaster at Willow Point, B.C.

Winnipeg, Man.—Tenders for supplying the number of single adjustable school desks required by the Winnipeg Public School Board for two years from date of contract, will be received until October 3, 1912. Specifications, etc., may be had on application to J. B. Mitchell, Commissioner of Supplies, School Board Office. R. H. Smith, secretary-treasurer, W.P.S.B.

◆

CONTRACTS AWARDED.

Craik, Sask.—The contract for the erection of a town hall was awarded to Messrs. Jas. Bruce and Son, of Lumsden, Sask., for $17,635. No tenders were accepted for the skating and curling rink.

Fort William, Ont.—The Canada Iron Corporation, of Fort William, have the contract for the supply and delivery of a quantity of cast iron and lapwelded steel pipe. John Wilson, city engineer.

Moncton, N.B.—At a meeting of the Water and Light Committee it was decided to award the contract for laying the city water pipes to Messrs. Docity T. LeBlanc and Fred Bourgeois.

Montreal, Que.—Messrs. Munderloh and Co., Ltd., have obtained a large contract for supplying steel pipe, in sizes varying from 8" to 20", for Medicine Hat. Mr. R. S. Lea is consulting engineer.

Montreal, Que.—The following contracts have been awarded: Three city trucks, one at $3,500, two at $3,200, supplied by Messrs. W. E. Seagrave and Co., of Walkerville, Ont.; fire engine, $5,800, by the Waterous Engine Co., 72 Queen St. W., Toronto.

New Westminster, B.C.—Contract has been let for the foundations for the new double track bridge for the Canadian Pacific Railway over Pitt River to the Foundation Company of New York, the contract price being half a million dollars.

Toronto, Ont.—The Property Committee of the Board of Education have awarded contracts as follows:

Western Avenue School—Masonry, $9,877, James Wickett; carpenter work, $8,100, Croker and Le Drew; plastering, $1,448, George White; painting, $650, F. Palmer and Company; roof and sheet metal work, $580.25, J. T. Flowers; porous terra cotta work, $1,377, Robert Bennett.

Vancouver, B.C.—The contract for the new home for the Vancouver Club was awarded by Architects Sharp and Thompson to the Norton Griffith Steel Construction Company, who secured the job on a percentage basis. The new building will cost $250,000 when completed, and that will be only half of what the entire building will cost. Another new wing is to be erected uniform with the one that is now under construction.

◆

RAILWAYS—STEAM AND ELECTRIC.

Halifax, N.S.—A marked falling off in the receipts of the Halifax Electric Tramways Company, Ltd., for the week ending Sept. [illegible], as compared with the corresponding period of last year. The figures are as follows:

1912	1911	Decrease
[illegible]	[illegible]	[illegible]

Leaside Junction, Ont. It is reported that the Canadian Northern Railway officials will order construction work started [illegible] during the next few weeks.

London, Ont. The municipal council have practically abandoned the scheme calling for the electrification of the London and Port Stanley Railroad. Several offers to lease the line have been received.

Dolarway Pavement

"It is permanent because it is concrete."

SOLVES THE CONCRETE PAVEMENT PROBLEM

UNTIL the advent of Dolarway, the success of concrete pavements was questioned. They were perfect in theory but did not work out in practice.

A few years ago Dolarway Pavements were laid in Ann Arbor, Michigan, and the problem of satisfactory concrete pavements was solved. The solution was as simple as it is satisfactory.

Over the concrete was spread a thin layer of Dolarway bitumen. This made the ideal plastic surface, without which concrete pavements had been a failure. The surface is not only inexpensive but its renewal costs very much less than the maintenance costs of any other form of pavement.

This thin sheet of Dolarway bitumen has proven ample to protect the concrete from fracture by traffic or damage by water or frosts. In fact, as long as the bitumen is maintained the concrete shows no wear or deterioration.

The total cost of a Dolarway Pavement varies from $1.00 to a little over that sum per yard.

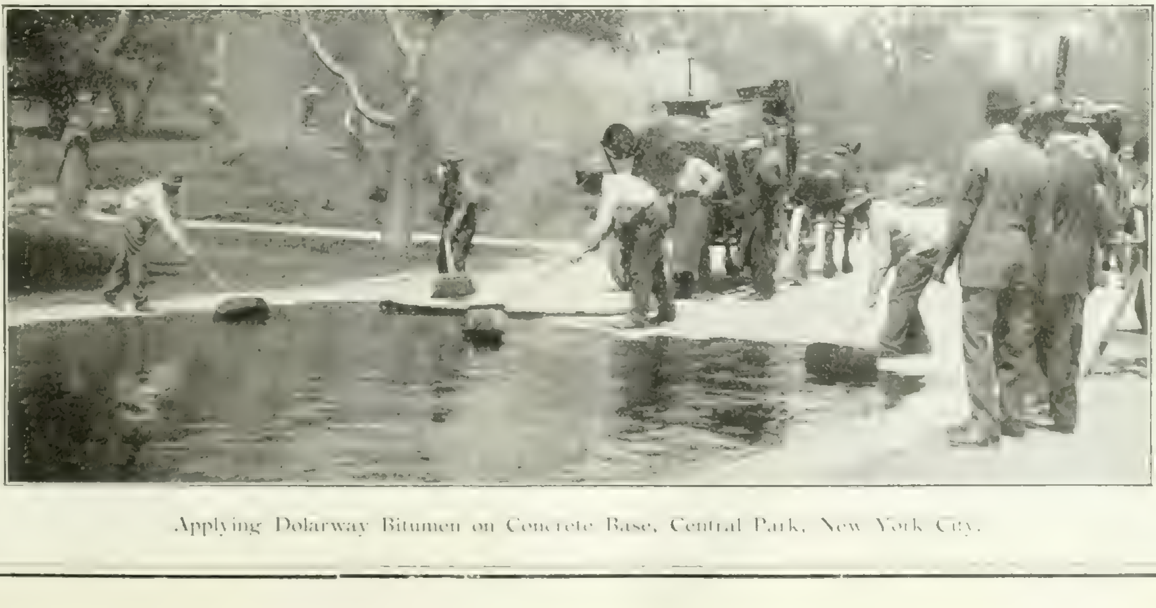
The pavement presents a handsome surface; it is quiet under traffic; no dust or mud is produced; no damage by oil drippings or thrusts of automobile wheels. It makes a most satisfactory cushion for horses which is one of the great objections to ordinary concrete pavements.

Dolarway is good enough for city streets and cheap enough for country roads.

Further details on request

DOLARWAY PAVING COMPANY

95 LIBERTY STREET, NEW YORK CITY



Applying Dolarway Bitumen on Concrete Base, Central Park, New York City.

Montreal, P.Q. — The management of the Montreal Tramways Company have recently purchased several right of ways and are planning to extend their lines in the near future.

Province of British Columbia.—Mr. Geo. A. Smith, P. L.S., of Alberni, B.C., has been awarded a contract by the Canadian Northern Railway for the survey work on the right of way of a new line to be constructed from Alberni to Cowichan Lake.

Vancouver, B.C.—The engineers of the Great Northern Railway overcame the difficulties caused by the tracks sinking in a bog as follows: The portion of the old track which sunk three feet under water in the bog was utilized as the foundation for a heavy mattress of timber held in place by piles. New rails were laid on this massive timber mattress and the rebuilt track ballasted after a row of piles had been driven to hold the ballasting material.

LIGHT, HEAT AND POWER

Elmira, Ont.—The Board of Trade of this municipality desire to obtain power from the Hydro-Electric Commissioners. If this is furnished it will be necessary to construct a transmission line for a distance of ten miles and there is a movement being made toward interesting the ratepayers of St. Jacobs in order that a transformer might be introduced at this point in the line.

Hagerville, Ont.—The ratepayers recently endorsed a by-law for the installation of power from the Hydro-Electric Commission into the town.

Latchford, Ont.—Mr. J. H. Black, chief engineer of the Northern Power Company, is in charge of a scheme to dam the Montreal River for the Ontario Government. This is the sixth attempt to successfully complete this work but the first under the superintendence of Mr. Black.

Ottawa, Ont.—The Hydro-Electric Commissioners will offer $2,000 for the price of expropriation of the Chats Falls property.

Shawinigan Falls, Ont.—A water turbine in No. 1 Station of the Shawinigan Water and Power Company's plant burst and flooded the building to a depth of ten feet.

Vancouver, B.C.—The ratepayers of Fourth Avenue have presented a petition to the municipal council in order that lighting standards may be placed in position along this street.

Winnipeg, Man.—The ratepayers endorsed a by-law giving the council power to spend $750,000 on an electric distribution system.

GARBAGE, SEWAGE AND WATER.

Bowmanville, Ont.—The council of this municipality [illegible] by-law to provide [illegible] to be paid [illegible] and sewage disposal works. John Lyle, Town Clerk.

Dunnville, Ont.—The Board of Water Commissioners [illegible] from the city of Berlin. These [illegible] of the Hydro [illegible] The well [illegible] the pump house in Dunnville.

Orillia, Ont.—[illegible]

Water [illegible]	$ [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	$ [illegible]
The [illegible]	
[illegible]	$ [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	$ [illegible]
[illegible]	[illegible]
	$ [illegible]

Preston, Ont.—The council are considering the matter of laying a new sewer at a cost of $13,000. The bill calling for the construction of this work has received a reading. Mr. Homuth is the mayor of this town.

Sarnia, Ont.—The town council have asked the ratepayers to endorse a $240,000 bond issue to be expended in an attempt to secure a satisfactory water supply from Point Edward. James Turner, engineer of water works.

Winnipeg, Man.—The ratepayers voted against the Poplar Springs water scheme. This called for an expenditure of $1,800,000.

BUILDINGS AND INDUSTRIAL WORKS.

Coquitlam, B.C.—Work has commenced on the construction of a shipbuilding plant. Vessels of from 300 to 800 tons displacement are to be constructed at first, but officials of the company hope to construct larger ships in the near future.

Coquitlam, B.C.—The management of the Call Switch Company will erect a $20,000 building at this point.

Fort William, Ont.—The executive committee of the "Order of Lions" are making arrangements for the erection of a club house in this city. The cost of this work is estimated at $50,000. Mr. C. E. Chapple is president of the Order in Fort William.

Guelph, Ont.—Tenders are to be called in a few days for the erection of a malleable iron works in this city. The plans include six buildings of brick and concrete.

Moose Jaw, Sask.—The municipal council have decided to spend the sum of $10,000 on the installation of a modern fire signal system.

New Liskeard, Ont.—It is probable that the management of the Wahi Iron Works will commence the erection of a factory in this city in the near future. Mr. McEwen, manager.

Oshawa, Ont.—The management of the McLaughlin Carriage Company have taken out a permit which will allow them to enlarge their plant. The addition will be two stories high 250′ x 60′.

Owen Sound, Ont.—The ratepayers of this town voted in favor of granting a loan of $60,000 to Hugo H. Gutenkunst, of Milwaukee, U.S.A., who proposes to establish a malleable iron works at this point. The new concern is to have a capacity of 25,000 tons for a start.

Port Arthur, Ont.—The Italian Catholics will erect a church on corner of Banning and Dufferin Street. Estimated cost, $20,000. R. Halton, architect.

The Roman Catholic Separate School intends erecting a ward school on John Street, between Banning and Ontario. R. Halton, architect.

Victoria, B.C.—The engineering department of this city will have erected a new garbage wharf at a cost of $10,000.

Watrous, Sask.—Mr. W. Helgeson, representing the Perfection Fanning Mill Company, has opened negotiations with the town council regarding the erection of a factory at this point.

West Vancouver, B.C.—The council propose to erect a deep-sea ferry wharf at a cost of $[illegible],000, and will seek the opinion of the ratepayers in this matter.

Welland, Ont.—The management of the Canadian Steel Foundries Company will enlarge their plant during the next few months. The plans include a new building and a large extension in addition to considerable equipment.

Winnipeg, Man.—The ratepayers voted in favor of a public [illegible] being erected at a cost of $50,000. Col. [illegible] H. Ruttan, City Engineer.

BRIDGES, ROADS AND PAVEMENTS.

New Westminster, B.C.—The C.P.R. has submitted for the approval of the Department of Public Works, through Mr. C. C. Worsfold, the Dominion resident engineer, plans for a new bridge across the Pitt River to replace the big single track bridge now in operation. The plans have been forwarded to Ottawa and as soon as approved the work of construction will proceed.

Volume 23. Toronto. Sept. 26, 1912

Contents of this issue on page 517

The Canadian Engineer

An Engineering Weekly

REFUSE DISPOSAL PLANTS

Prior to preparing the report on the disposal of the refuse of Newark, N.J., the engineers who prepared that report—J. C. Hallock, deputy chief engineer of the Department of Public Works, and F. O. Runyon, consulting engineer—made personal inspection of ten disposal plants of various types in order to determine their merits from an economic and sanitary standpoint. The plants visited were those at Minneapolis, Minn., Milwaukee, Wis., Chicago, Ill., Columbus, O., Cleveland, O., Buffalo, N.Y., Rochester, N.Y., Westmount, Can., Richmond Borough, New York, City, and Scranton, Pa. The conditions found at these several cities were described in the report, which descriptions as abstracted by the Municipal Journal of New York are given below.

Minneapolis Incinerator.—Minneapolis has especially attracted the attention of sanitarians because of the fact that Commissioner of Health Dr. P. M. Hall has trained the householders to drain the garbage and wrap it in paper before depositing it in the can. The special virtue of this method of handling garbage by the householder lies in the reduction of the fly nuisance, a cleaner garbage can and the insurance of a good proportion of combustible matter, in the form of paper, for the incinerating plant. The latter point is a detriment rather than a benefit where the destructor type of plant is in use, as it prevents a proper mixture of rubbish and ashes with the garbage for the better distribution of moisture throughout the mass.

During the month of January, 1912, the city collection department composed of one inspector and 31 drivers gathered 841 loads of garbage and 2,298 loads of ashes. The capacity of the garbage wagons is 100 cubic feet each with a "struck" load, but in practice the wagons are heaped so that their actual capacity is at least 33 per cent. in excess of this figure, or approximately 5 cubic yards. The ash wagon is the common type of bottom dump wagon of about 3½ cubic yards capacity.

All wagons are supplied by the city and each driver is paid $100 per month for his services and that of his team. Each driver is assigned a district and held strictly accountable for the removal of ashes and garbage therein and is not required to work according to a schedule of hours per day. His duties consist in the maintaining of a clean district and not in the rendering of a given number of hours' work per day. He is, however, required to make at least one collection of mixed ashes and rubbish and one of garbage from each household in his district each week.

The garbage is collected in metal bodies mounted on wheels or runners according to the season and is delivered at a transfer station about one mile from the centre of the business district, which is also the approximate centre of population. The mixed ashes and rubbish are carted to the low lying spots of the city, whether these be streets or vacant lots. The commissioner of health believes that within a few years there will be no more available dumping grounds within the city and that when this time is reached some other method of ash and rubbish disposal must be found.

The city ordinance authorizing and directing the commissioner of health to collect and dispose of garbage throughout the city and to take charge of and operate the city's crematory says in part "that the commissioner of health, in his discretion, may require the owners and proprietors of hotels, boarding houses, restaurants, commission houses, stores and markets, at their own expense, to collect and remove their own garbage and waste material and to convey the same to said garbage crematory or dispose of the same in such manner as shall be approved by the commissioner of health."

As having a bearing upon the method of collection and disposal of garbage in Minneapolis it might be noted that even here, where the householders more generally conform to the requirements for a complete separation of garbage from ashes and under the supervision of a highly efficient commissioner of health, our inspection of their largest dump disclosed a large flock of starlings feeding on all too evident garbage, proving conclusively that a perfect separation of these two classes of refuse is still to be realized.

The transfer station is on a siding of the Sault Ste Marie Railroad, where the metal bodies of the garbage vehicles are loaded by a traveling crane onto flat cars, twelve bodies to the car, with total average weight of 36 tons per car. From the transfer station the cars are taken to the incinerating plant, which is located about four miles from the centre of the business district of the city. At the plant a traveling crane picks up one body at a time and conveys same into the building, where a special motor on a crane tilts the body, discharging the contents into a hopper opening directly over an incinerator of the Decarie type. This plant was erected by the city about twelve years ago, before the organization of the Decarie Incinerator Company, but following the original designs of the inventor with modifications developed by the present commissioner of health. This type of plant is one in which the garbage is burned on an upper grate over a grate upon which coal is used in starting and at other times as may be necessary, the garbage gradually falling upon the lower grate and being there consumed.

In this plant the gases from the furnace pass over into what is commonly termed a Dutch oven, in which coal is continually burned and the function of which is to raise the temperature of the furnace gases, destroy germ life and remove noxious vapors. From this oven the gases are made to pass through a vertical fire tube boiler and thence through an induced draft equipment to the stack. The steam generated in this boiler is used for supplying a 50 kw. direct current lighting unit and for heating a medium sized workhouse, a tuberculosis hospital and a green house.

A duplicate generating plant for 200 4-ampere magnetite street lamps is now being installed in a building adjacent to the garbage plant; also a 150 h.p. water tube boiler. Such surplus steam as the garbage plant develops over and above that required by the buildings mentioned will be used by the electric plant, but the water tube boiler will be the main source of supply for the electric plant.

The garbage plant consists of two 125-ton units, but the commissioner of health informed us that its actual capacity was 300 tons per day. At the present time they are burning about 120 tons of garbage per day of 24 hours, using between two and three tons of coal per day.

The total cost of the plant was $64,000, but allowance should be made for the fact that a large portion of the labor was supplied by inmates of the workhouse.

The cost for collection of ashes, rubbish and garbage is $1.31 per ton. The cost of disposal of garbage is $0.78 per ton, which is reduced to a net cost of $0.56 per ton by crediting plant with the heat and light furnished to the city institutions before mentioned at the rate of 6 mills per h.p. for heat and 2 cents per kw. hour for light.

Milwaukee Destructor.—The records of the cost of operation of the destructor plant are not in such condition as to warrant their use as a basis for comparison, but from the 1911 data available in the office of the director of public works we found the average cost per ton of the destruction of the garbage to be $1.44 and the cost of mixed garbage and ashes to be $0.99 per ton. This includes the cost of 400 tons of coal used during five months of the year when the percentage of green garbage was high and it was necessary to use additional fuel.

These figures should not, in justice to the plant, be accepted, for the reason that the number of employees at the present time is far in excess of the actual requirements. From our inspection we are convinced that it would be properly and sufficiently manned with two-thirds the force employed at present.

The condition of the plant is excellent, the garbage is destroyed at temperatures between 1,400 degrees and 1,800 degrees Fahr., without odor, and all of the power used about the plant is obtained from steam generated by it in boilers through which the furnace gases pass on their way to stack.

The clinkers are now being used to fill up the lake front and are very valuable for this purpose, being hard and vitreous, absolutely sanitary and superior in every way to household ash. However, on account of a demand for their use in concrete construction it is proposed to install a crusher and screen and to dispose of the ground clinker by [illegible] A conservative estimate of the value of the by-products of destruction at [illegible]

Chicago Disposal.—[illegible]

[illegible]

Cleveland and Reduction Plant.—[illegible] was purchased by the city from a private company in 1905 for $87,500, the plant having a capacity of 100 tons per day. The city has since erected additional buildings and equipment increasing the capacity to 240 tons a day.

The plant was not well designed initially and it has been impossible to improve conditions by subsequent additions, the original buildings consisting of cheap sheet iron enclosures and the arrangement of equipment not conducive to economical handling. In spite of these handicaps and except for a period during a change of political administration, the operation of the plant including the collection department has been so well organized and supervised by an official with high ideals of public service as to show in 1907 a lower cost of collection and disposal than by contract in 1905, with a considerable increase in the amount of garbage handled.

The processes of reduction are, in general, similar to those employed in the Columbus plant and the local conditions which are controlling factors in the selection of the the method of refuse disposal are also similar, natural gas being used as fuel by householders and coal costing $1.85 per ton.

One of the principal ash and rubbish dumps was found to be on fire in several places.

Buffalo Reduction and Utilization.—In Buffalo, N.Y., the refuse is collected in three separate classes—ashes, garbage and rubbish—which the householders are required to place in separate cans. Ashes are carted to the dumps, garbage to a private reduction plant and all other refuse to a refuse utilization plant owned and operated by the city. The city contracts all of the collections and the reduction of garbage.

In 1907 the city purchased the utilization plant from a private corporation for $50,000. It consists of a brick building 200 x 50 feet and contained when purchased a destructor of the Meldrum type, with boiler through which the furnace gasses were passed and which produced the power required in plant operations. Since that time two boilers have been added and a sewage pumping plant. There is now being installed a destructor of the Heenan & Froude type.

The rubbish is unloaded on a receiving floor and raked into an inclined conveying apron which conveys it to a sorting room where girl pickers remove all salable material and place it in bins, the remainder passing through to the feeding floor over the destructor furnaces. This rubbish is dry or wet according to the condition when placed in the can by the householder or to the weather conditions during transportation to plant. The salable rubbish consists of paper, charcoal sacks, bags, rags, tin cans, metal and bottles. The tin cans are loaded in cars and sold to detinning companies and machinery has been installed for converting the cans into nailing caps. Bottles are sorted and sold to breweries and blueing companies, metal to dealers and old [illegible] and polishing [illegible] The plant is also credited with 70 cents per hour for steam supplied to the sewage pumping stations. The girl pickers work for $1 per day of eight hours.

The report of the Bureau of Streets for the year ending June [illegible] charges for operation of plant, including interest and repairs and also some new equipment, of $38,530.60, and receipts from the sale of rubbish of [illegible] profit for the year of $[illegible]

Rochester Incinerator.—At Rochester, N.Y., an incinerator plant has recently been installed by the Decarie Incinerator Company for the city and was undergoing its initial test at the time of the visit of Messrs. Hallock and Runyon.

The plant is of [illegible] ton capacity and is representative of the largest and most improved form of incinerator designed by this company. It is intended to handle rubbish only and is equipped with inclined conveyor from receiving floor to sorting room, where the various salable rubbish is removed by pickers and deposited in bins, the remainder passing by means of the same conveyor to and over the incinerator, where it automatically dumps into a hopper and chute to the furnace.

Between the receiving floor and the incinerator room there is a baling room equipped with a motor driven baling machine in which the paper of various classes will be baled.

In connection with the incinerator there is installed a 150 h.p. water tube boiler through which the combustion gases from the furnace pass, and thence to the stack.

The power for motor driven conveyors and baling machines and for lighting the plant is purchased from a local electric lighting company at 2¼ cents per kilowatt hour, and the steam produced has been contracted for by the same company at the rate of 10 cents per 1,000 lbs. per hour.

As this is a new and as yet untried plant there are no cost statistics to be reported.

Westmount Destructor.—Westmount is a municipal corporation which serves as the residential section of Montreal and has a population of about 16,000. The rubbish of this section is destroyed in a destructor plant which is under the charge of Geo. W. Thompson, who is also general superintendent of the light and power department of the municipality.

This plant is essentially a municipal electric lighting plant designed for commercial and public lighting purposes and erected as a protest against the exorbitant rates for lighting charged to the citizens and the municipality by the local electric light and power company. The destructor plant is an auxiliary enterprise operated in the same building, the steam generated in the destruction of refuse being used in the production of electrical energy.

The complete installation includes one 50-ton Meldrum destructor, one 50-ton Heenan & Froude destructor, five water tube boilers with an aggregate capacity of 1,000 h.p., and four engine-driven electric generators with an aggregate capacity of 1,000 kw.

The destructor plant burns garbage, rubbish and screened household ash. By screening the ash a combustible much higher in heating value is obtained, but at the expense of cleanliness, power and attendance.

There is a common collection of ashes, rubbish and garbage by the city, but when no garbage or rubbish is collected by a cart the ashes are passed through a screen. Carts drive up to the receiving or upper floor and dump their contents, which is then raked into storage bins or hoppers over the destructors. The refuse is pulled down and out of these hoppers into furnaces which are of the same type as those described in the Milwaukee plant, with the exception that clinker is handled by a car which travels on an overhead rail to a clinker yard. The clinker is used by the road department in concrete and road work and any not so used is sold to contractors.

The report for twelve months ending October 31, 1910, shows a total revenue from electric lighting and destructor plants of $102,149.17 and a total cost of operation of the combined plants of $75,426.38, leaving a net profit of $26,722.79. In the operating expenses are included interest on bonds, sinking fund for retirement of bonds and a most liberal reserve for a plant depreciation. The electric plant is charged with the heat furnished from refuse consumed. The destructor plant is credited with heat sold to electric plant, clinkers sold to private contractors, and garbage destroyed, the last item charged against the Department of Health—$9,449.06 last year.

The combined plants are ably administered under the immediate direction of Superintendent Thompson and they afford a striking example of the possibilities in a municipal enterprise of this sort when conducted with the same skill and keen business acumen that characterize successful commercial undertakings of the same magnitude. The plants are entirely free from political influence and the superintendent is empowered to engage and discharge employees, and is held strictly accountable for results

The garbage plant is free from odors and there has never been a complaint made against it, although it is situated in a strictly residential community.

West New Brighton Destructor.—The plant at West New Brighton, Richmond Borough, New York City, at the present time consumes approximately 25 tons of refuse per day at a cost of $1.34 per ton, which does not include fixed charges.

All of the power used is produced from the steam generated by the destructor gases and no sale of clinker is allowed. The plant will operate with improved economy when the quantity of garbage handled reaches a point reasonably near its rated capacity. Protests were made against its erection by householders in the neighborhood, but no complaints have been received by the department since the plant was put in operation.

Another plant of the same make and capacity, but with improved devices for feeding and clinker ejection, is being installed by the same borough at Clifton.

Scranton's Crematories.—The Scranton, Pa., plant consists of four garbage crematories of the F. P. Smith design and was installed by Lewis and Kitchen. It is designed to handle garbage and light combustible matter. Its rated capacity is 50 tons, but at times it has disposed of 90 tons per day. Combustion is at comparatively low temperature and is incomplete. No records have been kept of the temperatures and from our observations and comparison with incinerating and destructor plants we believe that the temperature in the combustion chamber is commonly below 1,250 degrees Fahr., the temperature at which garbage must be burned for the complete elimination of noxious vapors.

The plant is favored by its location next to a packing plant, the odors from which are at times highly objectionable, and on account of this circumstance any odors emanating from the crematory pass unnoticed.

The plant is inherently defective and changes have been made in its construction which increased its capacity for disposing of garbage without in any way improving its destruction from a sanitary standpoint.

Comparison of Methods.—As to refuse disposal, the authors considered dumping, the reduction system, the cremation system, incineration and the destructor system. Dumping they considered out of the question for Newark, since almost the only land available was the meadows, which would involve long hauls; moreover, as they are considered to be the future site of industrial establishments any fill made there should be such as would improve the value of the property and not depreciate it from a sanitary standpoint. "Dumps include putrescible matter, which in the heat of summer produce noxious odors and seriously interfere with the rights of adjoining property holders."

The reduction system is well adapted to cities where comparatively little or no coal is used as a household fuel and consequently where the difficulties in the way of a proper separation of household refuse are the least; but under the contract system it is always necessary to provide a bonus to induce the investment of private capital in the enterprise, and if undertaken as a municipal service it involves the installation of an equipment much more costly than for incineration or destruction and of a highly complex character.

Furthermore, the successful operation of a reduction plant is dependent upon a very efficient technical administration. In such a plant it is extremely difficult if not impossible to prevent the emission of objectionable odors, and as a rule these plants are located on the extreme outskirts of a city, an admission of the nuisance liable to be created.

The most valuable product of a reduction plant is the grease extracted, and to carry the process to its greatest refinement a percolating equipment employing naphtha in large quantities is used. This constitutes a constant menace to life and property, the destruction of plants at Chicago, St. Paul and Paterson affording examples of the dangerous character of this industry.

A reduction plant can only handle organic matter, and the contents of the receptacle of the careless householder who does not make a complete separation must go to the dumps or be otherwise destroyed by other means.

The conditions described as favorable to the installation of a reduction plant do not obtain in Newark, and the only feasible location for such a plant would be one well removed from the occupied ground on the meadows, this involving a long and expensive haul.

The cremation system or burning of garbage at comparatively low temperatures does not completely consume the organic matter, gives forth objectionable stack odors, and is generally an unsatisfactory method which does not comply with sanitary requirements for installations on a larger scale. For hotel or apartment houses where the fuel used and gases given off may be used in supplying the heat for a hot water supply system, higher temperatures may be carried, but in the case of larger installations the fuel cost for high temperature combustion would make this method prohibitive.

Incineration differs principally from cremation in the temperatures obtained in combustion, and although, like cremation, it requires the use of additional fuel, it is nevertheless a satisfactory method of refuse disposal for those municipalities which are content with their partial success in the enforcement of separate collections and the more or less objectionable ash dumps containing garbage mixed with the ash. It only partially solves the sanitary phase of the problem of refuse disposal, leaving the household ash to be carted to the dumps, and it is well recognized that a perfect segregation of the garbage from the ash is impossible of attainment, as evidenced by inspection of dumps where this system is employed.

The destructor system has previously been defined in this report as the burning of ashes, rubbish and garbage at temperatures above 1,250 degrees Fahr., but this definition should be amplified to include the requirement of artificial draft as a necessary adjunct to a high rate of combustion. This system is peculiarly favored where it is desired to utilize the power developed by the refuse consumed, but it should be kept in mind that the utilization of surplus heat is of secondary consideration, and that the primary object of mixed refuse destruction is to completely reduce the material to an innocuous clinker.

Although the combustion of [illegible] the cost [illegible] remembered that [illegible] in this system is a sanitary one, affording complete destruction of germ life in all classes of [illegible].

[illegible]

tion is correct; but where the haul to the plant is as costly as that to a dumping ground, or where it is practicable to maintain several plants and thereby reduce the length of haul, this argument cannot be upheld.

Another objection urged against the destructor system is the necessity for expert firemen, the stoking of refuse, which has wide variations as a fuel, requiring the exercise of greater skill and judgment than is the case in the stoking of coal of uniform heating value. In our opinion this argument is fallacious and based upon a very low conception of the grade of intelligence possessed by the competent stoker of boiler fires, who, in addition to his duties in stoking, is required to maintain a uniform pressure of steam and a stationary water line.

The advantages of this system of refuse disposal are many and have been most forcibly impressed upon us by inspection of the various types of plant. We list in the following the principal advantages:

First. The destruction of all organic matter in an absolutely sanitary manner.

Second. It permits the destruction of the ashes, rubbish, garbage and street sweepings, reducing all to an innocuous clinker.

Third. The fuel is supplied by the ashes, rubbish and street sweepings.

Fourth. The heat generated in combustion at high temperatures can be utilized in the production of power from which an income may be derived. A revenue can be obtained from the sale of clinker.

Fifth. A city can operate more than one plant with economy, which is not feasible in the reduction system. This permits of shorter hauls and reduces the risk of interference by fire or the failure of a part of the equipment.

Sixth. Separate collections are not necessary.

Seventh. The class of labor required in the operation of the plant is not as skilled as that required in the reduction system.

Eighth. The cost of renewals and repairs is considerably smaller than in other types of disposal plants.

Ninth. The plant may be located in the centre of the city without creating nuisance, experience at Westmount, Canada, and West New Brighton, N.Y., fully demonstrating this fact. This feature makes the system particularly desirable for Newark, where locations within the city limits would materially reduce the hauling cost

◆

CONCRETE MONOLITHS.

A system for the construction of monoliths being employed in connection with harbor work at Valencia embodies the use of moulds in the form of truncated pyramids measuring [illegible] feet square at the bottom and [illegible] feet square at the top, with a height of 26 feet. The bottom of the mould is constructed of wood and the sides of iron, and the mould is built so that the sides and bottom may be detached from one another. In operation the mould is assembled and is floated into sheltered water close to the site of the construction work. It is then partly filled with concrete by means of a crane, and is towed to the position to be occupied by the monolith, where the filling is completed. After the filled mould has been left in position for ten days the fastenings are released and the sides are raised in order to be fitted to a new bottom for a repetition of the process. The advantages claimed for this system include low cost, speedy construction, adaptability to curves and homogeneity.

AN ELECTROLYTIC STERILIZING PLANT.

A recent application of electrolysis to the industrial sterilization of water has been used in a plant in England of which the details have just come to hand. At a textile mill, which is devoted to the woolen dyeing and finishing processes, a supply of water is obtained from moorlands on which cattle are grazed, so that there is some slight contamination from this source; the result was formerly the rapid growth of algae in the storage reservoirs, which filled up the supply pipes. Grids were useless, as the fine silky threads lay across the grids in a felted mass which had to be removed with rakes every half hour, and the threads thus broken and released got into the mill and on the goods, whence they were irremovable.

Chloride of lime solution destroyed the weed but hardened the water; the result was that scale formed in the boilers and curdled the soap used in the fulling and finishing of the woolens, so the use of this chemical had to be abandoned, and the weed soon reappeared. Copper sulphate was tried, and this at once affected the dyes.

Mr. Toyne, the consulting chemist, was acquainted with Dr. Samuel Rideal's investigations into the subject of water purification, wherein the use of electrolytic sodium hypochlorite was advocated, and as a last resource he tried the electrolyzer made by Messrs. Ernest Grether & Co., of Manchester. After three days' trial this proved entirely successful; the weed was killed, and the water—which had previously been tinged slightly yellow, owing to the infiltration of peaty matter—was changed to the ordinary blue-green of pure river water. The proper strength of chlorine to effect the purpose was ascertained by experiment, and amounted to about two parts chlorine to 1,000,000 parts water. The little "Manchester" electrolyzer which was used is illustrated in diagram herewith. A couple of planks were thrown across the little stream which fed the reservoir, and the apparatus was mounted on these, so that the electrolytic sodium hypochlorite, as made, trickled into the brook, and was thus intimately mixed with all the water that entered the reservoir. An automatic feed tank was provided at a higher elevation, and a hogshead of brine, higher still, as shown, so that, after filling the hogshead once a day, the operation of the plant was entirely automatic. A little roof, not shown in the diagram, protected the apparatus from the weather. Current was provided from the mill-lighting circuit at 110 volts by means of an overhead line; the current amounted to about 8 amperes, and the overflow from the electrolyzer was at the rate of 1 litre per minute, with a strength of 3 grammes active chlorine per litre. The brine had a strength of 4 per cent.

When the amount of chlorine required had once been determined, it did its work in the reservoir, and spent itself on the organic matter therein; there was no chlorine present at the outflow. Daily chemical tests failed to show either chlorine or nitrogenous matter, and the dyes were not affected. If any free salt was present, the quantity was too small to be detected, and in any case it was harmless. The water was excellent for drinking purposes, and, in fine, the experiment was a great success from every point of view.

The subsequent development of this experiment is even more interesting: as winter set in, it was decided to stop the electrolyzer, as no growth of algae takes place in cold weather; at the end of a fortnight complaints were made of the reappearance of peculiar markings, or stains, on the material in course of treatment, which excited comment, seeing that this old trouble had been absent during an exceptionally hot summer. The bacterial action of the water was at once suspected, and the electrolyzer was restarted, when the fungoid growths at once disappeared. Needless to say, instructions were issued to run the electrolyzer henceforth summer and winter.

Further experiment has shown that in winter, when the growth of vegetation is suspended, the amount of electrolytic sodium hypochlorite may be reduced to 1 part per million, the contaminated water thus treated refusing to show any action on gelatine plates.

The importance of this later discovery calls for special emphasis, for it appears to have a much wider bearing than the original application of the system to prevent the growth of algae. The bacterial growth or mildew above-mentioned has long been a source of continual trouble in many bleach works, and has previously been ascribed to local infection, such as contact with old wood on floors or stillages infected with mildew, inferior sizing materials, etc., whereas it is now traced to the true cause—contaminated water supply—and simultaneously the remedy has been revealed, in the shape of the electrolytic sterilizer.

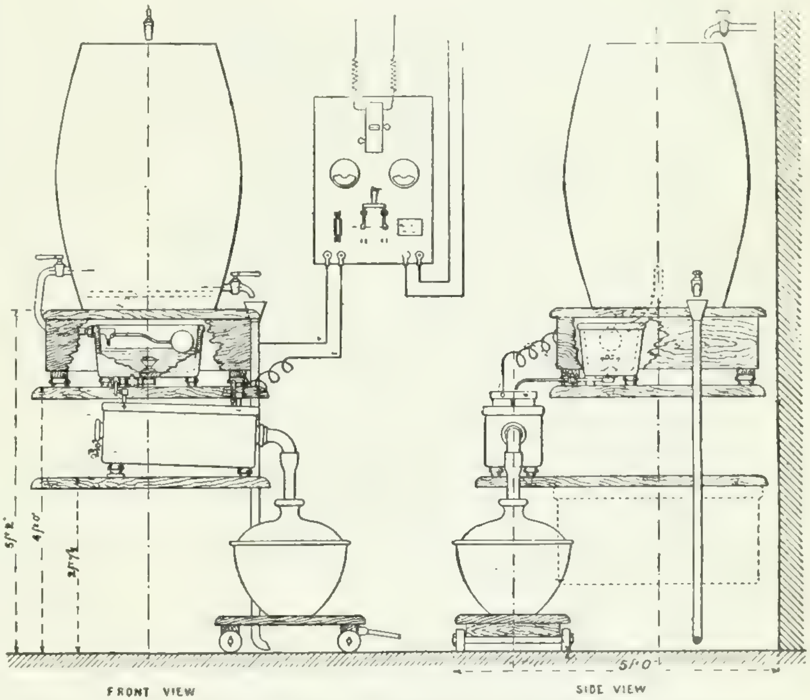


Diagram of Electrolytic Sodium Hypochlorite Sterilizing Apparatus.

The cost of working was estimated as follows:—Taking the cost of energy as derived from the mill at about 5 cents per unit, and running the plant at 8 amperes for 10 hours a day, the consumption of energy was 110 × 8 × 10 = 8.8 units, costing, say, 4 cents a day. The brine used amounted to 132 gallons of 4 per cent. density per day, requiring 52 lb. of salt, which, at the price paid by the dyehouse, cost 10 cents. The labor and attendance required was negligible, and the total cost thus came to about 14 cents a day.

The installation was at work all last summer during the exceptionally hot season, and has been in operation for nine months to the entire satisfaction of the owners of the mill. The system is, of course, applicable to a great variety of cases in which water is contaminated with organic impurities—for example, it can be used to purify the water of swimming baths, as is already done at Poplar by Dr. Alexander, with excellent results.

EXPERIMENTS IN OIL SMELTING IN BRITISH COLUMBIA.

The annual report of the Minister of Mines of British Columbia for 1911 contains some notes by Wm. Fleet Robertson, Provincial Mineralogist, on attempts to smelt with oil as fuel. For the past two years the Dominion Oil Smelting Company, Ltd., in Vancouver, has been conducting a series of experiments in the old Van Anda smelter, in an attempt to perfect or render practicable an oil-fired furnace for smelting ores, and has achieved a degree of success such as to render the process worthy of serious consideration. The particular form of furnace being experimented with is covered by Canadian patents granted to J. J. Anderson, and acquired by the company. More recently, March, 1912, Mr. Anderson has taken out United States patents for a new furnace, which is a modification of the Van Anda furnace, designed along lines suggested by Mr. Thomas Kiddie after the latter had made a test at the Van Anda plant.

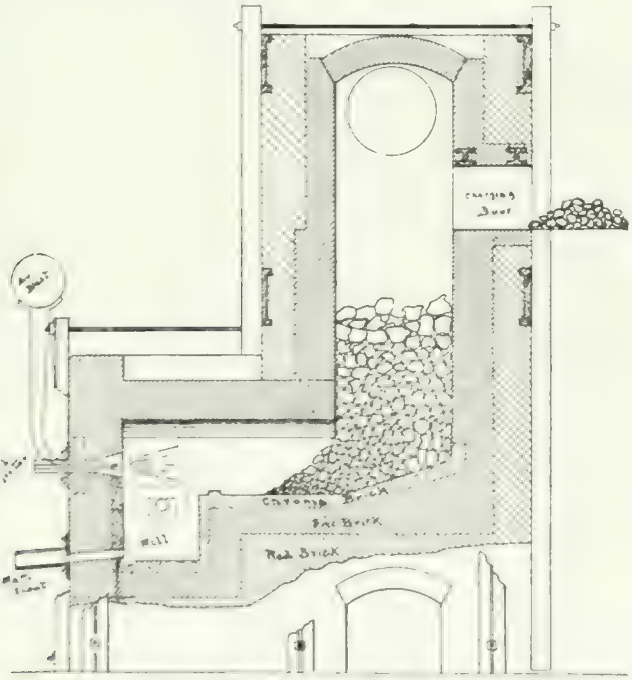


Fig. 1.—Dominion Oil Smelting Co., Oil Furnace Blast Furnace at Van Anda, B.C.

The Van Anda furnace, of which a sketch is given as Fig. 1, is, essentially, a shaft furnace superimposed above one end of a reverberatory furnace or combustion chamber. As previously the ore, with suitable fluxes, is fed into the shaft from the charging floor, passing down onto one end of the reverberatory hearth. The shaft thus serves as a feeding hopper for the reverberatory. The latter is fired from [illegible], which burns sprayed oil into the front of the chamber, the flame impinging on the foot of the ore column in the shaft. The products of combustion pass [illegible]

The present [illegible] that a considerable advance has been made toward that goal is indicated by the results of a test made by Mr. Thomas Kiddie, a metallurgist of British Columbia, who has had previous experience with oil-fired furnaces at the works of the Orford Copper Company, New Jersey.

* * *

MANAGEMENT OF TRACKLAYING ON NEW RAILWAY WORK.*

In the discussion of the methods employed to obtain the best and most economical results with tracklaying on construction work, the committee has limited itself to the consideration of the following points: (1) Should the building of new yards and main lines (which are not let to contractors) be handled exclusively by the engineering departments? (2) Should such work be handled by the maintenance-of-way department? (3) Should such work be placed under the direct supervision of a practical track man?

In regard to the first point, the plans, specifications, etc., should be prepared by the chief engineer, but the actual supervision of the work should be in charge of a practical track man. There should, of course, be a resident engineer on the ground to lay out the work in accordance with the specifications.

The man in charge can best ascertain the proper kind of material to be selected and the manner in which it should be placed on the subgrade in order to eliminate the possibility of soft spots which so frequently develop in tracks under the pressure of heavy traffic and which form the most serious drawback in the maintenance of a first-class track in the future. He can also provide good drainage, sufficient ballast under the ties, and proper spacing and placing of ties in accordance with the size and condition of ties provided, all of which are essential to the construction of good, substantial tracks. The construction of all new track work or such tracks as come under the head of "construction work" should be completed in detail at the cost of construction before being turned over to the maintenance department.

As to the second point, such work should not be handled by the maintenance-of-way department, for the reason that the average roadmaster has as much maintenance supervision as can be properly looked after, particularly during the working season.

As to the third point, work of this character should be in charge of a practical track man, selected by the proper officials, together with a resident engineer.

A saving in cost and time can be obtained by the use of a tracklaying machine in laying the first track, depending largely (of course) on good organization. Second and other additional tracks can best be constructed by unloading the necessary material from the existing track; this applies also to yard tracks. All necessary grading can be done by train to very good advantage when the material is not at hand to be hauled by teams.

The advantage in making fills by train lies in the fact that better material can be obtained and used after the material is unloaded from the train with a side plow and leveled back to the full depth and width for an additional track. If gravel ballast is to be used it can also be unloaded and spread on the grade with a spreader to the width and height required before tracklaying, so that when the steel is laid there is no ballasting to be done beyond unloading on a light lift [illegible]

---

*Abstract of a committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N.Y., Sept. [illegible]

THE DESIGN OF GIRDER AND TRUSS SPANS AND TRESTLE WORK IN STRUCTURAL STEEL.

The present status of structural steel designing was discussed by F. W. Dencer, Chief Engineer for the American Bridge Company at the Gary, Indiana, Plant, before the Civil Engineering Society of Valparaiso University in a recent lecture. Many details of design were discussed for various types of structures. The paper in full is published in the Engineering Annual of the University and is here abstracted.

At the close of the last century, structural designing had reached, as it seemed to us, a very high stage of development. Yet in fifteen short years, many of the designs were relegated to the files, never to be used again. Bridge and structural designing had gone through a remarkable series of evolutions and who can say that we are nearing perfection? The chances are that in the next ten years the progress made in scientific designing will be as great, if not greater than the progress made in the last ten years.

Undoubtedly, many phases of designing will be better understood, as for instance, (a) the treatment of connections to resist secondary stresses, (b) the forces produced by impact of the drivers, (c) effect of temperature on initial stresses, (d) deformation of trusses, (e) action of columns under stress, (f) action of the top chord of through plate girder spans, (g) theory of bearing surfaces and proper materials to be used in their design, (h) use of stiffeners, etc. The speaker does not wish to convey the impression that these subjects are not understood, at the present time, but that further developments along these lines are possible and very desirable.

The tendency of the future in structural engineering, will probably be along the lines of standardization. That is, through the co-operation of various railroads, a uniform train clearance will be adopted, wheel loads for two or three different types of engines will probably be used, the steel material will be rolled to the same specifications and be of the same quality and finally engineers will agree on a uniform set of specifications for workmanship. Some attempts in this direction have already been made, as is evidenced by the work of the American Railway Engineering and Maintenance of Way Association in producing the specifications which are used by many railroads and corporations and also on the Common Standard drawings which are used by the Harriman Lines.

The engineering profession has depended on the following agencies for means for improvements in the past and developments to be made in the future: 1. Designers of railroads and bridge companies who are continually making use of new ideas based on the observation and action of existing structures. 2. Research work and investigations at testing laboratories and universities. 3. Discussions and papers of engineering societies. 4. Improvement in the quality of materials and the use of alloys.

Not many years ago, the longest angles obtained from the mills were 60 ft., to-day angles 125 ft. long may be obtained. Besides new sections have been rolled which permit of greater possibilities in designing, such as 8 x 6-in. angles, 24-in. I-beams, etc.

To show the importance of the quality of material in its relation to designing, it might be well to call attention to special materials which have recently (within the last decade) come into use and have served to revolutionize existing methods of design.

Cast steel, because of its high tensile and compressive strength and its adaptability to conform to different shapes is used quite extensively for bearing boxes, shafts, shoes and bearing bolsters. It is used often for details where heretofore castings were prohibitive. A small quantity of aluminum is commonly added to the cast steel. It permeates through the entire mass without artificial stirring and adds to the ductility of the steel as well as preventing blow holes.

Because of the high price of cast steel, engineers were forced to design a great many details of rolled steel which from the standpoint of strength and good designing, was inferior to the cast steel designs. In recent years, the price of cast steel has dropped and engineers are using cast steel more extensively. The new Municipal Bridge of St. Louis just erected has chords of nickel steel.

Metallic nickel, nickel ore, or ferro-nickel to the extent of 3½ per cent. of nickel is added to the bath of steel made by the open hearth process. The nickel increases its density, elasticity and strength. The high elastic limit of nickel steel tends to prolong the life of the metal and because of its superior toughness, offers greater resistance to sudden strains and shocks.

Phosphor bronze, a combination of tin, copper and phosphorus, is used for bearings which are subject to high pressures and run at slow speed.

Lumen metal manufactured and patented by the Lumen Bearing Company is also used for bearings. It contains zinc, copper and aluminum. The advantages claimed for this metal are its light weight and low coefficient of friction.

Other alloys of varying proportions and metals are used for frictional surfaces, the most common of which is babbitt metal. It is composed of lead, tin, zinc and antimony. For high speed metal the base is tin, and for low speed the base is lead.

Manganese steel is used for purposes where an extremely hard metal is required, as for rail locks, frogs, or switches. The material is too hard to cut with a tool and must be ground where a finished surface is required.

Improved processes of making and rolling structural steel have enabled engineers to design structures with a higher degree of efficiency for the same weight. This statement must be taken within certain limits, due consideration must be given to the greater deformation caused on the material when the ultimate stress, and consequently the working stress, increases per square inch.

The use of alloys and special materials is mentioned briefly to show that their uses have much to do with the progress made in designing. In other words, many details that recently have come into use would be impossible were it not for the scientific progress made in steel manufacturing.

As this paper will deal principally with designs for the most practical details, we will attempt to show that many details can be simplified and made more practical without impairing their strength and often with better results.

The best design of structure is one which has the smallest number of members to resist the stresses, also each member designed with a minimum number of component parts, provided, of course, that due consideration is given to the proper distribution of the material. In other words, the simplest design is the best, other considerations being equal.

Girder Spans.—The depth of a girder is generally taken as the economic depth. This can be determined by expressing the weight of the girder in terms of the unknown depth. Frequently the depth of the girder span is determined by other considerations, such as the base of rail to masonry being fixed or to make suitable connections to adjoining spans.

An important step is to decide on the "building up" of the top flange. To avoid dapping of the ties, some railroads use four angles with side plates between. This method leaves the top flange clear on top without and projecting rivet heads or cover plates. The bottom flange is commonly made up of two angles and sufficient cover plates, the weight of the cover plates being about equal to the weight of the angles.

For the [illegible] of the top flanges of through plate girder spans engineers differs as to what formula to use to resist the deflection sidewise. Reliable tests are lacking, which would definitely determine the resistance necessary to prevent buckling. All engineers, however, are agreed that the ratio of "l" over "r" should come within certain limits, and in addition thereto the floor beams are extended by means of brackets, within the line of train clearance, to connect to the top flange. Sometimes assumptions are made, such as treating the top flange as a column free at both ends and with an effective length equal to two-thirds of the length of the girder.

For length of girder spans up to 60 ft. the expansion ends slide on castings, the effect of the deflection not being considered except that the casting should not be too wide on top. For longer spans shoes with pins are used to permit deflection. Roller nests should be used for the expansion ends. Segmental rollers about 6 ins. in diameter are better than the circular rollers, as more rollers can be used within a given area.

Pin shoes should be designed of cast steel instead of being built up of plates and angles. The distribution of bearing necessitates the use of stiffeners which in the shop are extremely difficult to secure a perfect bearing at the bottom, certainly from a theoretical standpoint a perfect and equal bearing of all stiffeners is impossible.

When designing end posts of girders the bearing areas required should be confined to as small a space as possible to prevent unequal transmission of the shear under deflection. The centres of the end stiffeners are placed exactly over the bearing casting. It is best to lay out the bearing castings with the end of the girder to make sure that the walls of the castings are placed under the bearing surfaces of the girders.

The chamfered legs of the end post angles which fit the fillets of the flange angles should not be counted in bearing, as the shop does not get a fit perfect enough to transmit bearing. The outstanding legs are figured only for bearing. The value of the rivets through the flange angles which are above the sole plate or bearing shoe will add to the strength of the bearing, but should not be counted in the computations.

Through plate girders are frequently designed with round ends; the reason commonly given is that the round ends will deflect any material protruding from the side of the car. This method of construction is very expensive and should be discouraged, at least be restricted to the ends of the girders having considerable projection above the base of rail. The speaker does not believe that from an æsthetic point of view the round ends are better.

[illegible] plates are used with round ends the side plates should be cut where the bottom edge meets the curvature of the flange angles. The space under the flange angles beyond the end [illegible] the end reinforcing plate should be filled with plates. This detail will simplify the shop work.

[illegible]

The cross frames should be connected directly to the top [illegible]

Engineers differ as to the use of stiffeners in stringers. Where stiffeners are not used a common specification is that the unsupported distance between the flanges should not be more than 60 times the thickness of the web. The thickening up of the web to conform to this specification and the omission of the stringers does not alter the weight materially; sometimes the weight becomes greater and sometimes smaller, and in addition has the advantage of simpler fabrication to the manufacturer and reduced cost to the buyer.

For all skew span work it is advisable for simple fabrication to study the design with the object of squaring the end frames, end stringers, etc. Frequently the skews of various spans vary by small amounts which, for practical purposes, could be modified slightly to make as many spans of one skew as possible. When designing more than one span the location of piers or bents should be studied with the idea of making as many spans of the same lengths as possible.

Truss Spans.—Inclined top chords are generally used for spans over about 200 ft. in length. For spans over about 300 ft. in length sub-verticals are used in order to give a better inclination to the diagonals. In the designs of the longer spans it is usual to connect the compression members which are built up of structural steel with riveted connections and the eye ears are connected with pin connections.

The interior columns should be designed not merely to conform to the column formula, but also to give good connections for the floor beams and bottom laterals.

Generally the flanges of the built-up members should turn out and not in, where for good packing it is necessary to turn in the flanges of the posts and diagonals; the flanges of the top chords and end post should always turn out. By turning out the flanges of built-up members the rivets in the tie plates and lacing bars can be more easily driven. To resist the thrust of the drivers as the engine comes upon the bridge the end bottom chords are generally made up of built sections for two panel lengths.

The top chords and end posts are built up of web plates, top and bottom flange angles and a cover plate. The bottom angles, which are laced, are made heavier than the top angles, so that the centre of gravity of the section may be more nearly in the centre of the member. Heavier angles give simpler shop work than the addition of bars riveted to the angles. If the desired section cannot be obtained with single webs, the webs should be doubled rather than by adding side plates between the angles. The plates between the flange angles are not connected to the angles and do not give as rigid a section as the additional webs do. Double webs may be held together in the centre by one line of rivets about 12 ins. centre to centre.

When designing sections for chords and columns of trusses the designer should draw the sections of the various members, taking into account the fitting of the posts to the top and bottom chords, so that there is clearance enough for lacing posts and bottom chords. Sometimes designs are received in which the posts are too narrow to permit a floor beam connection; again the chords are too narrow to allow the riveter to rivet the lacing bars when the angles are "turned in," and again the angles of the chords are too small to give room enough to drive the cover plate rivets where pin plates occur.

The working lines of the top chords and end posts on which the pins and intersections of posts and diagonals are located should be approximately the centre of gravity of the sections, but the fact should not be overlooked that the weight of the member itself lowers the centre of pressure. Consequently, if the eccentricity is small, the working lines may be taken on the centre line of the chord. To reduce the eccentricity of the [illegible] connections to a minimum the working lines of chords, posts and diagonals should meet at a point. Also care should be taken in spacing an equal number of rivets on each side of the centre of a member for the connections. Extreme care should be taken to avoid eccentricities at connections as far as possible.

For lateral or wind bracing connections it is a common error to connect the lateral plates to resist the stresses along the line of one component only. The connections should be made to resist both components. A difficult connection to make is at the point where the bottom laterals connect at the abutment. For the best design the transverse component should be carried direct by the end floor beam and the longitudinal connection by the bottom chord. As noted before, the end bottom chord should be a stiff member.

The bottom laterals are generally connected to the bottom of the posts and to the bottom flanges of the floor beams. The longitudinal component of the wind stress must go from the bottom of the post up to the pin to be carried by the eye-bars. As this eccentricity is unavoidable in our present designs, the posts must be designed to resist this bending. This is accomplished by a plate on each side of the post running to the bottom of the post and above the pin to be utilized also as a pin plate. For the large wind stresses it is advisable to design these reinforcing plates wider than the post to add greater resistance to the bending of the posts.

As the posts cannot be laced from the floor beam to the pin, this part of the post should be amply strong, by cutting the outstanding legs of the angles as little as possible, by extending the pin plates up to reinforce the weak section and by using as few countersunk rivets as possible. Countersunk rivets are not as good as full-head rivets in bearing and, besides, remove more of the section of the plates they connect by the counterboring. The chipping of the countersunk rivet also weakens the rivets by loosening them.

Eye-bars should be designed to conform to the dies of the manufacturers. It will be found that ins. is the maximum thickness for eye-bars, for tests have demonstrated that the thicker bars are not as efficient in tension per square inch as the narrower bars. It is recommended that only two or three sizes of pins be used on a span. If the pin is too large for the bending stresses the pin plates may be correspondingly reduced. Besides, the eye-bars will be more uniform and a less number of pilot and driving nuts are used. Pinplates for transmitting bearing to the pins should be designed with the idea that the web plate is transmitting its own bearing, therefore the bearing from the chord angles to the cover plates should be transmitted through the chord angles to the pinplates direct.

As truss spans are riveted up in the field after the span is "swung" clear of the blocking, the ends of the top chords at the splices come to a bearing for dead load only, consequently the splice plates should be designed heavy enough to carry at least the live load stresses.

In good designing splices should be avoided on the principle that a splice, even if excessively strong, is never as certain of action as a full member. It is important in a splice to secure a proper distribution of material and rivets. The reinforcing material should be adjacent to the material spliced, with the correct number of rivets to each part of the splice. For instance, it would be manifestly wrong to splice a 6 x 4 in. angle by putting all of the splice material on the 6-in. leg.

On through truss spans the tendency is for the stringers to elongate as the bottom chord stretches. It is therefore advisable to design the stringer connections with a wide gauge for the rivet lines to permit the connection angles to "spring" under deflection.

On deck truss spans, having the stringers riveted between the floor beams, the top chord compresses and becomes shorter, tending to throw compression into the floor system, but in reality bowing the stringers outward. To offset this condition the stringers are built a trifle short for short spans, or one expansion pocket is provided at the centre of the span for spans over 300 ft. in length.

On deck trusses where the stringers rest on top of the floor beams the difference in movement between the top chord and the bottom flanges of the stringers is the shortening of one panel of top chord plus the elongation of the bottom flange of the stringers. This movement is taken care of by slotting the holes of one end of each stringer. In such a case the top laterals should not be rigidly connected to the stringers. The only connection necessary is such that will support the weight of the laterals to prevent sagging.

Bottom laterals should always intersect at the centre line of the truss where eye-bars occur in order to prevent the twisting of the post. This is not so essential when the bottom chord is a built member, as the stiff member carries the stress from one side to the other. The objection to having central connections where stiff members occur is that the lateral plates become very long and ungainly. However, when eccentric lateral connections are used, the two sides of the member should be rigidly connected.

Top chord sections are usually shipped in two panel lengths. The engineers should remember this and design these sections of the same material to avoid the shop splice. The weight is practically the same and the member is stiffer without the splice.

The wide lacing bar having two rivets at each end is advocated instead of the narrow bars with one rivet at each end. In addition to its greater efficiency the wider bar is more easily riveted.

For truss spans the reaction of the end floor beams should be carried on the end pin and not on the shoe. This will enable the end beam to take up deflection with the trusses and also place the loading more central on the main shoe. The pin shoes, as noted elsewhere in this paper, should be of cast steel, while the main bolsters should be of cast steel or cast iron, depending on the amount of reaction.

The tractive force of the engine exerted when the brakes are set has a tendency to bend the floor beams in the direction of the moving load. This force, which is usually taken at one-fifth of the vertical moving load, is resisted by the stiffness of the floor beams for small spans. For long spans, say over 250 ft. long, it is best to provide a truss frame to carry the tractive forces over the trusses. For a solid floor, such as a trough section floor, I-beam floor, or where four lines of stringers are used for single track, the provisions for bracing against tractive force may be neglected.

Trestle Work.—The design of the viaduct will depend upon economic conditions and on the equipment for erection —that is, the length of span is determined from the length of boom on the traveller or derrick car. We are not concerned with the erection in this paper, but this point was brought out to show that all phases of construction should be considered.

After deciding on the lengths of the main girder and tower spans, the elevation of the trestle should be determined by making the tower spans of one length, and as many as possible of the main spans of one length. The elevation at the top of the piers should be fixed with the object of making all of the tower posts alike if possible. If the contour of the ground will not permit this, the tower lights should vary only where [illegible]

It is recommended that the tower spans be made of the same depth as the main girders. This has advantages, as omitting the brackets for carrying the short spans and utilizing the bottom flange of the tower span for the top strut of the longitudinal bracing.

From the point of view of the erector the erection is simplified by making the main girders and the tower spans of the same depth, for the reason that the traveller or derrick car can be run on the tower spans easily, whereas, in the case of the shallow tower spans, it is necessary to block up one end of the span and slide in the long girders afterward.

When the track is on a grade the two bents of any one tower should be made identical by adding fillers on the tops of the columns which are on the up-grade side of the tower. This provision simplifies the fabrication of the steel considerably.

The deflection of the main spans when over about 70 ft. in length throws the bearing pressure on the edge of the base plate. This unequal distribution of pressure may be overcome by the use of a short base plate or by having the girder reaction carried on a narrow strip of steel placed transversely to the length of the girder.

To secure the proper bearing of the columns on the masonry the stress must be distributed over an area considerably larger than the area of the columns. The best way to accomplish this is to provide a casting which flares out to the required area and the base of the column will be simplified without the use of elaborate wing plates, diaphragms, etc. It should be remembered in this connection that fitted stiffeners, wing plates, etc., are difficult to fabricate so as to insure bearing contact through the milled ends.

The diagonals of the longitudinal and transverse bracing are tension members. For simplified shop work it is recommended that the angles of these members be held together with tie plates and not with lacing bars. Narrow struts composed of four angles in the shape of an I-beam are perfectly riveted up with a solid web plate instead of being laced. The weight in either case is practically the same as the solid web may be utilized as part of the section of the strut.

Wide struts, of course, should be laced rather than built up with a solid web in order to save the weight.

Column sections are generally shipped in lengths not exceeding 60 ft. The engineer should design the column for the length of one shipping piece of the same cross section. [illegible]

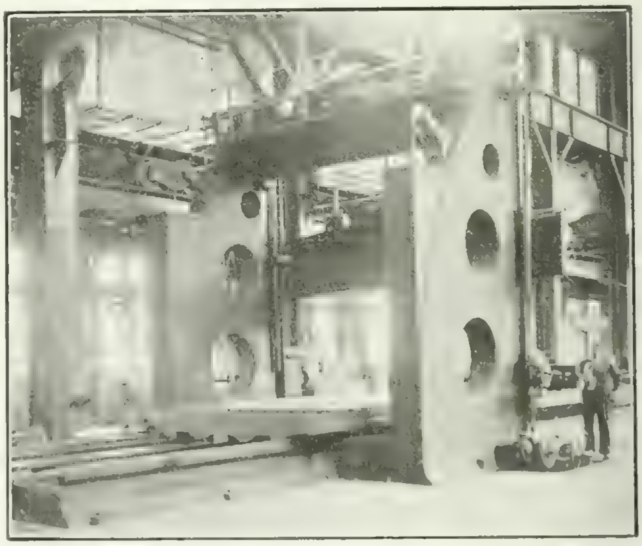
[illegible] ened in straightening rolls to secure an even surface in bearing. [illegible]

NEW WELLAND CANAL.

Tenders are likely to be called in a few months' time for the Welland Canal improvement. [illegible] instead of the swing gate system will be in vogue. All will [illegible]

A LARGE PLANER.

The planer, which is illustrated, was built by the well-known firm of Ernst Schiess, Limited, in Duesseldorf, Germany, and was furnished some time ago to the Mesta Machine Company in Pittsburg. When Mr. Mesta was in Europe some time ago he found that a great many large machine works were using Schiess planers, and was favorably impressed with the advantages of the German design. He consequently placed an order for such a Schiess planer with the agents of the German firm, the Wiener Machinery Company, 50 Church Street, New York, N.Y. The machine is now in successful operation for some time, and it may interest our readers to get acquainted with some data of this big planer. The machine has a planing length of 33 ft., a width of 13 ft. 1 in., and will accommodate pieces 11 ft. 6 in. high. There are four toolholders, two at each standard. All these holders are arranged for automatic setting in a horizontal, vertical or inclined position up to 45 degrees, and are furthermore provided with a quick-acting power arrangement, to be moved at the rate of about 2 ft. per minute, and an automatic lifting of the tools when the table is running back. The cross-rails can be lowered or raised at the rate of 10 in. per minute. All these quick changes can be made independently from the main drive of the machine, and this is accomplished by means of a 12 horse-power motor arranged on top of the machine. This motor is easily accessible from a bridge arranged for this purpose. Of course, the motor is operated in different ways very easily from a switch on the right side of the machine. The table, which is 10½ ft wide, and arranged to permit an easy removal of the shavings, runs in three wide, flat grooves, which are provided with a very good, durable and automatic oiling system. The table is driven by two broad steel racks by means of a 50 horse-power reversible motor. The motor runs with between [illegible] in such a way that when the table is running [illegible], which [illegible] and backward [illegible]. The machine complete without its motor, which was furnished by the Westinghouse Electric and Manufacturing Company, weighs about [illegible] pounds.



View of Planer.

A BRIEF DESCRIPTION OF A MODERN STREET RAILWAY TRACK CONSTRUCTION.[*]

By A. C. Polk.

With the increasing demands made on various traction companies throughout the country to provide good service, the matter of securing a permanent roadbed in the busy and paved sections of a city has become a serious problem. When the work is poorly done originally, and is not on a proper foundation, the cost of maintenance is increased, the paving along the poor roadbed becomes cracked and ruined by the movement of the track, unfavorable public comment on it arises, and the company finds itself face to face with one of two propositions, either the entire rebuilding of the roadbed or the attempt to surface and repair the old one. Either alternative is expensive, as the work will have to be done on a busy street and will interfere with car schedules, with consequent loss of revenue to the company and inconvenience to the public. Therefore, when the paving is done originally, the permanent roadbed should be substantial and effective.

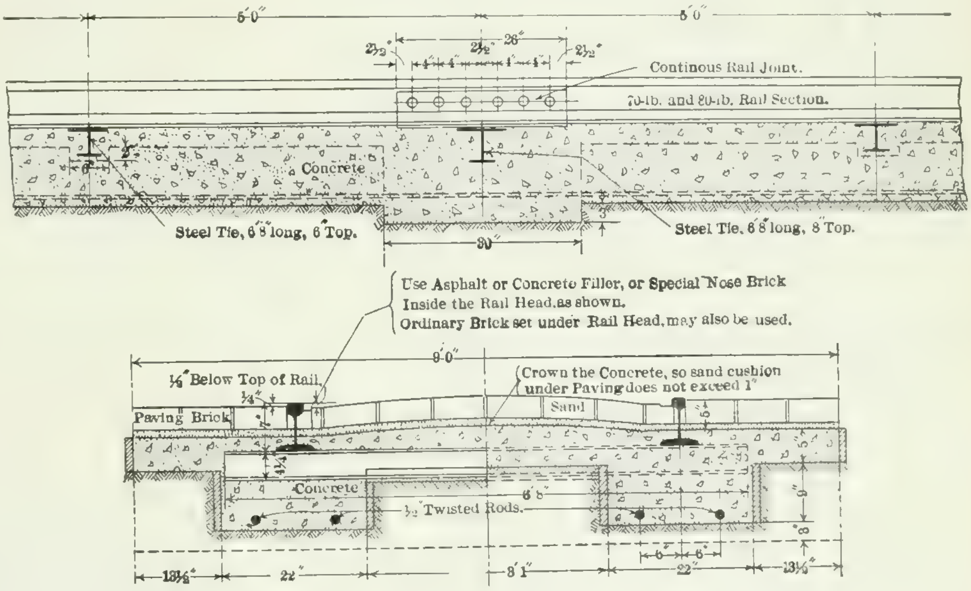
In this paper the writer has attempted to give a general description of the methods and materials used at Springfield, Mo., in rebuilding the Springfield Traction Company's lines on streets which were being paved by the city during 1911.

The company's franchise stipulates that it shall pave the space between its rails and for two feet outside of the rails, when the city paves on the various streets occupied.

The work was done by the company, under the writer's supervision, and aggregated more than three miles of new tracks.

It was desired to secure as permanent a roadbed as possible, in fact, one which would outwear the rail itself and allow its replacement without disturbing the roadbed if so desired. Fig. 1 shows the general cross-section and detail of the work as put in.

General Features.—The general features of the structure were, a 7-in., 70-lb. **T**-rail section, 62 ft. long, laid on steel ties, and directly under each rail longitudinal concrete beams, each reinforced with two ½-in. twisted steel rods, and a 5-in. concrete mat over the beams and the centre of the tracks for a paving foundation.



5′0″
5′0″
2½″
2½″
26″
2½″
4″
4″
4″
4″
Continous Rail Joint.
70-lb. and 80-lb. Rail Section.
6″
Concrete
3″
Steel Tie, 6′8″ long, 6″ Top.
30″
Steel Tie, 6′8″ long, 8″ Top.
Use Asphalt or Concrete Filler, or Special Nose Brick
Inside the Rail Head, as shown.
Ordinary Brick set under Rail Head, may also be used.
9′0″
⅛″ Below Top of Rail.
¼″
Crown the Concrete, so sand cushion
under Paving does not exceed 1″
Sand
Paving Brick
5″
4¼″
Concrete
6′8″
½″ Twisted Rods.
9″
8″
6″
6″
13½″
22″
8′1″
22″
13½″

Fig. 1.—Section of Concrete Steel Tie Track Construction.

In this case the city contractors were allowed to place the street pavement first, except where it was of asphalt. After the paving on each side of the track had been completed, the old track was moved to one side or the other on the completed pavement, and excavation between the tracks was commenced.

Excavation.—The standard depth below the finished pavement to which the general excavation was made over the whole 9-ft. space was 10 in., as shown by Fig. 1. Then two trenches were excavated to exact dimensions, a depth of 9 in. more, and running with the rail. At the joints these trenches were connected by cross trenches, 30 in. wide at an additional depth of 3 in., so that each joint tie would be thoroughly embedded and have a good thickness of concrete under it. Around each intermediate tie shallow trenches were excavated so that there would be at least 2 in. of concrete under the tie and 4 in. around its sides.

Ties.—All ties were punched at the proper gauge to take 7-in., 70-lb. or 80-lb. **T**-rails, but the 70-lb. rail was used principally. There were two types of ties, one under the joints which came opposite one another, and the other intermediate between them. The joint tie was an **I**-beam section, weighing 20 lb. per ft., 6 ft. 8 in. long, having an 8½-in. top, on which the joint rested, and a 4½-in. base. The intermediate ties were of the same length, but weighed 14.5 lb. per ft. and had a 6-in. top and a 4-in. base. All ties were spaced 5 ft. apart, or as near that as the distance between joints would permit.

Fastenings.—The rail was fastened to the tie by special lugs and **T**-headed bolts with square shoulders next to the head. These bolts could be inserted from the top, if so desired, being dropped through the rectangular hole punched in the tie, turned, and then raised until the square shoulder fitted up into the rectangular hole, which prevented it from turning while running down the nuts. The lug had a projection on its under side which also fitted into the rectangular hole, and prevented it from turning or backing off the rail. A socket wrench was used to run down these bolts rapidly. The joint ties were heavier and wider than the intermediate ones, as noted above, and were punched to allow the lug to fasten over the continuous joint which was used.

Joints.—Six-bolt continuous joints were used, and the following method of making them was adhered to with greatest care, as the joint is generally the weak part of the track work:

First, those parts of the rail with which the joint came in contact were carefully cleaned and polished with files and emery cloth until all scale, rust, and particles of dirt were removed and the surface was bright. Then those parts of the joints which came in contact with the rail received the same treatment. All contact parts were then greased and the joint put on. The tightening of the bolts was started from the centre, working out toward the ends, pulling up a bolt on one side of the centre and then the corresponding bolt on the other side, and when the bolts were all apparently tight a heavy sledge was held against the bottom of the joint on one side and the other side tapped briskly with a light sledge at the bottom only, and vice versa.

---

[*] Paper to be presented to American Society of Civil Engineers, Oct. 16th, 1912, and published in the August proceedings of the society.

Then the tightening process was repeated until nothing more could be gotten out of the bolts by one man with a wrench having a 30-in. handle. After a continuous joint has once been carefully made in this manner it is there to stay, and even if the bolts were removed the joint would remain under traffic for a long period without any signs of loosening. Another feature in making a joint of this type in this manner is that no bonds were used, or considered necessary. The net area in contact has a far greater current-carrying capacity than the No. 0000 copper bond generally used on heavy lines, and a test showed no trouble with return circuits. It has also been brought to the writer's attention that a section of track put down in a similar manner showed a first-class negative return circuit after two years under traffic.

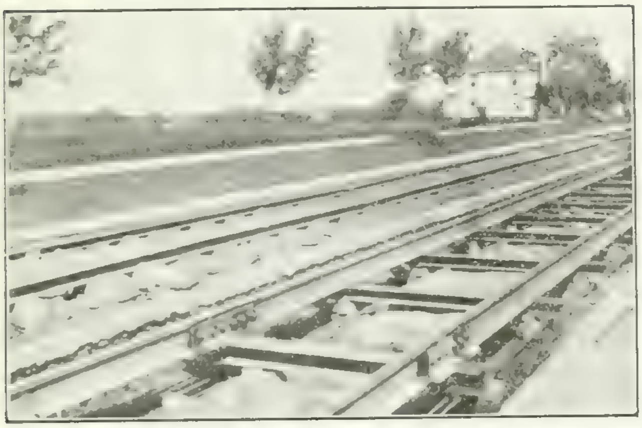


Fig. 2.—Reinforcement at Joints and General Construction.

Surfacing and Preparing for Concrete.—The track, having [illegible] as described, was supported on small piers of old brick placed under every other tie, and centring under the rail. The final surfacing was done with oak wedges on top of these piers, and both the piers and wedges were concreted in.

Two ½-in. twisted steel rods were placed in the bottoms of the trenches about 6 in. square. These also were supported at intervals on top of a brick which held them about 2½ in. off the ground. Under each joint two extra 4-ft. lengths of these steel rods were placed, to give additional strength at this point, which is usually considered the weak spot of track construction. This is shown on Fig. 2.

The track was then given its first surfacing raise, being [illegible] in keeping the skeleton track in correct line, variations in temperature kinking it.

Concrete.—[illegible] the mixer in such manner that they were about in the right proportions. These materials were cleaned up as the mixer progressed.

Of the two methods, the latter was found to be by far the most satisfactory, as there were frequent delays in the delivery of materials to the first mixer by the work train, and the temporary track was blocked for traffic beyond the point where concreting was in progress and, on single-track work, passengers had to transfer around the obstruction.

In the second method, all material could be delivered on the street for a considerable distance ahead of the mixer, and there was no reason for the mixer to be idle at any time on this account.

The concrete was composed of 1½-in. (maximum size) crushed limestone, Kaw River sand, and chats from the Aurora Zinc Mine district, the proportions being one of cement, two of sand, two of chats, and three of crushed stone, this making a very good mixture. The concrete was mixed very wet, dumped into movable chutes from the mixer, and deposited directly by them on the track. Great care was taken at all times to keep all loose material in the excavation cleaned up ahead of the concrete and to maintain the twisted steel rods in their proper positions. The concrete was puddled carefully under and around all ties with shovels and finally crowned, when it reached grade, with a special board or templet made for the purpose.

When the material through which excavation had been made was of a very loose character, or if bad weather had caved in the sides of the trench, forms were placed where necessary to hold the concrete to the exact dimensions of the roadbed. After the concrete had set for 48 hours, and in the majority of cases longer, the brick paving was done.

Paving.—The paving was of first-class paving blocks, laid on a 1-in. sand cushion, and grouted. The method of laying it differed somewhat from the usual practice. Along each rail, and snug up against it, was laid a 2 by 4-in. piece of timber. A stretcher course of bricks was then laid against it paralleling the rail, the tops of the bricks being only ⅛ in. below the top of the rail. The headers across the tracks were then laid and all the bricks were thoroughly rolled and rammed.

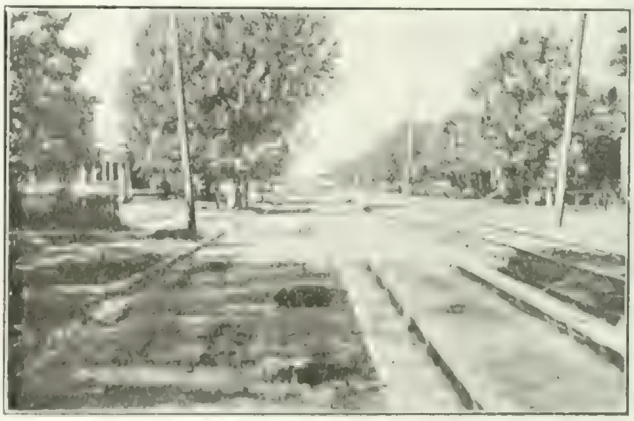


Fig. 3. Concrete and Track Work Complete, Ready for Brick Paving.

Before grouting, the 2 by 4-in. piece was removed and the space [illegible] concrete to a plane 1 in. below the top of the rail, forming the flangeway for the wheels. After this had set, the [illegible] pavement was grouted thoroughly and carefully. When [illegible] up, the grout remaining over the top of the pavement was allowed to stand until it had [illegible] set and was fairly stiff, then dry sand was sprinkled over it and the whole was swept thoroughly with wire brooms, thus removing all surplus grout sticking to the tops of the bricks and presenting a very neat, clean surface. It was noticeable, too, how very much the paving contractor improved in the character of his work, when this specification of cleaning off the top of the brickwork was strictly enforced. By this method all irregularities of laying and surfacing are strongly brought out, and easily seen and corrected.

Cost.—The cost of track construction of this type for paved streets, including the paving between and for 2 ft. outside of the rails, using the 70-lb. high T-rail, under the conditions at Springfield, was approximately $5 per ft. of single track. This cost may seem to be high, but, when the permanent character of the work is taken into consideration, and the cost of doing street work under other methods is analyzed and compared, it will be found to be very reasonable. It possesses several advantages over some of the methods in vogue. It takes less concrete than the old method of filling under and around wooden ties. It places the concrete and the strength where it is most needed, and, when properly put in, it is certainly permanent, and the roadbed will easily outwear two or more sets of rails under heavy traffic. The rail can be changed without disturbing the roadbed in the least, if proper provisions have been made in the steel ties originally.

On one section of similar track construction, known to the writer, not the slightest sign of any motion could be detected after 3 years' operation, and it is reported to be in as good condition as the day it was built.

The writer trusts that the foregoing brief description may prove of interest to members of this society and bring out some discussion on work of this class, concerning which very little has appeared in the technical press.

The work was done by the Springfield Traction Company, owned and operated by the Federal Light and Traction Company, of New York, and was executed under the general direction of Mr. W. A. Haller, chief engineer, the writer being in immediate and full charge of all construction matters at Springfield, Mo.

COST OF PUMPING WATER.

The following costs of pumping water by steam power and by electric power are abstracted from a letter written to Municipal Engineering by Mr. William Plattner, consulting engineer of North Attleboro, Mass.

Electricity in the waterworks has now been used for more than fifteen years, and the electrically driven pump has taken a permanent place among the steam driven machinery.

Like all other machinery in waterworks or elsewhere, the electric pump has its limitations. There are situations, however, and they are very numerous in waterworks pumping, where the electric pump is not only a great convenience but a profitable investment. In any power or pumping device, the use of electricity is a question of service, cost of power and investment charge. Conditions in different localities differ, and no two installations are likely to be the same, viz.: pressure (fire and domestic), hours of pumping (day or night), capacity of stand pipes or reservoirs, number of water consumers (flat rate or metered), total head, including suction, discharge, friction, etc.

Here are a few towns that purchased electricity for pumping water, also the price paid per kilowatt hour:

Lincoln, Ill., population 8,000, rate 5 cents to 2 cents per kw. hr.

Dover, N.H., population 13,000, rate 2 cents per kw. hr.

Norwood, Mass., population 9,000, rate 1.6 cents per kw. hr.

Cheboygan, Mich., population 6,000, rate $26.50 per h.p. per year.

Other towns pumping water with electrically driven pumps are as follows: Lima, Ohio; DeKalb, Ill.; Maywood, Ill.; Grand Haven, Mich.; Rockford, Ill.; East Douglas, Mass.; Dudley, Mass.; Harvey, Ill.; Lagrange, Ill.; Blue Island, Ill.; Holland, Mich.; North Chelmsford, Mass.; Uxbridge, Mass.; Webster, Mass.

A comparison as to cost of pumping water, electricity vs. steam, follows. This is for a town of 4,500 people in New England, 200,000 gallons of water pumped per day or 73,000,000 gallons per year. Water is pumped to reservoir from driven wells, pressure 62 pounds.

By Electric Power.

Cost of Plant.

Brick pumping station, 20 x 20 ft.	$ 800.00
Grading, road, fences, etc.	150.00
One 5½ x 8-inch double acting, triplex pump, capacity 220 gallons per minute, in place on foundations, with all measuring appurtenances, including sand and air chamber, and independent pump for renewing the latter, connected with one 20 h.p. electric motor	1,835.00
	$2,785.00

Annual Expenses.

Interest on $2,785.00 at 4 per cent.	$ 111.40
Depreciation on pumping station, $800.00, at 2½ per cent.	20.00
Depreciation on pumping plant, $1,835.00 at 5 per cent.	91.75
Electric current purchased, 60,833 kw. hrs. at 3 cents	1,824.99
Oil, waste, repairs	50.00
Attendance, one-eighth of one man's time	105.00
	$2,203.14

By Steam Power.

Cost of Plant.

Brick pumping station, chimney, coal room	$6,300.00
Grading, road, fences, etc.	250.00
One 9 x 18 x 18½ x 12 duplex compound condensing pumping engine, capacity 220 gallons per minute, set in place, with all necessary appurtenances, connected with one 90 h.p. horizontal return tubular boiler complete in brick setting	4,730.00
	$11,300.00

Annual Expenses.

Interest on $11,300.00 at 4 per cent.	$ 452.00
Depreciation on pumping station, $6,300.00, at 2½ per cent.	157.50
Depreciation on pumping plant, $4,750.00, at 3⅓ per cent.	158.33
Boiler insurance	21.00
342 tons coal at $4.75 per net ton	1,624.00
Oil, waste, repairs, etc.	75.00
Attendance, one-half of one man's time	420.00
	$2,908.33

SOUTHERN VANCOUVER ISLAND

The area described in a report to the department of mines, Ottawa, by Mr. C. H. Clapp, includes that part of Vancouver Island which is south of the Alberni-Nanaimo road, and east of the Alberni canal and Barkley Sound; and also includes Saltspring Island, and several smaller islands off the east coast of Vancouver Island, in Haro Straits. This area is approximately 4,000 square miles.

Much of the southeastern and eastern part of the region is accessible by road. In the vicinity of Victoria, on the Saanich Peninsula, and along the east coast north of Cowichan Bay, the country is well settled, and there are many good roads. Main roads extend from Victoria west to East Sooke and Jordan River, and northwest by way of Sooke and Shawinigan Lakes to Duncan. There is a stage road from Duncan to Cowichan Lake, and another from Nanaimo to Alberni. There are two railroads in the area, the Victoria and Sydney, and the Esquimalt and Nanaimo. The former is located on the Saanich Peninsula, while the latter follows the east coast as far north as Nanoose. At the present time an extension is being built across the island to Alberni. Other extensions and new railroads and tramways are projected, to open up the interior of the island.

At present the inlets and lakes, a few of the rivers, and the Cowichan Lake and Alberni roads furnish ready access to the interior of the island, and no very long packing trips need be made. Such trips at the present time must be made without the aid of pack animals, as the trails are not numerous, and with two or three exceptions are suitable only for men. Even these trails, when well located and cleared of brush, are of the greatest assistance, for on them seven or eight miles may be readily travelled in a day by one carrying a heavy pack; while without a trail three miles is often the limit which it is possible to travel in a day, with the hardest sort of muscular work. The establishment of more trails is, therefore, of the greatest importance, and would fill a most urgent need.

A large part of the shore may be safely traversed in a small boat. Coasting steamers run between Victoria and ports on both the east and west coasts.

The mineral resources of southern Vancouver Island include deposits valuable, or possibly valuable, for gold, copper iron, fuels, fluxes, lime, cement pigment, clay, sand and gravel and stone. Coal has been the chief source of mineral wealth, and copper and some gold have been commercially produced. Lime, cement, clay, sand, gravel, and crushed stone as well as coal are being produced at present.

Gold is found in the gravels of a large number of the streams of southern Vancouver Island, but with two or three exceptions, the principal deposits all occur in the streams which drain the area underlain by the Leech River slates and have been derived from very low grade quartz veins in that formation. The gold-bearing gravels [illegible] Where accumulations of gravel at the old mouth of Lost River and near the mouth of [illegible]

The copper deposits of southern Vancouver Island are [illegible] zones with accompanying quartz veins, under which is the [illegible] Mount Sicker. The contact deposits, which are developed chiefly in metamorphic limestones near their contacts with intrusive igneous rocks, are the more numerous. They are, as a rule, small, irregular, and of low grade, but some of them are of considerable economic interest. The deposits occurring in shear zones are of little importance, with the exception of the special Sooke type, which is of great prospective interest. The Tyee deposit, now largely worked out, is the only deposit from which there has been a commercial production.

The iron ore deposits are of four types, contact deposits, impregnated schists, replacement or segregation deposits in the Sooke gabbro, and bog ore deposits. The contact deposits are by far the most important; and consist of bodies of magnetite, which have been formed in the metamorphosed Nitinat limestones, near the intrusive Beale diorite. The bodies are large, and low in phosphorus, but high in sulphur. The chief deposits occur in the valleys of Gordan River and its tributary, Bugaboo Creek. The impregnated schists occur in the Sicker series. The mineral-bearing rocks are dark red, jaspery schists, with 10 to 15 per cent. of magnetite. Since the magnetite can be easily concentrated they are of prospective importance. The other two types are apparently of no value.

Coal is the source of a very important industry on the east coast; the coal being obtained near the base of the Nanaimo formation in the Comox basin, and in the northern part of the Nanaimo basin, from 600 to 1,500 feet above the base. These coal deposits have not been examined during the present investigation. Coal of commercial value is apparently absent from the other basins of the Cowichan group, and is almost certainly absent from the Tertiary sediments of the west coast. These sediments have also been prospected for oil, but the conditions for the accumulation of oil do not seem to be favorable.

The crystalline limestones of the Nitinat and Sutton formations furnish excellent and ample material for flux, and for the manufacture of lime and cement. Cement is manufactured in the southeastern part of the island by the Vancouver Portland Cement Company, and lime is burned by several manufacturers also in the southeastern portion of the island.

A bog deposit of yellow ochreous clay in the Sooke district is a possible source of material for a base for colored paints.

There are two types of clay deposits in southern Vancouver Island, the shales of the Nanaimo formation and the clays of the stratified superficial deposits. The greater part of the shales of the Nanaimo formation are sandy and impure, but associated with the coal in the Nanaimo and Comox basins are thin, lens-like beds of clay-shale. This shale is mined by the coal companies and used by the British Columbia Pottery Company at Victoria, where it is mixed with the clays of the superficial deposits, for the manufacturer chiefly of sewer pipe. The clays of the stratified superficial deposits are used for the manufacture of common bricks and drain tiles, at Victoria, Sidney, Sidney Island, and Somenos.

Sand and gravel are also obtained from the stratified, superficial deposits of southeastern Vancouver Island.

The fractured and sheared character of the rocks renders most of them unfit for building stones. In rare instances the marbles may be of value, and some of the dark granitic [illegible] exposed near Alberni canal would doubtless make good building stone. The sandstones of the Cowichan group, especially of the Nanaimo and Comox basins, offer excellent material for stone of that kind.

The traps, especially those of the Metchosin volcanics, offer abundant material for an excellent quality of crushed stone. The Metchosin volcanics are quarried at Albert head, in Esquimalt district, by the British Columbia Trap Rock Company.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 26, 1912. No. 13

CONTENTS OF THIS ISSUE.

Editorial: PAGE

Concrete Sidewalks 517
Winnipeg Water 517
The Pollution of Waters 518
Road Improvements 518

Leading Articles:

Refuse Disposal Plants 503
An Electrolytic Sterilizing Plant 507
Experiments in Oil Smelting in British Columbia 508
Management of Track Laying on New Railway Work 508
The Design of Girder and Truss Spans and Trestle Work on Structural Steel 509
A Large Planer 512
A Brief Description of a Modern Street Railway Track Construction 513
Cost of Pumping Water 515
Southern Vancouver Island 516
Special Trackwork for City Electric Railways 519
Deodorizing Sewer Air at Winnipeg 522
How to Obtain Efficiency from Pressure Filters 523
Stone Ballast 525
The Purification of Water from Standpoints Other than the Hygienic Aspect 526
Railway Receipts and Expenses 529
Some Observations on the Disintegration of Cinder Concrete 530
Book Reviews 531

Personals 535
Coming Meetings 536
Engineering Societies 536
Market Conditions 24-26
Construction News 67
Railway Orders 74

CONCRETE SIDEWALKS.

In the building of concrete sidewalks a wide diversity of opinion exists among engineers as to the foundation to be used. A few years ago it was quite customary among municipal engineers to provide in the specifications for the laying of drain tile under the centre of the walk. This drain tile was very often laid when there was no necessity and without outlet, with the consequent result, the drains filled with water and very often froze in the winter. In many of the towns and cities throughout Canada may be noted sidewalks with a longitudinal crack running along them. This in nearly all cases was the result of the water freezing in the drain tile. The drain tile is not very often used or called for in specifications at the present time, but the question of foundation is still an important one. The usual specifications call for a foundation base of several inches of cinders or gravel. The object of this base is to provide a foundation of porous material to furnish proper drainage. It stands to reason that when the sidewalk is laid upon a naturally drained soil, such as gravel or sand, this porous base is, therefore, unnecessary. If the sidewalk is built on clay, the base of cinders or gravel may have the same effect as the drain tile mentioned above, particularly if no way is provided to remove the water that will collect in the porous base. To the engineer who has had some experience in laying sidewalks, it will be appreciated how hard it is to make the contractor provide drainage for the foundation.

We believe that in most cases the best results will be secured by omitting the porous base and by placing the sidewalk on the bare earth. Information received from a number of municipal engineers recently leads us to think that this is being done in many of our towns and cities now. The results appear in all cases to be as favorable, or more favorable, than with the use of a base. The omission of the clause in the specification calling for a foundation of cinders or gravel will usually be justified, and will result in a considerable saving.

◆

WINNIPEG WATER.

Winnipeg has reached the point where some decisive action must be taken with regard to its water supply. The chief available sources of supply, as pointed out in the recent report by Prof. Slichter, are the Winnipeg River, the Poplar Springs, the Crystal Springs, artesian wells and Shoal Lake. Shoal Lake, the source recommended in the report, is about ninety miles distant from the eastern extremity of the city, in the Lake of the Woods district. The Provincial Board of Health maintains that the water supply of the city should be of an abundant and pure character, and derived from a visible source. The Commission of 1907, who reported on the water supply for Winnipeg, recommended Winnipeg River as a source of supply, but they stated that Shoal Lake was their ideal. They thought, however, that such a project at that time was too expensive. City Engineer Ruttan, in his report on Prof. Slichter's recommendations, states that hitherto the great cost of a supply from Shoal Lake has been considered an insurmountable objection. He adds that the quality of Shoal Lake water leaves nothing to be desired, and it is to be regretted that the engineering data available is not sufficient to enable an accurate estimate of the cost of the project to be made. He suggests that steps be taken to have a thorough and accurate survey of the Shoal Lake project made, so that all the points now in doubt, including the cost, may be determined.

It is clear, therefore, that from every standpoint Shoal Lake water is the best for the city, and it comes down to a question of cost. It is to be hoped that after a thorough engineering investigation Winnipeg will be able to secure their water supply from this source.

◆

THE POLLUTION OF WATERS.

Last week we noted in the editorial columns that the International Joint Commission has been instructed by the government of the United States and Canada to investigate the question of pollution of boundary waters. The closing session of the Canadian Public Health Association Congress, held last week in Toronto, was marked by a strong resolution adopted by the executive council, taking a firm stand on the question of the pollution of waters. The resolution states:—

"That a committee of members be nominated to draw up a memorial to be presented to the Dominion Parliament, as follows:—

"That it is against the interests of the public health that raw, untreated sewage be permitted to discharge into waters which are used as sources of water supply.

"That it is the conviction of the Canadian Public Health Association that an Act of Parliament regulating the pollution of streams and lakes is required in order to strengthen the action of provincial authorities in this matter.

"That the committee appointed be given power to draw up the said memorial and present parliament all available evidence and data bearing upon the matter of prevention of pollution of waters which may be or are used as sources of water supply."

Last year at the annual meeting of the Canadian Society of Civil Engineers a similar resolution was passed and a committee appointed to approach the Dominion government on the same question. Resolutions like the above, when backed by such powerful organizations, should be instrumental in drawing the attention of the Dominion authorities to the necessity for some immediate action towards the regulation of the pollution of streams and lakes throughout Canada.

In one of the addresses delivered before the American Public Health Association, held in Washington last week, the statement was made that so much damage does sewage do to the water in the vicinity of large cities that Lake Michigan is more or less polluted to a distance of several miles from shore, at times heavily so.

The speaker added that the intake pipes supplying drinking water for the towns along the lake shore should be carried out from twelve to fifteen miles from shore, and sewage disposal plants should be provided in the cities discharging sewage into the lake or rivers emptying into it.

An Act of Parliament regulating the pollution of streams and lakes would certainly aid in strengthening the hands of the provincial authorities in preventing raw, untreated sewage being discharged into waters which are used as sources of water supply. The public are gradually being impressed with the danger of polluting them with a haphazard system of disposal. Modern technical conditions demand the abandonment of primitive methods and the utilization of scientific methods of treating sewage before it is allowed to enter the streams and sources of water supply.

ROAD IMPROVEMENTS.

The second annual report of the Road Board of Great Britain affords some interesting data concerning road improvement. The report shows that about two and a quarter million dollars has been expended upon the improvement of road crusts, and about two hundred and seventy-five thousand dollars upon road widening and improvement of curves and corners. In certain criticisms of the work of the Road Board which have been made in Great Britain, the predominating note appears to be the slowness made in the employment of tar-spreading. It is stated that there can be no two opinions that both in the case of the dusty roads of last summer and the wet roads of the present year the judicious use of tar has worked wonders. It would be difficult, even in the case of a variable and treacherous climate like that of England, to find two summers more unlike one another than those of this year and last year, but both for the crumbling roads of 1911 and for the sodden roads of 1912 the tar has been found to give excellent results. This is more especially the case with the soft roads, intended for rural traffic, made with local sandstone, as in Surrey, for instance, or with some of the more porous varieties of limestone. On certain of the Surrey roads tarred three years ago, which received a light coating of tar again this spring, there is surprisingy little wear perceptible, whereas on roads of the same character in the immediate vicinity where no tar was spread the rain is running in streamlets along the channels worn during last summer in the soft metalling, the surface having been pounded into dust and distributed over the hedges and gardens. Not only does the tarred road behave better under the elastic tire, but it certainly throws off the wet and keeps sound much longer than the untreated macadam.

Where tar or heavy oils have been used on the road surfaces in this country, it has been almost universally successful. It is surprising the improvement that will result from even one application, and it is certain that the use of such surfacings will widely increase.

◆

AMERICAN PIG-IRON COSTS.

During a recent discussion between representatives of iron mining companies and Ohio taxation officials of Cleveland, Messrs. Hanna and Company presented the following statement as to the cost of making a ton of pig iron in the Valley:

Iron ore, 2 tons	at $2.75	$5.50
Freight to Valley	" 0.56	1.12
Coke, 1.2 tons	" 2.25	2.70
Freight from Connellsville	" 1.35	1.62
Limestone, .5 ton	" 0.65	0.325
Freight on limestone	" 0.35	0.175
Cost of raw material		$11.44
Conversion cost at furnace		2.00
Cost of one ton of pig iron		$13.44

With basic, foundry and malleable iron selling as low as [illegible], the selling price was less than the cost as given.

SPECIAL TRACKWORK FOR CITY ELECTRIC RAILWAYS.

The following is abstracted from an article by Mr. W. E. Turner, published in the August issue of Applied Science.

In the construction of electric railways in cities, and especially in paved streets, the special track layouts constitute one of the most important items to be decided on, ordered, constructed and maintained by the engineering department. The high first cost, high maintenance, and quick depreciation of even the best layouts, make them an item of great importance to the company.

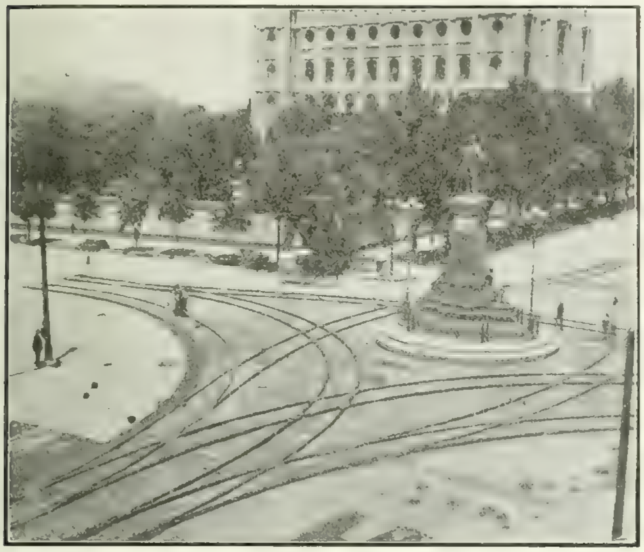


Fig. 1.

As a general rule the street railway company does not manufacture its own special work and it is not the intention of this article to deal with the manufacture of specials, but rather to present a few of the most important considerations for the engineer of the railway and at the same time to explain terms and conditions which may not be familiar to those who have not encountered much special work.

A special layout is a combination of switches, mates, frogs, crossings, and curves, arranged to make connections between different tracks. In its simplest form it is a plain ninety degree crossing of two tracks, and in its more complex phases it becomes a very intricate network of steel.

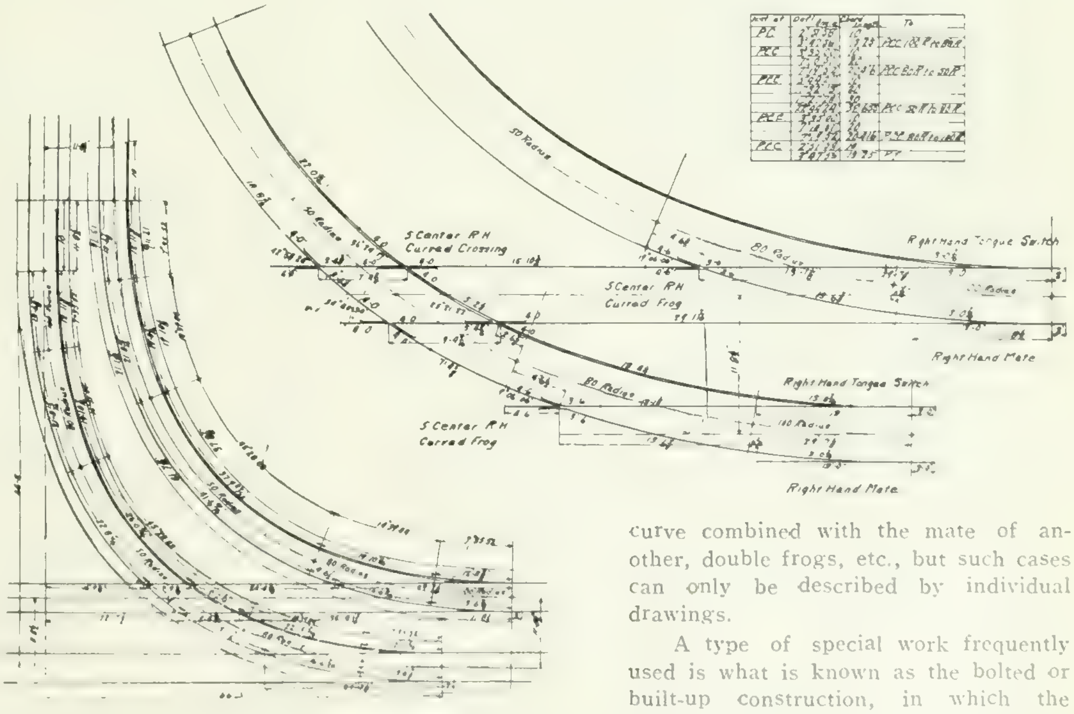


Fig. 2.

Fig. 1 shows a sample layout of average complication for a business district intersection. This particular instance is what is known as "the Brigham Young Layout," surrounding the famous statute of Brigham Young at the corner of South Temple and Main Streets in Salt Lake City. In the background may be seen the Mormon temple and tabernacle, the latter having the curved roof. This layout is on the tracks of the Utah Light and Railway Company, and the other illustrations and descriptions are drawn largely from this company's standard practice. It may be interesting to note that the Brigham Young layout cost about $13,000, complete, in place, and repaved.

In Fig. 2, showing a five-centre curve, may be found the names of the most commonly used pieces in track layouts. It will be noticed that in all cases tongue switches and mates are referred to instead of split switches, which are used entirely on steam roads, but very seldom on city electric lines. There are right and left hand switches, those shown on Fig. 2 being known as right hand because the curve turns to the right when entering it from the switch. There are also right and left hand curved frogs and crossings.

A cross-over is a connection between two parallel tracks as shown in Fig. 3. The switches and mates are the same as those shown in Fig. 2, but in this case we have straight frogs and it is not necessary to carry them in "rights" and "lefts." Right hand cross-overs are always preferable where the traffic takes the right side of the street on account of avoiding a "facing switch," that is, one in which the point of the tongue faces the approaching car. Cars must stop or run very slowly when passing a facing switch. A turnout is similar to a cross-over except that the second track ends at the turnout instead of going right through. Sometimes spring switches are convenient at turnouts. For instance, if all the traffic going south takes the turnout, and all going north takes the through track, the switch may have a spring holding the tongue in position for the turnout. It is evident that cars going north will enter the switch from the rear end and spring it out of the way as they pass.

Besides the above commonly used "specials," there is an infinite number of odd pieces, such as the frog of one curve combined with the mate of another, double frogs, etc., but such cases can only be described by individual drawings.

A type of special work frequently used is what is known as the bolted or built-up construction, in which the specials are built up of pieces of rail, planed off to fit together, bent for wings and curves, and bolted through steel bars and cast steel fillers. Practically all steam road specials are made in this way, and being the least expensive form of construction, the build-up specials are adaptable to electric roads in unpaved streets where traffic is light. They are used extensively for steam and electric crossings.

A more rigid form of construction is the cast iron body which, in the molten state unites so closely with the rail components as to form practically a solid mass. The cast body has usually the hardened renewable centre. The centre plate is hardend by patented and more or less secret processes, a very satisfactory combination being manganese steel, which will wear probably four times as long as ordinary rail steel.

The most substantial, and incidentally the most expensive, specials are simply solid castings with no rolled sections, but with the ends cast in the form of rolled sections to join abutting tracks. Such castings are used for very complicated pieces, and for points of heavy traffic, such as important steam road crossings in pavement, in which case the whole crossing is sometimes cast solid or hardened steel. This form is quite expensive to use.

Hardened steel rails may be obtained for use on curves where the wear is very excessive. Titanium alloy steel has been recently introduced for this purpose.

In deciding what layouts are necessary for any particular system, the first consideration is, of course, the traffic, that is, the regular car routes and special car routes for such purposes as getting in and out from barns, packing cars for resorts or circuses, fair day routes, etc. The next matter of importance is the geographical situation—width of streets, location of curbs, distance between track centres, and possible obstructions such as poles.

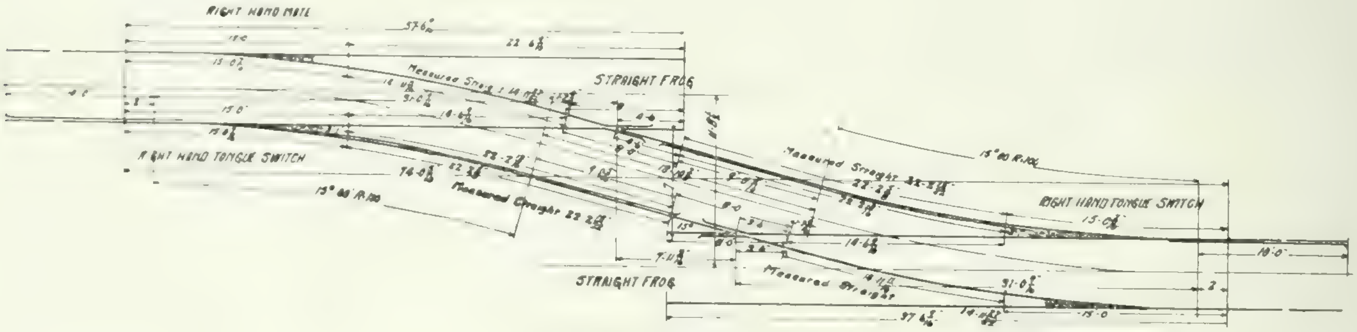
At the same time it is well to investigate whether cars can pass each other on curves. This can most conveniently be done by drawing up to scale a double track curve, such as shown in Fig. 2, and drawing on a separate piece of tracing linen, to the same scale, the longest car likely to be used, with the centres of both pivot plates marked. The drawing of the car is cut out and placed on the curve. By following the centre line of the track with the two pivot points, a clearance curve may be traced where the end of the car [illegible].

Besides these fixed conditions to be encountered, the engineer must himself fix a condition to make every possible piece of special work conform with certain standards. For instance, there is no reason why practically every switch and mate on the system should not be made for a 100-foot radius curve. The greatest advantage in conforming to standard pieces is, of course, interchangeability and keeping [illegible] which may be [illegible] for repairs, and other good advantages are the reduction of office work on [illegible] [illegible] keeping stock, in the field in laying out work, and in the shop and track departments by [illegible] with which the men are familiar. Track should be standardized by using only one or two standard rail sections. Throughout the system [illegible] of 65-pound A. S. C. E. [illegible] it is generally better to employ compromise joints to the special work than to order specials in odd sections.

If all double tracks are maintained at a fixed distance between centres, it will be a great step towards holding to standard special work. That will at least provide that all crossovers and turnouts may be standardized and will insure the same advantage to curves to a very large extent.

In the design of curves the first consideration is to fit the ground and clear obstructions, the second to use standard pieces in every place possible, and the third to get the greatest available radius of curvature. As the most of the street intersections will probably be of similar design, a standard curve such as shown in Fig. 2 may be employed for all such places. In Salt Lake City, there are two standard curves in use, viz., the five-centre curve, which is shown in Fig. 2, for narrow streets, and a three-centre curve for the broader streets. The least radius in the three-centre curve is 66 feet 7 inches, and in the five-centre curve, 50 feet.

A compound curve, such as shown in Fig. 2, facilitates sharp curves on corners, permits the standard 100-foot switch and mate, and swings the car gradually from large to smaller radii. Its use is to be preferred to a plain curve. It is easily laid out in the field by reference to the table in the corner. Some of the large steel companies recommend spirals at the entrance to curves. Instead of running over a 100-foot radius and an 80-foot radius to get to the central 50-foot curve, they would start with a 100-foot radius and spiral around by an infinite series of decreasing radii to reach the 50-foot curve.



Standard Right Hand Crossover

Fig. 3.

In connection with the least radius of curvature practicable for general use it is a matter impossible of accurate calculation and one upon which authorities differ. Curves of as small as 35-foot radius, and possibly less, are in use, but it is conservative practice to establish a limit at 50 feet. On a 50-foot curve the rail wear is very excessive, wheel depreciation is high, and the load on line and motors is severe.

Referring again to the necessity of standardizing all pieces, a list is given of the specials usually carried in the Utah Light and Railway Company's stock, as an illustration of the number of pieces necessary even when all work is standardized. The 80-pound specials are high tee rail for use in the commercial district, and the 65-pound A. S. C. E. for use elsewhere. It will be noticed that frogs are not referred to by number according to steam road practice, as that system is not applicable to right and left hand curved frogs.

Besides this list there are some odd pieces left from previous administrations. The above are all of the manganese centre, cast body type. Steam road crossings are all special and ordered as required and are mostly of the bolted construction bought on a tonnage basis.

As the listed specials range in value from $50 to $400, they represent a considerable investment. The stock is piled in the material yard along tracks. The pieces are marked 5CL, 3CR, etc., and they are handled with a light derrick car.

List of Specials Carried in Stock—U. L. & Ry. Company.

	Frogs	Curved Crossings	
80lb R.H. switches	80lb R.H. 5C	80lb R.H. 5C	80lb straight 15° frogs
80lb L.H. switches	80lb L.H. 5C	80lb L.H. 5C	80lb square crossings
80lb R.H. mates	80lb R.H. 3C	80lb R.H. 3C	
80lb L.H. mates	80lb L.H. 3C	80lb L.H. 3C	
65lb R.H. switches	65lb R.H. 5C	65lb R.H. 5C	65lb straight frogs
65lb L.H. switches	65lb L.H. 5C	65lb L.H. 5C	65lb square crossings
65lb R.H. mates	65lb R.H. 3C	65lb R.H. 3C	
65lb L.H. mates	65lb L.H. 3C	65lb L.H. 3C	

Note. R.H. and L.H. denote right and left hand, respectively.

Drawings should be made of all standard layouts showing distinctly the track alignment, gauges, length of wings required, and in ordering the specials the above drawings may be sent to bidders without any detailed drawings of the construction, and without any rail lengths, frog angles, or other details which may be readily worked out from the data given. The steel companies always re-calculate these items and use one of their standard forms of construction on the specials. An exception is in the bolted or built-up construction for which it is well to have a standard drawing, showing type of construction preferred, in detail but leaving out angles, radii, wings, rail sections, etc., which must be filled in for each individual case on a separate skeleton drawing.

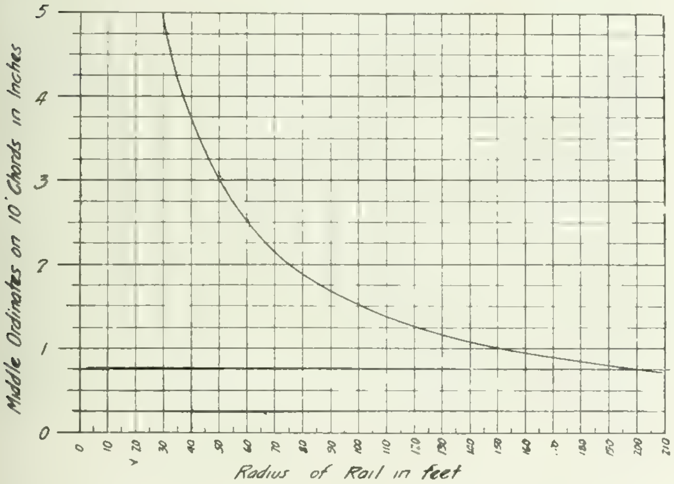


Fig. 4.—Middle Ordinate Curve for Rail Bending.

An order for specials should cover the points to be found in the following sample order.

Sample Order.—Three crossings, right hand, standard 5-centre curve, hardened steel renewable centre construction, C. I. body, for use with 7-in. 80-pound rail, Lorain section No. 335 with 1-in. by 5½-in. bar guard plate as shown on drawing, No. X. Drilling for track bolt, 3-in. 6-in. 1⅛-in. holes; for bonds 31-32-in. holes 6 in. from ends, all 3¼ in. above base of rail. See drawing No. Y for drilling. General layout on drawing No. Z (see Fig. 2). (It is sometimes advisable to refer to a catalogue number for type of construction.) All the drawings mentioned may be on the same or different sheets.

Whole layouts may be ordered complete from the steel companies and for complicated layouts it is a good idea to have them made up completely in the same shop, and every piece marked according to blue print. For instance, the Brigham Young layout (Fig. 1) was ordered complete and is all made of guard rail section.

It is customary to make up all simple layouts which require only the standard stock specials, in the railway company's shop. For this purpose, besides having access to a blacksmith shop, there should be a rail bender, a fairly heavy drill press, a metal saw and saw sharpener. The track shop should be convenient to a vacant space large enough to fit together one or more layouts before taking them to the work.

Layouts are staked out with a transit at the shops and in the field. (See transit notes on Fig. 2). For all curves which are not standard the following information is supplied by the engineering department for use of field and shop men; all data necessary for the exact location of track centres such as the P. C., radius and central angle of each curve, the distance between track centres and lengths of tangents. The following details more particularly for the shop men: size of rail, lengths of specials, location of switches, mates and frogs from point of curvature, lengths of each piece of rail measured straight before bending and the middle ordinate of each curved rail on, for example, a 10-foot chord.

Two points might be noted in connection with this, first, that the description of curves by degree of curvature is not convenient when the radius is small, and second, that drawings or measurements, showing the location of the points of frogs or crossings, refer to the intersection of the two gauge lines and need not necessarily coincide with any actual point.

Fig. 4 is a curve showing middle ordinates on a 10-foot chord for different radii of bent rails. For very sharp curves the middle ordinate is different for the outer and inner rail. This curve is derived from the very simple formula—

Middle ordinate $= R - \sqrt{(R + \frac{1}{2}C)(R - \frac{1}{2}C)}$ where R = radius in feet of the bent rail, and C = the chord length in feet.

In the case first considered, the length of chord is 10 feet.

◆

A LARGE CONVERTER.

What is declared to be the largest converter in existence has been blown in at the Boston and Montana smelter at Great Falls, and officers of the Anaconda company are watching its operations with much interest, as the result will decide whether such a monster furnace can really effect a saving in smelting operations. President B. B. Thayer, of the Anaconda company, witnessed the start of the new converter, which will take approximately 50 tons of molten metal. It is of the upright type, to which the Anaconda company has always adhered, while others have tried the barrel-shaped converter. The bearings in the new converter weigh 13 tons each, and when it is full of metal the whole weight is approximately 300 tons. When compared with the former types in use those familiar with the smelting business will recognize the tremendous increase in size is represents. It has a diameter of 20 ft., while those in former use were 12 ft. The wind box has a height of 7 ft. The converter proper, not including the cast iron bearings and gears, weighs 65 tons, and 130 tons of brick were used in the lining. So far the converter has worked satisfactorily. Concerning the company's plans for rebuilding the Great Falls smelter, President Thayer said the contracts for the steel had been signed, and would be delivered not later than the middle of November. The work of reconstruction will then proceed as rapidly as possible.

DEODORIZING SEWER AIR AT WINNIPEG.

A sewer ventilation test, covering a period of three months, was made at Winnipeg, Canada, during 1910 to determine the efficiency of 10 Beeman sewer deodorizing machines located in manholes. Each machine consists of a reservoir containing wood alcohol, the fumes from which impinge upon a platinized porcelain disc about 1½ inches in diameter. The disc is first heated to cherry redness and remains incandescent as long as the alcohol fumes are supplied to it. The combustion of the alcohol fumes produces formalin in sufficient quantities to deodorize the sewer air when it emerges from the manhole. The cost of operation, per day, according to a report by Col. H. N. Ruttan, city engineer of Winnipeg, ranges from 9 to 18 cents for each machine, not including capital charges. Since these tests were made the large burners on some of the machines were replaced by smaller burners with a consequent reduction in the consumption of alcohol and cost.

Operation and Cost of Sewer Deodorizing Machines at Winnipeg, November 1, 1910-January 31, 1911.

[illegible]

A report by Dr. J. H. Leeming, city bacteriologist, indicated that no bacteria were found in the sewer air, either before or after passing through the machine, and that the formalin is not in sufficient quantities, nor in contact with the air a sufficient length of time, to have any effect upon bacteria if they did exist in the sewer air.

From the tests at Winnipeg Colonel Ruttan draws the following conclusions: (1) The machines will deodorize sewer air; (2) they will not destroy bacteria nor will they have any effect in preventing them from emerging from the manholes, assuming that they exist in the sewer air; (3) [illegible] per day; (4) the number of manholes in the city sewer system is approximately [illegible] and the number of deodorizing machines should not be less than one in every third manhole.

[illegible]

[illegible]

coming from the abattoirs, but at the end of November these burners were removed and the ordinary burners substituted, and have been working more satisfactorily since.

The city of Winnipeg entered into a contract for 50 more of the deodorizing machines; they were supplied by the International Sanitary Company, Limited, of Winnipeg, which has submitted the following estimate of the cost of yearly operation of the Beeman deodorizers on the basis of 800 machines being operated 12 months in the year: 800 machines at $75, $60,000, or a yearly interest of $2,400; cost of alcohol, 800 machines using 1 gal. at 62½ cents every 9 days, $20,000; cost of attendance, 1 man, $900; cost of rig and driver, $1,200; cost of wicking and sundries, $100; allowance for extras, $300; total, $24,900 yearly.

To this would have to be added the cost of the machines which, estimating 12 years as the probable life, would give an annual cost of $5,000, making the estimated yearly expense a trifle under $30,000 yearly.

◆

ELECTRO-METALLURGICAL DEVELOPMENTS IN CANADA.

In a paper on this subject read before the American Electrochemical Society, Mr. S. Dushman refers to the copper-nickel deposits in the Sudbury district, and Dr. Haanel's scheme for the magnetic separation of the iron and magnetic nickel from the copper, precious metals and non-magnetic nickel compounds, followed by electric smelting of the iron-nickel portion to form ferro-nickel, and electrolytic treatment of the tailings as is practised at present in dealing with the matte, which process would enable Canada to export finished products instead of matte, as is now done. Referring to the iron ores of Canada, Mr. Dushman points out that Canada has immense iron-ore deposits distributed at widely different points. The deposits in Northern Ontario, in the Ottawa and Gatineau districts, and in Vancouver and Texada Islands are specially noteworthy. Many of these ore deposits are situated in localities where coke for smelting operations has to be imported from Pennsylvania at prohibitive cost. In fact, it is only in the extreme eastern portion of Canada, where the iron ore of Newfoundland can be worked economically with the coal deposits of Cape Breton, that an extensive iron industry has developed. In Ontario and British Columbia coke for metallurgical purposes has to be imported. The deposits are, however, usually situated near some source of water-power that could be developed at low cost. The lack of ores suitable for treatment by the blast furnace has been one of the factors preventing the growth of an iron industry in Ontario. But by the use of electrothermic processes and some method of concentrating the ores, it is quite within the limits of possibility that a much larger iron industry could be developed in Ontario. Recent Government experiments on [illegible] ores from different points in Ontario have demonstrated that first-class Bessemer concentrates (with one exception) can be produced from the crude ore submitted for testing purposes, and it has been [illegible] sulphur, when submitted to a process similar to the Grondal system of briquetting. These briquettes could, of course, be treated in the electric furnace. The combination of concentration and electric furnace [illegible] when it is considered that Ontario contains numerous sources of water-power that could be developed at low cost. Considering the advantages offered by electrothermic processes and their special applicability to Canadian ores, there seems to be no doubt [illegible] future for the electric iron and steel industry in that country.

HOW TO OBTAIN EFFICIENCY FROM PRESSURE FILTERS.*

By H. W. Cowan, C.E.

Before discussing the efficiency of any type of filtering appliance it will be necessary to give a brief resume of what has brought about their evolution.

The first type of filter, consisting of a large prepared bed of sand, was the result of observation of the effects produced on water which had flowed through layers of sand and gravel, giving a clear and crystalline stream as the result.

On putting this into operation, good results were not obtained immediately, but after several days' run the resulting effluent was apparently satisfactory.

The reason for the change was due to the slimy deposit which had formed on the surface of the sand.

This produced a sticky coating round the particles of sand on the surface of the bed to which suspended matter adhered and was retained, in the same way as globules of mercury will run together and become incorporated.

Further experiment showed that with clear waters it took considerable time for the film to form; that only certain rates of flow were permissable, anything higher causing damage to the film, through which break the water flowed as there was little resistance to its passage through the sand at that point. The disturbance set up caused surface currents which further broke up the film, and led to still greater inefficiency.

The rate of flow being determined and maintained, a growth of algae appeared after a time which added to the closeness and strength of the film, allowing a higher rate of flow to be used.

When everything appeared to be satisfactory, after some weeks' operation the water supply showed signs that breaks in the film were present.

These proved to be due to the presence of insect larvae, blood worm tubes having formed in the sand, from which the insect Chironomous on maturity emerged in large numbers, leaving small perforations through which the water flowed at a high rate, producing vibrations which broke up the continuity of the film.

On cleaning the beds, which were an acre in extent, for a volume of two million gallons per twenty-four hours, a repetition of the first troubles in again tuning up the beds before they were effective was experienced.

Regulations being used to determine the rate of flow, and careful examination being made from day to day to show when the beds required cleaning improved the position until it was found that the algoid growth in winter was much slower than in the summer months, calling for varying adjustments to suit seasonal conditions. In short, expert attention had to be given to slow sand filters to be productive of good results.

The disadvantages of this method of filtration had to be overcome, something being required to form the filtering film quickly, positively and evenly, which would operate to the same advantage in summer and winter, the cleaning of which could be simplified so that it might be performed more frequently, before insect ova could be deposited, and allowing of a much higher rate of filtration.

The first results of these conclusions led to the construction of covered filters to prevent varying conditions in summer and in winter, and the aforementioned insect troubles, but the high cost involved, the difficulty in cleaning, the time required for filming, and the slow rate of flow were still to be surmounted.

In overcoming these difficulties America led the way by patenting the first mechanical filter, to be closely followed a few months later by British engineers with other patents of a similar nature, all claiming a rapid rate of flow, simplicity of cleaning, positiveness in filming, and the occupation of a relatively small space.

These filters were shells constructed of wood staves, steel or iron in which the sand was enclosed so that it could not come in contact with contaminating influences, crushed quartz, charcoal, polarite or oxidium, (patented substances) being also used as the media.

Ferrio Oxide was used as a means of forming the film by entangling the colloidal and suspended particles, which fell on the filter bed, forming a felt in which organic and lighter substances were arrested.

Mechanical filters passed the water at a rate of from eighty to one hundred times that of slow sand filters, and immediately came into favor on account of the clarity of their filtrate, and the large saving in space.

They were washed by passing water through from the under side of the filter bed for several minutes, and running the sediment washed out to waste.

At this time the discoveries of Pasteur, Koch, and other scientists, with regard to bacteria as the means of transmitting disease, enabled research work to be conducted with regard to the real impurities of water and not those apparent only to the eye.

The proof that water was the chief agent in carrying disease gave a stimulus to water purification, having in view the elimination of pathogenic germs.

This led to the study of the effect of using ferrio oxide on the water treated by mechanical filters, which showed that iron was left in the water after filtration.

The growth of such organisms as Crenothrix, Cladothrix, Spirophyllum was produced in the water mains, Crenothrix in particular with its sack-like bladders deriving sustenance from the iron present, and filaments discolored with ferruginous matter were produced.

These filaments attached themselves to the pipes, and diminished their carrying capacity about one per cent. yearly, while back pressure and fluctuating flow detached fragments which discolored the water and gave off an unpleasant odor.

Resulting from this alumina sulphate was put into use, and ferrio oxide practically discontinued, the disadvantages of the latter being overcome. Practically all mechanical filters use this as a film producer at the present time.

The use of alumina sulphate produces a white, sticky viscid film (alumina hydrate) which is precipitated when reacting with the lime in the water. This collects suspended matters, and deposits them on the sand bed, having at the same time the property of removing coloring matter from the water treated, by its coagulating action.

The hydrate being absolutely insoluble, no trace of it can be detected in the filter effluent by chemical reaction, even the well-known log wood test failing to show its presence.

The success obtained led to the attempt to use a coagulant in slow sand beds, by first passing water through large coagulating basins, from which it flowed to the filter beds. This has never proved satisfactory owing to the large area of the beds preventing an even deposit on their surface.

Mechanical filters were now subject to more rigorous tests for the elimination of bacteria, and were found to be unsatisfactory owing to the foulness in the filter material not being removed by washing on account of the sticky nature of the film, which a reverse flow could not remove completely.

Attempts to force air through to assist the passage of the wash water were made but while the filter was apparently clean it was really becoming more polluted through its whole bed.

---

* Paper read before the Canadian Public Health Association Congress, Sept. 17th, 1912, Toronto.

When completely contaminated this would break through, showing a high bacteria count at varying periods, preventing continuous efficiency from being obtained and using a large amount of filtered water in the attempt to thoroughly wash the bed.

For these reasons mechanical pressure or closed filters have been looked on with disfavor for domestic supply, and American engineers have, as a body, reverted back to the open type filter, in which the sand is removed from time to time for complete cleansing, and a much lower rate of flow is used.

The excessive rating of pressure filters had much to do with causing American engineers to discontinue their improvement, but in Britain several engineers persisted in their experiments to obtain absolute cleansing, and finally succeeded in making a filter which could be cleansed mechanically.

In this filter the reverse flow was used, while the sand was violently agitated by means of agitators which released the sticky coating from the grains of sand. The power required to operate the washing mechanism, however, was so great that its use was not feasible.

A few years later the introduction of water under pressure through jets in the agitators, caused the sand to be put into such a state of suspense while they were being revolved, that a very trifling amount of power was necessary.

This allowed of continuous efficiencies of ninety-seven per cent. being obtained. A large amount of reagent was consumed which made operating costs prohibitive, and further study led to consideration of the stone germ proof filter invented by Pasteur.

It was felt that if a silica sand could be used which would compress under the water pressure into a temporary stone, allowing a high rate of flow to be obtained and the minimum of coagulant for the reduction of bacteria, that the difficulty would be solved.

Following these lines the modern filter was devised.

As it now stands the pressure filter constructed in Britain represents the highest type of commercial efficiency, more especially since the use of turbines operated by the inflow of water to pump in the coagulant have been devised

With these turbines as the rate of flow varies so does the amount of alum introduced, and the introduction of the alum before the water passes through the turbines enables these motors to thoroughly mix the coagulant so that positive hydration is obtained before the raw water reaches the filters.

Further observations have led to the discovery that the [illegible]

[illegible]

The rate of precipitation or sedimentation under pressure [illegible]

[illegible]

An adequate means of thoroughly agitating the sand should be employed while the washing operations are going on, and the water used should not exceed what is economical.

The best test for effective washing is to occasionally take a sample by removing the manhole and passing a tube into the sand two minutes after washing has been performed.

The sand withdrawn when placed in distilled water should show little or no turbidity, if it has been properly cleansed.

It is important that only a steady acting pump giving a steady flow free from vibrations be used, as jerks or unsteadiness in the flow might cause distortion and breakage of the film.

A means of adding the coagulant should allow of careful adjustment, varying in proportion to the water passing through the system, and such means should provide for the intimate mixing of the alum to ensure complete hydration.

In no case should pressure filters operate at a greater rate than four thousand gallons per square foot of filtration area in the twenty-four hours.

Their effluent should be free from suspended matter and color so that a platinum wire one-twentieth inch in diameter can be discerned at a depth six and one-half feet.

The bacteria count per cubic centimeter capable of growing on agar or gelatine at 18 degrees Centigrade after forty-eight hours incubation should not exceed one hundred whatever the amount present before treatment.

There should be no bacteria typical of sewage present such as bacilli coli, typhosus, enteritidis, no cholera vibrio nor dysentry bacilli in fifty cubic centimeters incubated for forty-eght hours at 20 degrees Centigrade.

No taste or odor should be distinguishable when water is heated to 37 degrees Centigrade.

Water for washing should not exceed two per cent. of the whole supply.

An effective pressure filter will satisfy these requirements besides having the following advantages:

Simplicity in operation.

Economy in operating costs.

Low initial cost.

Not more than two pounds reduction in pressure, in passing through the filters when clean.

They may be affixed direct to the main and pumped through.

They are suitable for extension by the addition of extra units.

They can be removed at little cost to another site, should circumstances require it.

They are continuous in efficiency, with proper washing mechanism.

Occupying small space they can be housed at a low cost.

Being manufactured ready for erection they can be erected rapidly, cheaply, and in any weather.

They can be used for water softening by the addition of simple appliances.

In Britain pressure filters of high efficiency are supplying a population equivalent in this country to four hundred [illegible], large municipalities having found them highly satisfactory.

Dr. Percy Frankland, in an analysis of the supply of Banbury taken from the river Cherwell, found that the bacteria [illegible] per cent., no coli being found in [illegible] cubic centimeters.

The [illegible] reservoir at Buxton, Derbyshire, show certified reductions of [illegible] to 99 per cent.

The town of Shrewsbury drawing water from the river Severn showed that coli could not be detected in less than five hundred cubic centimeters.

Many similar results, showing as high a continuous efficiency as 99.9 per cent. warrant the attention to those interested in public health work in Canada to this type of filter, which, when properly constructed, is the most suitable for the conditions ruling here.

◆

STONE BALLAST.*

Rock ballast should be made from hard, tough, durable trap, flint, or limestone rock, or other hard stone. It should be broken to cubes, the maximum of which will pass through a 2½-in. ring and the minimum will not pass through a 1½-in. ring. The crushed stone should be free from screenings, dirt and rubbish.

Ballast can be handled in side-dump cars with flat bottoms, or in coal cars, but drop-bottom ballast cars will secure very good results. Ballast after being unloaded should be handled with a spreader. The track should be prepared by digging out the old ballast down to the bottom of the ties, and rounded up to ½ in. above the bottom of the ties in the centre. This will keep the ties from running together until the track is filled with stone. This should be leveled off at the ends of the ties.

All decayed ties should be removed and replaced with new ones. Ties should be properly spaced and track put to gauge, and all spikes driven down so that the ties will be tight up to the rail. Then crushed-stone ballast should be unloaded to fill between the ties in the centre of the track. This will help keep the track in line and prevent the ties from bunching. About 8 or 12 inches of stone ballast should be placed under the ties if possible, and a minimum depth of 4 inches should be maintained.

In raising track on a 9-in. raise, the track can be put up in one lift if a large force of men can be secured. Ordinarily the track is put up in two lifts. In raising in one lift the foreman in charge will soon learn how many rail lengths a train of 15 or 20 cars will raise to the required height. The number of rails are counted off and sufficient ballast is unloaded and plowed out. Four men are started making places for jacks. One end of the sight board is placed on the stake, and the board leveled.

Four jacks are used; two being half a rail ahead of the others. The first pair raises the track about half the required height. No tamping is required with these jacks, as the stone runs under the track by its own weight. The second pair of jacks raise the track to the full height. A force of 20 men should follow to tamp, and these should be followed by a foreman and eight men to put the track in perfect line. The first half of the day should be given to raising the track, the balance of the day being devoted to tamping and lining.

Where two lifts are made, the ties should be tamped with shovels their entire length. After the second lift, the ties should be tamped with tamping picks or bars, the tamping extending from ends of ties to 12 inches inside of rail. Particular attention should be paid to tamping under the rail, but the centre of the ties should not be tamped.

In dressing up single track with ballast, the ballast should be filled in at least within one inch of top of ties and sloped from ends of ties. The edge of ballast slope should not be less than 4 feet from gauge line of outside rail.

Double track should be dressed in the same way, the stone in the centre ditch being level with the stone in the track. When the track is bonded for electric signals, it is very desirable that the stone be kept below base of rail. The track, after being raised, should be left from four to six days before dressing.

In handling 600 to 1,000 yards of stone daily and giving track 9 to 12 inches of raise, the force employed largely depends on the amount of traffic handled, and the views of the officials. A force of 40 to 50 men should be used, and a force organized as follows will give excellent results:

1 Chief foreman.
1 Assistant foreman to raise track.
1 Assistant foreman to line track.
2 men flagging.
4 men digging out for jacks.
13 men on jacks (4 digging holes, 8 on jacks, 1 with levelboard).
20 men tamping.
8 men lining.
1 water boy (or more if necessary).

Minority Report.—The size of stone which the majority of the committee recommend is too large for the maintenance of good track. The size should run from 1¾ in. maximum to ½ or ¾ in. minimum.

---

*Abstract of committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N.Y., Sept. 10-13.

◆

CANADIAN PACIFIC RAILWAY IN WASHINGTON.

A New York banking house is informed by its Spokane representative that, in order to obtain a water grade from Kingsgate to Grand Forks and also to avoid three mountains, Canadian Pacific will build additional mileage through the northwest part of Washington, and will utilize the lines of the Spokane International, Idaho and Washington Northern and Spokane Falls and Northern. In this way Canadian Pacific will obtain a new freight line which will occupy an important position geographically in that general section of the Northwest.

Canadian Pacific, according to the same information, has secured from the Hill interests the right to use that part of the Spokane Falls and Northern known as the Red Mountain Line, running between Northport and Rossland, and the further extension of the Hill line to Nelson known as the Nelson and Fort Shepard.

At the present time Canadian Pacific has under way the location and surveying of a new freight line from the terminus at Metaline Falls to Waneta at the junction of the Columbia and Pend d'Oreille Rivers. Canadian Pacific, according to plans recently adopted, will operate its freight to Kingsgate over its own line and over the Spokane International to Clagstone Junction, over the Idaho and Washington Northern to Metaline Falls, over the new Canadian Pacific line to Waneta, and thence by way of Spokane Falls and Northern to Marcus, Grand Forks, the Fraser River and the coast. Canadian Pacific and Great Northern recently entered into an agreement to build jointly the line over the Hope Mountains to the Fraser River.

According to Engineer Dibblee, in charge of the location work, a very easy grade between Metaline Falls and the boundary has been secured, and work will be rushed on this section as well as on the projected line from the boundary to Trail, a distance of thirty miles. Between Metaline Falls and the boundary line eleven tunnels will be built. The total length of the line from Metaline Falls to Trail will be forty miles and construction will cost approximately $3,000,000.

THE PURIFICATION OF WATER FROM STANDPOINTS OTHER THAN THE HYGIENIC ASPECT.*

By George W. Fuller.

In addition to hygienic purity, a perfectly satisfactory water supply should be of good appearance as to absence of mud, vegetable stain, grosser microscopic organisms, soluble and suspended iron; and it should also be free of offensive tastes and odors, excessive hardness and abnormal corrosive action on service pipes.

Within certain reasonable limits, depending upon local conditions, all of these characteristics are worth obtaining in a first-class modern water supply. In fact, the standards of "physical and chemical quality" as distinguished from "hygienic or bacterial quality" are steadily growing higher, due to the demands of the consumers for a supply in which there is public confidence and which does away with bottled water and household devices for treating the public supply. Indirectly, this question is related to the public health through the tendency of the public to avoid for drinking purposes a hygienically pure but otherwise unattractive public water supply, and to use well water or bottled water of doubtful bacterial content.

In this paper it is proposed to outline briefly some of the recent developments in America concerning the physical and chemical features of water purification, and to refer incidentally to the historical development of some of the more important steps.

Removal of Mud or Turbidity.

Plain Sedimentation.—Fifteen years ago, or prior to the completion of the Louisville tests in 1897, the clarification of the muddy water which is so characteristic of the majority of American rivers was accomplished but partially, if at all. Plain sedimentation when applied at its best ordinarily removed only 50 to 75 per cent. of the total suspended matter. With basins holding several days' supply, such as those at Washington, Philadelphia, Pittsburg, Louisville, St. Louis, Kansas City, Omaha, etc., the effluent as delivered to the consumers contained for weeks at a time sufficient silt and clay to make it conspicuously muddy. At times the partially settled water contained several hundred parts per million of suspended matter.

Storage Reservoirs and Avoidance of Muddy Water.—In [illegible] [illegible] were large enough to serve as storage reservoirs from which the supply from the river was shut off at periods of very muddy water in the stream. This [illegible] years at Washington, Baltimore, Covington, York and elsewhere. It is expensive and is seldom tried at present. When the river is muddy for a period exceeding the storage capacity of the basin the benefit of the method not only fails, but the consumers [illegible] muddy water for many weeks. [illegible]

Coagulation and Sedimentation.—[illegible] carbonates and bicarbonates of lime and magnesium naturally [illegible]

gelatinous white precipitate of aluminum hydrate. This sticky mass envelopes the tiny particles of clay and also the bacteria, and forms them into particles of a size that subside quite readily. This process, which is in effect a chemical precipitation method, is of considerable assistance in that it provides a fairly efficient means of removing those minute clay particles, perhaps one-tenth of the size of the bacteria, which will not settle by plain subsidence in an indefinite period. When coagulating chemicals, such as sulphate of alumina or sulphate of iron in connection with lime, are added to the water, it is possible to obtain a fairly clear effluent, provided a proper dose of coagulant is used with respect to quantity and quality of turbidity, and further provided that a period of one to two days or more is allowed for the particles of suspended matter to deposite upon the bottom of the basin. This method has been used at quite a number of places and is still in use at St. Louis, Kansas City, Leavenworth, Omaha, Nashville, etc. It is not wholly satisfactory as compared with the results obtained by filtration, as there is no ready way to correct the poor results obtained from an inadequate dose of coagulent and which correction is much more feasible when use is made of a filter plant. This method can scarcely be called for ordinary problems a complete and satisfactory solution of clarifying muddy water, although its favor has been enhanced somewhat recently in conjunction with sterilization processes, such as the application of hypochlorite of lime.

Plain Sand Filtration.—Forty-five years ago sand filtration was substantially an unknown art in America. There were some crude strainers of artificial construction, but they are unworthy of detailed consideration. The art of sand filtration in America dates from about 1867, when the late James P. Kirkwood, C.E., made an extensive tour of the leading European cities and prepared a report for the Water Commission of St. Louis, Mo., detailing the results of his foreign studies. That report has become a classic, not only in America, but also in Europe, as it was translated into German. It exercised much influence in standardizing the European practice of water filtration.

After Mr. Kirkwood's return to America he found by tests with small sand filters that they would not remove the enormous quantity of sand, silt and clay, such as are found in the Mississippi River at St. Louis. On a somewhat larger scale the same conclusion was demonstrated by tests conducted with the Ohio River water in 1884 by the late Charles Hermany at Louisville.

With the advent of the germ theory of disease there was found in America thirty years ago a feeling among engineers that sand filtration was impracticable through inefficiency and great cost for the ordinary American problem. Two or three small plants were built in the early seventies along the Hudson River, particularly at Poughkeepsie and Hudson, but the question of water clarification remained substantially in abeyance until it was pushed forward as an incidental feature of hygienic water purification

It was the work of the Massachusetts State Board of Health, through its tests conducted at the Lawrence Experiment Station and its advocacy at the Lawrence city filter plant in 1892, that marked the beginning of the present period of wide-spread installation of modern filter plants in America. The Merrimac River at Lawrence contains almost no clay, and but little silt other than at rare intervals when the river is in extreme flood. The data from Lawrence, therefore, while applicable for many of the problems in New England, did not offer a solution of the typical American problem of water clarification or of water purification.

Sand filters, when operated at fairly slow rates, say from [illegible] to six million gallons per acre per day, are efficient in removing [illegible] in quite large amounts. Fine clay particles, however, generally pass through the ordinary sand filter, even when operated at rates much lower than what is called standard European practice, namely, 100 millimeters vertical drop per hour, or 2.65 million gallons per acre per day. Experience shows that when the unfiltered water contains for several days at a time more than about 30 to 50 parts per million of fine turbidity, the effluent is liable to suffer from deterioration in quality, not only as to its appearance, but also bacterially.

---

*Paper [illegible] International Congress on Hygiene and Demography, Washington, D.C.

There are some exceptions to the rule, but generally speaking, sand filters outside of the New England States and some points along the Atlantic seaboard have not been successful in treating American river waters, even after they are submitted to prolonged sedimentation. The only sand filter plant along the Mississippi River, for instance, at Rock Island, Ill., was abandoned some years ago, and in its place was built a mechanical filter plant.

Sand Filters Aided by Sedimentation and Coagulation.—In 1898 the writer conducted extensive experiments for the city of Cincinnati, Ohio, upon the clarification and purification of the muddy Ohio River water by sand filtration in conjunction with sedimentation and coagulation. Similar tests were made in 1901 at New Orleans. This method can be made efficient, but it is ordinarily more expensive than when mechanical filters are used in place of sand filters. Local conditions influence the solution of this problem. Successful use of sand filters with coagulation is to be found at Indianapolis, Washington, Poughkeepsie, and some other places. The feature which needs especial care is to see that the floors of coagulated masses are removed from the water with sufficient care so that the surface of the sand bed does not become clogged too quickly. Ordinarily the water should undergo sedimentation for 18 to 24 hours before it reaches the sand beds. This feature adds to the cost of the complete method and in cases where insufficient coagulant is used there is some danger from serious clogging of the sand beds.

Sand Filters and Pre-filters.—At present there are few or no instances where decided exception is taken to the use of coagulants. Experience has shown that it is safe and feasible to use them where there is intelligent management. Local custom and existing works, however, in some instances force a consideration of methods in which no use is made of these very helpful coagulants. This has led to efforts to clarify water by preliminary filters as well as by sedimentation before application to ordinary sand beds. This is the method in use at Philadelphia, Steelton, Wilmington, Albany, Montreal, and some other places. If the river water is not too muddy from fine turbidity it is of considerale aid. The method has decided limitations, however, in that at times of severe flood the percentage removal of suspended matter is least when it should be most in order to prepare the water properly for normal sand filtration.

In several instances coagulation is used in conjunction with some straining device, such as the practice at Steelton, and arrangements of this general order are now being installed at Pittsburg to aid the local sand filter.

Mechanical Filters.—Where coagulants are required, mechanical filters have rapidly come to the front during recent years. They have been installed or have been recommended for use at nearly every plant of considerable size, outside of the New England States, during the past few years. The modern mechanical filter plant is so well known from numerous published articles that no description is necessary here. It is quite different from and materially better than the earlier devices of this general type. The plant of the East Jersey Water Company at Little Falls, N.J., was placed in service in Septemer, 1902. It was the first large plant in practice to embody the technical and engineering features developed from the tests at Louisville, Cincinnati, Pittsburg, etc.

This type of plant ordinarily operates at the rate of about two gallons per square foot per minute. When the water is properly coagulated such filters may satisfactorily perform at rates from 25 to 50 per cent. in excess of this rate. Such devices deliver a water of excellent appearance and under proper supervision they are substantially as efficient as sand filters in securing bacterial removal. These plants have recently been built with concrete tanks and hydraulically operated gate valves to control the operation of the plant, as well as automatic appliances to insure a pro rata application at all times of solutions of chemicals to the varying volume of water to be filtered. Their recent history is closely identified with a succession of mechanical improvements which allow the devices to be operated reliably and economically. The cleaning of the sand layers is done once or twice a day by reversing the flow of water for periods of five minutes or so at a time. While the water is flowing upward through the sand layer the sand is also stirred by compressed air in cases where the water is not applied at sufficient velocity (2 feet vertical rise per minute) to bring about this result.

Mechanical filters have been installed at Little Falls, New Milford, Louisville, Harrisburg, Cincinnati, Columbus, Toledo, New Orleans, and at some 300 smaller plants. This type of filter constitutes the characteristic method now in vogue in America for insuring a well clarified water supply from the ordinary American rivers which are highly charged with silt and clay. Undoubtedly it is the most efficient and economical arrangement for the majority of American water purification problems outside of certain areas along the Atlantic seaboard.

Color Removal.

For many years it has been known that ordinary sand filters will remove from 25 to 35 per cent. of the color or vegetable stain from the applied water. Such results have been obtained at numerous places in New England. It has been the endeavor in solving many American problems to secure filtered water that does not contain more than about 10 parts per million of vegetable stain as measured by the platinum-cobalt standard. This is approximately the dividing line above which the color becomes readily noticeable to the consumer as seen in a glass upon the table and especially in a porcelain bath tub. Where sand filtration will not allow a result as good as or better than this to be obtained, there has been an effort in a number of places to employ coagulants and thus take advantage of the decolorizing effect of sulphate of alumina. This is an important factor which was considered in arriving at the recent determination in New York City to employ coagulation and mechanical filters for the treatment of the present water supply from the Croton watershed supplying the old city of New York. Sulphate of iron and lime do not give a satisfactory color removal, as demonstrated at Toledo and elsewhere.

In some cases intermittent filters as at Ludlow reservoir, Springfield, Mass., have aided in bringing about an unusually high removal of color. This seems to be due in part to an anaerobic decomposition having taken place in the water before its filtration. The color unites with iron in the water and is precipitated upon aeration. Another interesting feature that has been established at the new filter plant at Springfield is that when the coagulant is applied as an overdose to a part of the water to be treated, it is said that the mixture of the entire mass of treated and untreated water is decolorized to a greater extent by the sulphate of alumina than would be the case if the same quantity of coagulant were to be applied at a uniform rate of dosing to the full volume of water delivered to the purification works.

When the water to be treated contains varying high amounts of both mud and color much care is required in adjusting the required dose of coagulant to the composition of the water.

Microscopical Growths.

Some years ago an unusual effort was made to prevent the appearance in water supplies of microscopical growths of algae and other organisms larger than bacteria for the sake of minimizing their influence upon objectionable tastes and odors. In some instances, particularly in Massachusetts with unfiltered supplies, the bottom and sides of impounding reservoirs were stripped so as to obtain in the exposed surface soil only a small quantity of organic matter. This practice has not recently been followed for the large reservoirs for the new water supply of New York City, or elsewhere, particularly if the impounded water is muddy at times. It is considered better to aerate and filter the water to correct the unfavorable influence of these growths rather than to try to prevent them.

Microscopic growths have been killed in a large number of instances in America through the use of copper sulphate and to some extent by the use of hypochlorite of lime. The latter seems to have certain limitations and is not in such general use as copper sulphate.

Filters incidentally serve for the removal of microscopic growths. In some instances certain types of filamentous growths are likely to give trouble due to filter clogging. At Cincinnati experiences of this kind have been encountered and aid has been secured through the application of hypochlorite to the unfiltered water. It is a style of problem that requires special treatment in most cases.

Tastes and Odors.

Many surface waters, particularly those which are not turbid, contain at times objectionable tastes and odors. The latter are sometimes due to growths of organisms themselves. In other cases they are due to the disintegration of the organisms and to the liberation of certain oils which are very penetrating in their nature. Still other objectionable tastes and odors are found in waters that have undergone anaerobic decomposition which causes offensive gases to be liberated.

Aeration is a great help in the removal from water of these properties which produce objectionable tastes and odors. Combined with filtration, either mechanical or sand filters, there is obtained the most practicable method of securing a satisfactory water as to freedom from tastes and odors. It is one of the characteristic features of the new Catskill supply for New York City, and is being carefully [illegible] supply of [illegible]

Iron Removal Plants.

There are half a dozen plants in America, mostly of small size, where ground waters are aerated in order to pre-[illegible] filters. Most of the earlier filters were of the sand filter [illegible]

Water Softening.

[illegible]

found and even in the Great Lakes district the water is much harder than it is along the Atlantic seaboard. The cost of softening very hard water supplies has undoubtedly been a factor in retarding developments along this line. Experience has shown, however, that it is a perfectly feasible matter to soften the western waters if it is so desired.

At Grand Rapids, Mich., a mechanical filter plant is approaching completion that is to be used in conjunction with a softening plant. This plant will remove mud and vegetable color from the Grand River water and reduce its temporary or carbonate hardness by perhaps 50 per cent., so that it will equal what is called locally the "Lake Michigan standard." The total hardness of the softened and filtered water will be approximately 125 parts per million. The reduction in hardness will be effected by lime without soda.

Corrosion of Pipes.

Service pipes, particularly those of galvanized iron or wrought iron, are more liable to corrosion with filtered water than with unfiltered water. In part this is due to the elimination of substances, such as silt and vegetable matter which retard in a physical way the rate of corrosion, and in part it is due to an increase in carbonic acid which in the presence of oxygen is a very prominent factor in influencing the total amount of corrosion, the rate of corrosion and the amount of dissolved iron which may be present in water as drawn from the faucet and is thus the principal feature of unsuitability from the standpoint of iron stains. It is scarcely feasible to remove the oxygen present in water and, in fact, aeration tends materially to increase the oxygen up to the limits of the saturation point of this gas.

Carbonic acid seems to be the principal feature related to the speed amount of corrosion of iron by filtered water. Where coagulants are used there is a corresponding increase in amount of free carbonic acid. This has led some people to consider this feature as quite a draw-back to the use of coagulants. It has been studied recently in New York City from the chemical viewpoint with much thoroughness. The conclusion has been drawn that it is feasible to control the amount of carbonic acid through the proper addition of lime or soda. This feature will be an interesting part of the new Croton filter plant.

With hard waters in the south and west there has been comparatively little or no difficulty as regards corrosion of pipes by filtered water. The problem, therefore, is related more particularly to the soft waters along the Atlantic seaboard.

Speaking generally, water purification as relates to filtration is on a thoroughly well established basis in America. The features that differ most essentially relate to preparatory treatments rather than to material differences in designs either of sand filters or of mechanical filters. The use of chemicals for purposes of coagulation and softening has been studied in the last few years with considerable thoroughness and the problem is one that is so related to [illegible] that each project should be carefully studied on its own merit rather than to attempt to [illegible] the type of works which may be in [illegible]

[illegible] that the successful methods of water purification should receive intelligent [illegible] the case where the type of water calls for the use of coagulating chemicals.

RAILWAY RECEIPTS AND EXPENSES.

As the month of July began a new fiscal year for the railways and also from all indications a period of reviving traffic, it is probable that railway returns will be closely watched, especially during the months of the presidential campaign. But the uninitiated reader who tries from the newspaper reports of earnings and expenses to keep track of the business of the railways has a perplexing task, for in one and the same issue of a newspaper he not infrequently finds statements of earnings and expenses that may refer to different periods separated by weeks or months, or maybe a year or more.

The accounting departments of many of the principal railroad companies make up at the close of each week estimates of the receipts for that week and sometimes include estimates of the expenses. These are primarily for the information of the officers and directors of the companies, but are frequently sent to the newspapers. Thus appear estimates and cumulative estimates for the first, second, third and fourth weeks of each month and for the entire month. These are but estimates in gross, and as such serve as the earliest approximate indications of increase or decrease in the volume of traffic. They are widely regarded by business men as a barometer of the general business of the country. From these estimates various financial newspapers frequently compile tables showing approximately the earnings and expenses of a number of roads selected as representative.

As soon after the close of each month as practicable each railway company is obliged to send to the Interstate Commerce Commission a report of its total operating revenues during that month with separate specification of the receipts from freight, passengers, mail and express; of its total operating expenses with separate specification of those incurred for maintenance of way and structures, maintenance of track and equipment, for securing traffic, conducting transportation and in general; of the net operating revenue; of revenue from outside operations; of taxes; and of operating income which is the amount remaining as available for rentals, interest on bonds, appropriations for betterments, and dividends.

The filing of these monthly reports with the Interstate Commerce Commission is usually not completed until about six weeks after the close of the month to which they refer. From these official reports the Bureau of Railway Economics, an organization maintained in Washington by the railways, compiles a summary of revenues and expenses for the month which is usually issued within a week after all of the reports have been filed. Most of the newspaper publications of earnings and expenses give the amounts for the different railways separately, the information thus presented being of especial interest to the investor who wants to know what each road is doing. The compilations of the Bureau of Railway Economics, however, are of the collective earnings and expenses of the Eastern, Southern and Western groups of railways, thus showing the ebb and flow of traffic for the three great sections of the country, each of which has its peculiar economic characteristics. These publications also contain comparisons of the earnings and expenses per mile of line, thus showing the actual trend of railway business, the indication of which is often confused in other compilations by the use of aggregates applying to the total mileage, which is continually increasing to a greater or less extent. The earnings and expenses are thus also reduced to concrete and comprehensible units of measurement.

For example, in its summary of earnings and expenses for June, 1912, the Bureau of Railway Economics shows that the net revenue for the month increased about 48 cents for each day for each mile of line over the net revenue of June, 1911. It shows that during the fiscal year ending June 30, 1912, total operating revenues increased $23 per mile of line, operating expenses increased $83 per mile of line, leaving a decrease in net revenue of $60 per mile of line. An increase of $48 in taxes and a decrease in net revenue from outside operations resulted in a decrease in operating income of $112 per mile of line for the year. This is equivalent to a decrease in the operating income of the 215,000 miles of line to which these reports have applied on the average, of over $24,000,000.

The monthly report of the Interstate Commerce Commission issued usually about a month later than the summary of the Bureau of Railway Economics presents an abstract, company by company, of the monthly reports filed with it.

As soon after the close of the fiscal year as is practicable, and under penalty not later than September 30th, each railway company is required to make to the Interstate Commerce Commission an elaborate report of its transactions for the year. This includes a statement in great detail of receipts and expenditures, of mileage, of locomotives and cars, of the number of employees and their compensation, of the capitalization and capital issues, of statistics as to train miles, car miles, freight traffic movement, ton miles, passenger miles, taxes, and of profit and loss.

The statistics contained in these reports are of such great volume that their compilation requires several months, the annual report of statistics of the railways of the United States issued by the Interstate Commerce Commission not appearing as a rule until a year or more after the close of the year to which the statistics refer. It is a most valuable compendium placing before the student of railway transportation the most complete available information. The system of accounts prescribed for the railways by the Interstate Commerce Commission and the publicity in regard to their affairs which it has enforced have placed the railways in that position where far more is made public about their accounts and their affairs than is known in regard to any other industry of the United States, or any of the state or municipal governments.

In addition to all the reports that have been enumerated each railway company makes an annual report to its stockholders to which many newspapers give more or less extended reference, and many if not all of the State Railroad Commissions require separate reports.

◆

MINING IN NEW BRUNSWICK

The North Shore Railway and Navigation Company, which has sixty men working a small coal mine at Beersville, in Kent County, twenty miles from Moncton, and selling the coal to the Intercolonial Railway, has also ordered machinery for the manufacture of bricks. Dr. H. J. Von Hagan, the president of the company, declares that New Brunswick has the best material for manufacturing bricks and other clay products that can be found in Canada, or in the eastern states outside of New Jersey. He is bringing several engineers from New York to inspect the company's property in Kent County.

It is announced that a large number of miners will be brought from the Old Country to work in the mines in Queen's County, where there will be great development as soon as the Gibson and Minto Railway is completed this fall. Homes are being built for miners. The Canadian Pacific Railway will take one hundred thousand tons a year out of the district, and the Intercolonial Railway has contracted for twenty thousand tons. It is estimated that there is anywhere from one hundred million to one hundred and fifty million tons of coal in this district.

SOME OBSERVATIONS ON THE DISINTEGRATION OF CINDER CONCRETE.*

By George Borrowman.

Cinders, as an aggregate in concrete, are used rather commonly where a light, cheap mixture is desirable; also in fireproof construction, and perhaps in the latter capacity this kind of concrete finds its most important application.

Its efficiency, however, has been the subject of considerable discussion. Various tests have been made, the results of which tend to show the superiority of this material over all other fire-resisting substances. There are also several patented floors involving cinder concrete which have been used successfully. Nevertheless, it has failed in some instances when employed for ordinary purposes, cracking and disintegration taking place. These discordant results are due, no doubt, as Freitag suggests in his "Fireproofing of Steel Buildings," to the use of cinders of varying quality, but to the writer's knowledge the matter has not been further investigated. A particular case of disintegration, accompanied by a powdery efflorescence on the surface of the concrete, was observed by D. S. Avery, now Chancellor, but formerly head of the department of chemistry in this University, who prompted some study of the phenomena, and also made various helpful suggestions during the experiments.

Blocks of concrete containing cement, sand and ¼-in. cinders were first prepared, the proportions by weight being 1:2:3, respectively. The cinders were from steam coal and slack, and were carefully screened. The cement and sand were of good quality, the latter being sieved through 20-mesh on to 30-mesh screens.

Another lot was made up using cinders from ½ in. to 1 in. in size, the proportions being 1:1:1. In each case just enough water was used to insure thorough incorporation without running. All the blocks were placed on a glass plate to prevent loss of moisture and covered with a damp cloth for two weeks.

At the end of this period, the specimens having the proportions 1:2:3 showed no change, but were somewhat porous and friable, owing to the realtively large bulk of cinders. A little later, however, fine cracks developed, with general disintegration. The others (1:1:1:), though compact and hard, also showed signs of cracking, and in a short time the breaks became very pronounced. In each case they radiated from certain points.

These latter specimens were broken open to facilitate examination, and in some cases the breaks originated from cinders that showed oxidation of much iron. The surfaces of the concrete bounding the cracks crumbled easily, indi[illegible].

The appearance of these oxidized cinders suggested the presence, originally, of much ferrous iron, probably as sulphide. The analysis of the cinder stock showed considerable sulphur as sulphide and sulphate, also iron, though the proportion of ferrous iron could not be determined in material of this sort with accuracy.

Analysis of Cinders.

	Per cent
SiO_2	[illegible]
Total Iron Fe_2O_3	[illegible]
Al_2O_3	[illegible]
CaO	[illegible]
MgO	[illegible]
S	0.60
SO_3	5.82
Undetermined (C, etc.)	5.37
	100.00

It seemed probable, then, from the foregoing data, that oxidation of iron and sulphur produced internal stress and consequent cracking, aided, no doubt, by the general weakness produced by the diffusion of soluble sulphates. This theory was further strengthened by finding that the efflorescence, found on the surface of the disintegrating concrete before mentioned, was ferrous sulphate.

On this assumption attempts were made to bring about similar results by substituting for cinders artificial iron sulphide, prepared in several ways. These experiments, however, were not successful. On breaking open the blocks, the sulphide was found to be unchanged, surrounded by hard, compact cement. Soluble sulphates being absent in the mixture, the blocks had, of course, greater initial strength than those containing cinders, and would have withstood considerable stress had there been any. The lack of oxidation, though, in these tests, indicated that in the case of the cinders the necessary oxygen must have come from the cinders themselves, since they were equally well protected from the air.

This conclusion drew attention to the fact that about one-third of the cinder stock consisted of a very porous coke. As is well known, this substance will persistently occlude large amounts of oxygen. According to Starr and Lewis, air-dried coke contains absorbed gases in the proportion of about 0.7 c.c. per gram of coke, 2 to 6 per cent. of the gases being oxygen. The oxidation in the concrete was most pronounced in the coke. Moreover, some pieces of the latter were picked from the cinder stock and tested for sulphide sulphur, about 1 per cent. being found. One nodule from which cracks radiate proved to be a piece of coke so thoroughly oxidized as to look like a mass of ferric oxide. This was tested and found to contain but a trace of sulphur.

As a final experiment, some of the original stock of cinders were kept exposed to air and moisture until, on washing, they showed the presence of no soluble sulphate. They were then made into a block of concrete similar to those prepared before (1:1:1). Under parallel conditions no disturbance took place, the material retaining perfect stability.

From these tests we may conclude that cinders with much sulphide and sulphate sulphur are likely to give unsatisfactory results, especially if there is much coke or porous material present; also that such material may be improved if allowed to weather, with occasional washing, until the ferrous iron and sulphur have been oxidized and leached out.

---

[*] Abstract of paper in "The Journal of Industrial and Engineering Chemistry," June, 1912.

◆

HARBOR IMPROVEMENTS BEING MADE.

There are now five dredges at work in St. John Harbor. Some of them are doing work in connection with the big Courtenay Bay contract for which the Norton Griffiths Company will organize a subsidiary company, and for which new dredges are being constructed. It is expected that dredging in Courtenay Bay will be begun this fall. The other dredges are clearing the site for additional steamship berths at West St. John. With regard to the dry dock at Courtenay Bay, the present plans only provide for one [illegible] long, and an agitation is now in progress to have it made 1,150 feet, which is the length of the proposed dock at Levis.

BOOK REVIEWS.

Raising the Wreck of the U.S. Battleship, "Maine." Published by Lackawanna Steel Company, Buffalo, N.Y. Size, 8 x 10¾ inches; paper; 40 pages; price, $1.

A good deal has been written concerning the raising of the wreck of the battleship "Maine" in Havana harbor. The problem was one of the greatest engineering interest. A complete description of the entire operation has recently been issued by the Lackawanna Steel Company as Bulletin No. 102. This description is handsomely illustrated and describes in considerable detail the history of the sinking of the "Maine" and progress of the work towards its final removal. The company which publishes the book is interested because it furnished the steel piles which were used to construct the large cofferdam surrounding the wreck. This very interesting and correct description will be of considerable value in illustrating what may be done under similar circumstances.

Materials and Construction. By James A. Pratt. Published by P. Blackiston's Son & Company, 1012 Walnut Street, Philadelphia, Pa. Size, 5 x 7 inches; cloth; 187 pages; 85 illustrations; price, 90 cents.

This is a text book of elementary structural design. The author states that his purpose in compiling the text and set of problems was to present such studies in the elementary laws of construction as will give the student an understanding of the more simple formula and ability to apply such to every-day practice. The work is so arranged that it is available also as a handbook of the necessary formulae and principles of constructive details. No attempt is made to cover any advanced engineering work; only such material being included as is essential for the training of the young mechanic.

Preliminary Studies in Bridge Design. By Reginald Ryves. Published by the St. Bride's Press, Limited, London. Size, 5 x 7½ inches; cloth; with a number of illustrations; price, 60 cents.

This book is a reprint of a series of articles under the same title which appeared in "The Surveyor and Municipal and County Engineer" early in 1912, and is the first of a series of small volumes, each complete in itself, dealing with the design of ordinary highway bridges of moderate spans. The book is intended to provide the student with a foundation for the study of bridge design, and at the same time suggest to the experienced engineer that some of the facts which he takes into account in designing bridges will have more significance and greater value if he will study them in the light of the basic principles which really hold some of them together and separate these from others. This little volume will well repay reading, both to the student and the experienced engineer.

PUBLICATIONS RECEIVED.

Proceedings of the International Association for Testing Materials. Congress papers and reports delivered at the Sixth Congress of the International Association. Mr. H. F. Porter, secretary of the Sixth Congress, 1 Madison Avenue, New York.

Report on Timber Conditions Around Lesser Slave Lake. By D. Roy Cameron, B.A. Being Bulletin No. 20, Forestry Branch, Department of the Interior. R. H. Campbell, Director of Forestry, Ottawa.

Forest Products of Canada, 1910. Compiled by H. R. Macmillan and W. Guy H. Boyce. Being Bulletin No. 21, Forestry Branch, Department of the Interior. R. H. Campbell, Director of Forestry, Ottawa.

Annual Report of the Bureau of Industries, for the Province of Ontario. Being part 3, Municipal Statistics. Published by the Ontario Department of Agriculture, Toronto.

Municipal Statistics. Being Municipal Bulletin No. 6 of the Bureau of Industries of Ontario. Published by the Ontario Department of Agriculture, Toronto.

Ontario Railway and Municipal Board. The sixth annual report to December 31st, 1911. Copies may be secured from the secretary, Ontario Railway and Municipal Board, Toronto, Ontario.

Timiskaming and Northern Ontario Railway Commission. Tenth annual report for year ending October 31st, 1911. Copies may be secured through the Department of Public Works, Parliament Buildings, Toronto.

Proposed Rules and Regulations for Inside Work. Advance copies of the rules and regulations for electrical wiring compiled by the Hydro-Electric Power Commission of Ontario, to be revised and published after October 15th. Copies may be secured from the secretary, Hydro-Electric Power Commission of Ontario, Toronto.

Southern Vancouver Island. By Charles H. Clapp. Being memoir No. 13 of the Geological Survey Branch, Department of Mines, Canada. R. W. Brock, Director, Geological Survey, Department of Mines, Ottawa.

The Geology and Ore Deposits of Phœnix Boundary District, B.C. By O. E. LeRoy, being Memoir No. 21, Geological Survey Branch, Department of Mines, Canada. R. W. Brock, Director of Geological Survey, Department of Mines, Ottawa.

U.S. Department of Agriculture Publications

Bulletin No. 44, Office of Public Roads. The Physical Testing of Rocks for Road Building. By Albert T. Goldebeck and Frank H. Jackson.

Bulletin No. 46, Office of Public Roads. Oil-Mixed Portland Cement Concrete. By Logan Waller Page, Director, Office of Public Roads.

Bulletin 249, Part I., Office of Experimenting Station. Earth-Filled Dams and Hydraulic-Filled Dams. By Samuel Fortier and F. L. Bixby.

Bulletin 249, Part II., Office of Experimenting Station. Timber Dams and Rock-Filled Dams. By Samuel Fortier and F. L. Bixby. A. C. True, Director, Office of Experiment Station.

Bulletin 88, Forest Service. The Properties and Uses of Douglas Fir. By McGarvey Cline and J. B. Knapp. Henry S. Graves, Forester.

On the Measurement and Division of Water. By L. G. Carpenter. Being Bulletin 150, of the Agricultural Experiment Station, Colorado Agricultural College, Fort Collins, Colorado.

Preliminary Information Respecting Waterpowers. Being instructions relating to the gathering of certain preliminary information, prepared by Arthur V. White, M.E. Copies may be secured from the secretary of the Commission of Conservation, Ottawa, or the Department of Lands, Victoria, B.C.

Canadian Highway. Written after the planting of the first sign post of the Transcontinental Highway, by P. W. Luce, secretary, The Canadian Highway Association, Room 4, Cunningham Block, New Westminster, B.C.

Third Semi-Annual Report of the Sewage Disposal Commission. City of Fitchburg, Mass., for the six months ending March 31st, 1911.

Annual Report, Board of Water Commissioners, City of Kingston, N.Y., for the year ending February 29th, 1912, with a summary of operations for past year.

The Zinc Deposits of Northeastern Tennessee. Bulletin No. 14. By A. H. Purdue, State Geologist, State Geological Survey, State of Tennessee.

Report of the Bureau of Mines, 1912. Vol. 21, Part 2. Being reports on the District of Patricia, recently added to the Province of Ontario. Compiled and edited with an introduction by Willet G. Miller, Provincial Geologist, Bureau of Mines, Parliament Buildings, Toronto.

Calendar, The Royal Technical College, Glasgow. The Calendar of the Royal Technical College, of Glasgow, has come to hand.

◆

CATALOGUES RECEIVED.

Pocket Magnetic Compasses. Small pamphlet forwarded by Keuffel & Esser Co., New York, illustrating different types of their pocket magnetic compasses.

Sheet Steel Piling. The Lackawanna Steel Company, Buffalo, N.Y., forward their Bulletin No. 104, entitled "Lackawanna Protected Steel Sheet Piling."

Babbitt Metals. A little booklet entitled "Shakespeare and Babbitt Metals," illustrating different babbitt metals manufactured by the Canada Metal Company, Limited, head office and factory, Fraser Avenue, Toronto.

Concrete Building. Small booklet forwarded by the Aitken Cement House Company, Peoples Gas Building, Chicago, illustrating the Aitken system of reinforced concrete building construction.

Flexible Cable. Pamphlet illustrating whipcord, braided flexible cable for use in workshops and mines, is forwarded by W. T. Glover & Company, Limited, Trafford Park, Manchester, England.

Manila Rope. Being catalogue No. 12-8, a brief treatise for engineers on rope used for the transmission of power, together with formulae, tables and data used in mill engineering. The C. W. Hunt Co., West New Brighton, N.Y.

Hoisting Engines and Derricks. The Clyde Iron Works, of Duluth, Minn., forward handsome 9-in. by 12-in., cloth bound catalogue illustrating their complete line of hoisting machinery. The catalogue conveys an excellent idea of the capabilities of this plant. Copies may be secured by addressing the company at Duluth, Minn.

Four-Wheel Drive Tractor. A little booklet describing the four-wheel drive gas tractor manufactured by the Heer Engine Company of Portsmouth, Ohio, and represented in Canada by Mr. [illegible], The Canadian Heer Company, 808 McArthur Building, Winnipeg. The Heer Engine Co. also forward their catalogue of two-cylinder opposed gas-[illegible] engines.

Steam Pumps. In a [illegible] catalogue just issued by the [illegible] Steam Pump Company of New York City, the [illegible] of operation and the different engineering features of the [illegible] are fully illustrated. The catalogue gives [illegible] and curves showing the steam consumption and the cost of operating [illegible] under different conditions, and [illegible] types of pumps. Copies of this publication may be had by addressing the [illegible] Steam Pump Company of Battery Place, New York.

FIRST GOLD FROM PORCUPINE

The returns to the Ontario Bureau of Mines show that the output of the metalliferous mines and works of that province for the six months ended June 30th, 1912, was as follows:—

Product.	Quantity.	Value, 1912.
Gold, ounces	11,854	$ 235,198
Silver, ounces	14,258,403	7,936,600
Copper, tons	5,170	736,409
Nickel, tons	10,179	2,166,805
Iron ore, tons	12,342	33,060
Pig-iron, tons	283,926	3,942,638
Lead ore, tons	17	849
Cobalt, cobalt and nickel oxides, crude cobalt material, etc., lbs.	854,324	192,073

The figures of gold production as compared with the first six months of 1911, show an increase of $192,878. This is practically the first fruits from Porcupine, chiefly from the Dome mine. Since the six months ended the Hollinger mill began turning out gold, and as there are now several smaller producers as well, the output for the full year may be expected to reach a considerable sum.

The yield of silver from the Cobalt mines, measured in quantity, shows a reduction of 973,566 ounces from that of the first six months of last year, but the money value was $292,400 greater, owing to higher prices for silver.

Nickel and copper from the Sudbury mines touched high water mark, and if the production continues at the same rate, 1912 will show a record for both metals. This is also true of pig-iron. Iron ore, however, shows a falling off as compared with a year ago.

The by-products from the refining of the silver ores, such as cobalt and nickel oxides, had a value of nearly three times that of the corresponding period in 1911.

◆

MONTREAL TRAMWAYS COMPANY.

President Robert, of the Montreal Tramways Company, in response to a request made some time since by the city council, presented his suggestions of what was required to provide a better street railway service in the city of Montreal. He advocated that another east and west street in the down-town district—namely Vitre Street—be opened through to Windsor Street, at the Canadian Pacific Railway depot, and that the company be permitted to lay down tracks thereon. He further advocated that two additional north and south streets be given to the company for the purpose of laying car tracks, both streets being east of Bleury Street, the growth of the city in the north being rapid and the traffic being now too heavy for the existing lines. Grading and improving Guy Street, a north and south street in the west end, leading to the mountain side residential district, was also suggested and the president considered that the construction of a subway under the canal was very essential, to provide against interruptions to both the street car service and vehicular traffic. The elevation of the Grand Trunk Railway tracks was considered essential. Delays through the canal amounted to thirty-two hours in August and those due to waiting on trains to pass on the Grand Trunk Railway were sixteen hours. The Board of Control will consider the recommendations.

NEW METHOD OF TESTING WELDS.

A new method of testing welds was presented by Mr. C. Fremont, of Paris, in a paper read before the Congress of the International Association for Testing Materials. An abstract of the paper follows:

The impact test was selected to determine the strength of forged welds in order to ascertain the limits between which this strength is likely to vary. Small prismatic test pieces, measuring 8 x 10 mm. in cross-section, were employed. These pieces were left unpicked. The unit of comparison was the strength of the original metal. The welds were made in fairly large numbers in France and elsewhere by smiths, specially on account of their skill. The welds —steel on steel, iron on steel, and iron on iron—were of the scarf-jointed type, so as to obtain large contact surfaces. Each piece welded was of square section and about 35 mm. on the side. Macrographic etchings of the welds in all cases showed a line of demarcation between the two metals at the seat of the welds, the portions in contact not having interpenetrated.

The square section iron employed in these various welds had a tensile strength of from 35 to 40 kg. per square millimeter and the mild steel a tensile strength of about 40 kg. per square millimeter. The impact test on the unnicked test prisms 8 x 10 mm. in section gave about 50 kilogrameters in the case of the steels, the test pieces not exhibiting fissures in any instance, and from 26 to 32 kilogrameters for the iron, the fracture of the metal being fibrous. Prismatic test pieces similar to the foregoing were prepared from the welded pieces, but in such a way that the bending test could be applied in line with the welds to enable the strength of the latter to be determined. Under the impact test all these pieces exhibited in all cases a strength inferior to that of the natural metal. In most of the tests the test pieces fractured in consequence of the weld opening, the strength being insignificant, less than 1 kilogrameter. Among the better results the steel-steel test pieces underwent a fair amount of deformation before fracturing, the force required being from 15 to 16 kilogrameters; that is to say, only one-third of the strength of the original metal, which could be bent right over without breaking or even cracking.

The static strength obtained in the testing forged scarf jointed welds is equal to the static strength of the metal only when the welded surface is sufficiently large to compensate for the lower elementary strength per unit surface, just as in a brazed joint.

Autogenous welds are still weaker than forged welds, not only because of the smaller surfaces of adhesion they present, but also on account of the lack of continuity in the added metal and of not being hammered.

◆

SUBSTITUTE FOR BRIDGES IN SASKATCHEWAN.

Owing to the great width of the North and South Saskatchewan Rivers, the cost of bridging them is very high, and in order to provide the settlers with access to their markets the Government maintains an ever increasing number of ferries accross these streams.

In 1905, at the inauguration of the province, there were twenty-two government ferries. There are now thirty-three, and by the end of this season there will be five more, all of them being under construction, and some of them almost finished at the present time. Three of these new ferries will be on the South Saskatchewan, namely, north of Pennant, north of Cabri, and south of Owensville postoffice in range 21, west of the third meridian. Two will be on the North Saskatchewan, one west of Hepburn, and the other south of Frenchman's Butte.

SYNTHETIC AMMONIA PROCESS.

An announcement of special interest in New York by Professor Hofrat Bernthsen, an eminent German scientist, lecturing in the Eighth International Chemical Congress. He explained that a system has been discovered in Germany for the synthetic manufacture of ammonia, by the uniting of nitrogen and hydrogen. The ammonia is prepared by passing the gases through a tube containing a substance for promoting reaction at a temperature of about 900 degrees Fahrenheit, and under a pressure.

As ammonia is extensively used in the manufacture of ice and in the preparation of fertilizers, notably ammonium sulphate, Dr. Bernthsen predicted that its synthetic preparation was an important step forward, inasmuch as its components—nitrogen and hydrogen—may be obtained from water and air respectively, at a negligible cost. The world's consumption of ammonia for 1911 was estimated in value at $80,000,000.

◆

MINERAL PRODUCTION IN BRITISH COLUMBIA

Copper is the only mineral showing an increased production in British Columbia. Lead and zinc show decreases, while iron is a negative quantity in the preliminary review for 1911, compiled by the provincial mineralogist, Mr. W. Flett Robertson.

A considerable falling off in the production of lead is shown, the average price of which for 1911 was practically the same as for 1910. The most serious decrease was in the output of the St. Eugene mine; this amounted to more than 8,000,000 pounds. The Sullivan increased its output between 2,000,000 and 3,000,000 pounds, and to that extent reduced the decrease in quantity from East Kootenay mines as compared with 1910. Approximate figures of production for 1911 are: St. Eugene, 6,000,000 pounds; Sullivan, 11,000,000 pounds. Ainsworth Division mines produced but little lead in 1911, whereas in 1910 they contributed about 2,500,000 pounds to the total for that year, the three shippers having then been the Bluebell, Highland, and Whitewater group. The 1911 total from all properties in Ainsworth Division is estimated at less than 300,000 pounds. Slocan maintained its output, the total from the Richmond-Eureka, Ruth-Hope, and Rambler-Cariboo, and that from the Slocan Lake section—Van Roi, Standard, and Hewitt-Lorna Doone —having together been somewhat higher than the corresponding figures for 1910. Nelson Division had the Emerald and Molly Gibson mines as its chief producers of lead. There was a relatively small production from the Lardeau District, and still smaller from Portland Canal.

A statement published last autumn showed the total expenditure by the Dominion of bounty on lead to July 1st, 1911—that is, for eight years—to have been $1,617,020. Of this sum, $249,370 was paid in the fiscal year ended March 31st, 1911, and $49,714 for three months to July 1st, 1911. After deduction of $50,000 appropriated for zinc-ore reduction experiments, there remained, as at July 1st, 1911, of the $2,500,000 originally voted an unexpended balance of $832,980.

The estimated increase in the copper production of the Province, as compared with 1910, is about 1,200,000 pounds.

The Boundary District made a decreased production in 1911 by about 6,500,000 pounds (the reason for which has been already explained), and West Kootenay (chiefly Nelson Division) also shows a decrease of about 300,000 pounds; but against these decreases is to be placed an increase of about 8,000,000 pounds in the Coast District. The more important copper-producing districts of the Province are the Boundary, Coast, and Rossland; of these, the Coast bids fair to in future make a much larger output of this metal than it has done in recent years, for in both the Britannia mine, in New Westminster Division, and the Hidden Creek mine, near Goose Bay, Observatory Inlet, very large bodies of copper ore of commercial grade have been opened. No production of copper has yet been made at the latter mine, which was not extensively developed until the year just past, but it is planned to put in reduction works as soon as all arrangements necessary for smelting ore on a large scale are made. The increase in output of copper at the Britannia mine in 1911 as compared with 1910 is believed to have been between 6,000,000 and 7,000,000 pounds, but the actual output is not yet available. The Marble Bay mine, Texada Island, also made a substantial increase, but this was in part offset by a decrease at the neighboring Cornell mine. There is little comment to be made relative to either Boundary or Rossland mines in regard to their copper production, which is being generally well maintained, except when the supply of coke for the blast furnaces of the copper smelteries is interrupted.

The New York average price of electrolytic copper for 1911 was a trifle lower than that for 191—12.376 cents as compared with 12.738 cents—but the former year closed with an average for the month of December of 13.552 cents per pound, which was the highest monthly average since January, 1910. The expectation is that a higher price will rule in 1912, so the outlook for this year is considerably brighter. If this increase of one cent a pound occurred in the beginning of the year and had been maintained throughout, it would have meant an increase in the total value of this year's copper production of about $400,000, and the copper mining companies would have benefited to this increased extent.

The smaller output of zinc in 1911 than in 1910 is accounted for by the fact that it was not practicable for either the Whitewater group of mines or the Lucky Jim, in the Slocan, to ship ore, owing to the absence of transportation facilities, for the Kaslo and Slocan Railway line, six miles of which was destroyed by fire in the summer of 1910, has not yet been reconstructed. Further, the Whitewater mill, also burned, has not been replaced, though in both mines much development work has been done, and shipment of ore will take place whenever it is possible to send it out.

No zinc concentrate was produced by the Slocan Star mill, though production may be resumed in 1912. There are now three mills in Four-Mile camp, Slocan Lake, equipped for producing a zinc as well as a lead concentrate, namely, those of the Van Roi, Silverton Mines, Limited (Hewitt-Lorna Doone), and Standard. Of these, the Van Roi produced in 1911 concentrate containing more than 2,000,000 pounds of zinc, and the Silverton Mines, Limited, a much smaller quantity. The Standard mill is a new one, the operation of which was only commenced late in the year.

[illegible]

Some prospecting for iron ore has been going on in [illegible]

CORROSION OF IRON AND STEEL PIPE.

The resistance to corrosion of iron and steel pipe has been the subject of controversy for a long time, both steel and iron having adherents who believe the one would corrode less than the other under the same conditions. A recent series of experiments undertaken by William H. Walker, of the Massachusetts Institute of Technology, results of which were published in July, 1912, by the National Tube Co., indicates that there is no difference in the corrosion of iron and steel pipe taken on the average.

Naturally a poor steel will show less resistance to corrosion than a good iron, but the converse is also true. Comparisons should be made on practically equal grades of product.

Water which contains oxygen induces a rapid corrosion of pipe of either kind, while water without oxygen, other conditions being equal, will show much less corrosion, or none at all if no other corrosive elements are present.

Doctor Walker made 64 comparisons of steel and iron pipe where the history of the installation was known. The cases where iron was found more corroded than steel amounted to 20, and where steel was more corroded than iron to 18. There were 9 cases where there was no difference between the two.

In order to determine the relation between the so-called acid-corrosion test and actual corrosion in service an experiment was made in which pipes were subjected to 20 per cent. sulphuric acid for four hours at room temperature. Although every care was taken to have identical conditions with all samples subjected to the test, it was found that no reliance could be placed in it. It was shown to be erroneous and misleading. The acid test not only did not agree with the service test, but the steel and iron showed no agreement when considered by themselves.

ENGINEERING WORK IN QUEBEC.

Some important engineering work is in progress and projected at Quebec owing to the prospective entry of the Transcontinental Railway, which will have its eastern terminus in that city. This work includes a new bascule bridge to provide railway connections with the Louise Embankment, a pontoon to provide a berth for coasting vessels, several landing sheds, new piers to form part of other harbor work which will cost $2,000,000, and two grain elevators. Plans have been prepared, and the work is to be undertaken as soon as financial conditions permit. It is anticipated that when these proposals have been put into execution Quebec will be able to obtain a larger share of the St. Lawrence grain traffic.

* * *

The Canadian Mining Institute held their annual session in Victoria, B.C., during the week of September 15th. Some of the speakers and entertainers illustrated their topics with lantern slides, among these were, Mr. E. Jacobs, secretary of the western branch of the Institute, who spoke on the Copper Mining and Smelting Industries of British Columbia.

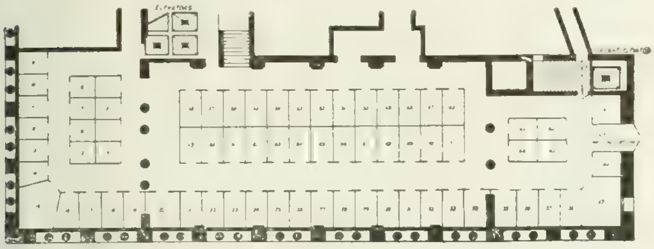
OBITUARY.

Mr. William F. [illegible], Toronto, the oldest Dominion Land Surveyor, is dead. He came to Toronto about twelve years ago from Durham, Ont., where he had lived for a great many years. In early life he was probably the best known surveyor in the employ of the government. Two of his greatest tasks were the surveying of the Counties of Grey and Bruce about half a century ago. He retired from active work [illegible]. He was [illegible] years of age.

CONVENTION OF ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.

The fifth annual convention of the Association of Railway Electrical Engineers will be held in the Auditorium Hotel, Chicago, October 21-25.

The electrical men of all the big railroads of United States and Canada will here be gathered together for a conference on standardization of electrical practice on steam railroads, and many valuable papers and committee reports are planned.



The great hall occupying the 9th floor of the Auditorium Hotel has been reserved for convention exhibits, and judging from previous years, this space will all be taken by prominent manufacturers of electrical equipment.

Size of Booth and Cost.

Booths Nos.	Area.	Price.
1–8	42 sq. ft.	$18.90
9–14	48 " "	21.60
15	126 " "	56.70
16–18	60 " "	27.00
19	56 " "	25.20
20	90 " "	40.50
21–38	60 " "	27.00
39	142 " "	63.90
40	56 " "	25.20
41	64 " "	28.80
42–45	48 " "	21.60
46–71	60 " "	27.00

As in previous years, an excellent entertainment programme will be provided which will include an informal dance, automobile tour of Chicago's parks, theatre party, closing with the annual banquet.

◆

THE MEMPHIS UNION STOCK YARDS.

The Memphis Union Stock Yards, recently completed at Memphis, Tenn., are generally considered to be the most modern and up-to-date stock yards in the world.

About 20,000 horses and mules were sold annually in the city of Memphis before the erection of these stock yards, nearly all of them at retail. With the completion of the new structure and the wholesale trade which it is estimated that this will bring, the annual sales will undoubtedly run 60,000 to 80,000 head.

The stock yards comprise the auction and commission stables, which have a capacity of 2,000 horses and mules, a private mule barn with a capacity of over 8,000 head, and an auction pavilion arranged for the selling of from 500 to 1,000 horses and mares throughout the week.

One of the important features which had to be arranged for in the construction of these stock yards was the covering of some 400,000 square feet of the buildings with a durable fireproof roofing.

As the buildings were situated alongside a railroad, the fire risk was believed to be too great for shingles or any other inflammable roofing, and, on account of the space to be covered, a roofing unduly high in cost or that necessitated painting or gravelling, or any considerable amount of repairs or renewals, was considered impracticable. After investigation of roofings that were claimed to meet these requirements, the J-M Asbestos Roofing, made by the H. W. Johns-Manville Company, New York, was selected; in consequence, all the buildings were covered with this roofing.

This fabric is made of pure, long-fibred asbestos (stone) felt, securely cemented together with a combination of Trinidad Lake and other natural asphalts. Approximately 400,000 square feet were necessary, or about ten acres.

It is estimated that these new stock yards will effect an enormous saving between buyers and jobbers in the horse and mule business. The stock will be shipped direct to the yard by the raisers, instead of being sent to some other wholesale market and re-sold to come to Memphis. This will cut out an average additional expense of about $200 per car load by approximately $10 per head, and, with the sixty to eighty thousand head it is expected will be handled in a year, the saving approximates three-quarters of a million dollars annually.

◆

A NEW ENGINEERING FIRM.

A new office has been started by four Montreal men, a mechanical, an electrical, and two civil engineers, each with a number of years' practical experience in their several particular lines. The scope of the work to be taken up embraces all kinds of estimating for contractors and their engineers, such as taking out quantities on building work to assist the contractor in tendering on contracts, estimating on heating, plumbing, ventilating and electric lighting, making up valuations for insurance purposes, drawing up detail plans for every description of engineering work. There should certainly be a field for such an engineering firm in this country. The address and offices of the company are: Estimators and Quantity Experts, 210 Board of Trade Building, Phone Main 786, Montreal.

◆

PERSONAL.

MR. JAMES T. CHILD, city engineer of Calgary, Alta., has tendered his resignation to the city commissioners.

MR. FRED L. OLMSTEAD, of Boston, Mass., has been engaged by the Toronto Harbor Commission in connection with the preparation of plans for the water front of this city. Mr. Olmstead is well known amongst municipal officials both in Europe and North America.

MR. FRANK L. CODY has resigned as assistant manager for the Northern Ontario Light & Power Company, at Cobalt, Ont., because of ill health. Mr. Cody has been in Cobalt district for the last six years, and was formerly general manager of the Great Northern Silver Mines and the Cobalt Light, Power and Water Company.

DR. A. E. BARLOW, president of the Canadian Mining Institute, left Montreal for British Columbia, August 18th. His intention is to visit a number of the mining centres in West Kootenay and elsewhere before proceeding to the Coast. He presided at the western meeting of the institute in Victoria on September 18th and 19th, and will preside also at a meeting to be held September 30th, at Frank, Alberta.

MR. A. D. WOODMAN, of the Canadian Domestic Engineering Company, Limited, Toronto and Montreal, has been elected to membership in the Engineers' Club, of Toronto. Mr. Woodman's firm has obtained a large number of Toronto contracts within the past couple of years, including the new Technical School, on which the engineering work will probably amount to $350,000. At the present time the Canadian Domestic Engineering Company, Limited, has approximately ninety contracts on hand for engineering work in connection with heating, ventilating and power houses.

◆

COMING MEETINGS.

AMERICAN ROAD CONGRESS.—First Annual Session to be held in Atlantic City, N.J., at the Million Dollar Pier, September 30th to October 5th, 1912. Secretary, J. E. Pennybacker, Colorado Bldg., Washington, D.C.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE CANADIAN HIGHWAY ASSOCIATION.—Meeting will be held in Winnipeg, Man., October 9th to 12th. Secretary, P. W. Luce, Room 4, Cunningham Block, New Westminster, B.C.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack. Meets every first and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES—[illegible] Sec.-Treasurer E. Hingley, [illegible]

[illegible]

THE UNION OF CANADIAN MUNICIPALITIES.—President, [illegible]; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., [illegible]

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, [illegible]; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. [illegible]; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible]; Secretary, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor [illegible]; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, [illegible]; Secretary-Treasurer, [illegible], Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, [illegible], Man.; Secy.-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2129 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Bassano, Alta., waterworks and sewers	Sept. 30.	Sept. 5.	80
Brandon, Man., two tubular boilers and stokers	Sept. 27.	Sept. 5.	67
Brockville, Ont., wharf	Oct. 2.	Sept. 12.	67
Franklyn Point, P.E.I., wharf	Oct. 8.	Sept. 12.	67
Fairhaven, N.B., pierhead to public wharf	Oct. 8.	Sept. 19.	71
Goderich, Ont., breakwater	Oct. 10.	Sept. 19.	71
Holberg, B.C., pile wharf and pile bent approach	Sept. 30.	Sept. 19.	71
Lanorail, P.Q., extension wharf	Oct. 10.	Sept. 19.	71
Massett, B.C., pile wharf	Oct. 15.	Sept. 19.	71
New Westminster, B.C., ladder dredge	Oct. 8.	Sept. 19.	80
Niagara Falls, Ont., centrifugal pump	Oct 1.	Sept. 19.	80
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., iron posts	Sept. 25.	Aug. 22.	78
Owen Sound, Ont., retaining wall	Sept. 28.	Aug. 29.	68
Penticton, B.C., concrete station	Sept. 25.	Sept. 19.	71
Quebec, P.Q., grain elevator	Oct. 21.	Sept. 19.	80
Seaforth, N.S., breakwater	Oct. 7.	Sept. 19.	72
Shutty Bench, B.C., wharf	Sept. 30.	Sept. 19.	72
St. Pierre les Becquets, P.O., wharf, approach and dredging of berth for headlock	Oct. 15.	Sept. 19.	72
Toronto, Ont., pavements	Oct. 1.	Sept. 19.	72
Toronto, Ont., sale of Normal School property	Sept. 30.	Aug. 15.	68
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78
Willow Point, B.C., wharf	Oct. 11.	Sept. 19.	72
Winnipeg, Man., sub-structure and approaches of bridge, Red River	Sept. 25.	Sept. 19.	72
Winnipeg, Man., travelling crane	Sept. 25	Sept 19	72
Winnipeg, Man., school desks	Oct. 3.	Sept 19	72

* * *

TENDERS.

Brockville, Ont.—Tenders for the construction of a timber superstructure of wharf, on part of the Tunnel Bay Dock at Brockville, Ont., will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 2, 1912. Plans, etc., at the offices of the Department of Public Works, Ottawa; S. J. Chapleau, Esq., district engineer, Corry Building, Ottawa, Ont.; J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto; and on application to the postmaster at Brockville, Ont. (See advt. in Canadian Engineer.)

Cobourg Harbor, Ont.—Tenders for the construction of an extension to west breakwater at the entrance to Cobourg harbor, Northumberland County, Ont., will be received at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 16th, 1912. Plans, etc., at the office of this Department, and at the offices of J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; J. L. Michaud, Esq., District Engineer, Merchants Bank Building, Montreal, P.Q.; and on application to the postmaster at Cobourg, Ont.

Dalhousie, N.B.—Tenders for dredging required at Dalhousie, N.B., will be received until September 30, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Full particulars may be obtained at this office.

Dorchester, Ont.—Tenders for the construction of a drain in the Township of North Dorchester will be received until September 30. Plans and specifications may be seen at the office of C. A. Jones, Petrolea, and the clerk's office, Dorchester. R. Bankes, reeve; W. B. Lane, clerk.

Fort William, Ont.—Tenders for dredging required at Fort William will be received by R. C. Desrochers, secretary, Department of Public Works, Ottawa, until October 1st, 1912. Full particulars may be obtained on application to the secretary.

Fort William, Ont.—Tenders for building Blake School No. 1 will be received up to September 30th, 1912. Specifications may be seen at W. C. Hulbert's, secretary-treasurer, Blake, Ont.

Glen Williams, Ont.—Tenders will be received for concrete dam at Glen Williams, Ont. Plans and specifications can be seen at Muldron & Rudd, engineers, Guelph, or at Glen Woolen Mills, Glen Williams.

Kenora, Ont.—Tenders received until 28th of September, 1912, by H. F. McNaughten, secretary, Department of Public Works, Toronto, Ont., for heating, plumbing, electric wiring, slate roofing, galvanized iron work, plastering, painting and glazing required for the registery office in course of erection at Kenora. Plans and specifications can be seen at above department, and at the Court House in Kenora.

Kingston, Ont.—It is expected that the Dominion Government will shortly call for tenders for the erection of a steel bridge across Kingston harbor. Plans for a temporary bridge to replace the old structure while a causeway is being built are in the hands of Chief Engineer Chapleau.

Ottawa, Ont.—Tenders addressed to C. W. Macnab, county clerk, will be received until 9th October, 1912, for the construction of a bridge on the town line between the counties of Lanark and Carleton. Bids are asked for a bridge having concrete abutments and concrete floor upon steel beams; likewise, upon alternate plans for a wooden bridge. Clear span, 25 feet. Plans and specifications may be seen and forms of tender obtained at the office of R. W. and S. E. Farley, 164 Sparks Street, Ottawa.

Toronto, Ont.—Mr. B. Ripley, engineer grade separation, Canadian Pacific Railway, will receive tenders up to noon October 5th, for the construction of a sub-structure on the Avenue Road Subway. (See advt. in this issue Canadian Engineer.)

Toronto, Ont.—Tenders for the equipment of windows, fanlights, etc., in the City Hall, with metal weather strip, will be received until October 8, 1912, by G. R. Geary (Mayor), chairman Board of Control, City Hall, Toronto. Full particulars, etc., at the offices of the Property Department, City Hall, Toronto.

Toronto, Ont.—[illegible] trades mentioned in connection with a shelter in Ketchum Park, Toronto, will be received by G. R. Geary (Mayor), chairman Board of Control, City Hall, Toronto, up to noon of October 8th, 1912: Mason work, etc., carpenter work, galvanized iron, plumbing, heating, electric wiring and fixtures, plastering, painting and glazing. Plans and specifications at the office of the City Architect, City Hall, Toronto.

Vancouver, B.C.—Tenders for the installation of ornamental light standards on a number of streets will be received until October 17th, 1912, by Wm. McQueen, city clerk, City Hall, Vancouver. Particulars at the office of the city electrician, City Hall.

Vancouver, B.C.—Tenders (in lump preferred) will be received by Messrs. Burke, Horwood and White, architects, 28 Toronto Street, Toronto, until October 24th, 1912, for all trades, except plumbing, heating, wiring and the general mechanical equipment, required in the erection of a departmental store at Vancouver, B.C., for the Hudson's Bay Company. Drawings, etc., may be seen at the offices of the architects after September 28th and at the offices of the Hudson's Bay Company as follows:—Winnipeg, on and after October 1st; Vancouver, on and after October 5th. Also at office of clerk of works at new building of the Hudson's Bay Company now being erected at Calgary.

Victoria, B.C.—The time for receiving tenders for schoolhouse, Powell River, is extended up to noon of September 30th, 1912. J. E. Griffith, public works engineer, Department of Public Works, Victoria.

Winnipeg, Man.—Tenders for cutting approximately 500 cords of cedar posts into paving blocks will be received until September 27th, 1912, by the chairman, Board of Control, Winnipeg. Particulars at the office of the City Engineer, 223 James Avenue, Winnipeg.

Winnipeg, Man.—Tenders for the manufacture and delivery, f.o.b., Winnipeg, of 3,200 k.w. self-cooling, oil-insulated, single-phase transformers will be received until September 25th, 1912. Particulars at the office of the City Light and Power Department, 54 King Street. M. Peterson, secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders will be received until September 30th, 1912, at the office of M. Peterson, secretary, Board of Control Office, Winnipeg, for the supply and installation of two additional boilers in the Hospital Power House and for the construction of a concrete tunnel and necessary pipe and connections from the boilers to the King George Isolation Hospital. Full particulars at the office of the City Engineer, 223 James Avenue.

Winnipeg, Man.—The time for delivery of competitive drawings for plans of proposed new city hall for the city of Winnipeg has been extended up to noon of February 15th, 1913. Further information may be obtained on application to M. Peterson, secretary, Board of Control Office, Winnipeg.

◆

CONTRACTS AWARDED.

Calgary, Alta.—A rough estimate prepared from tenders received indicate that the cost of erecting the high-level [illegible] include pavements, car rails or electric light. The materials of construction are reinforced concrete.

Edmonton, Alta.—Messrs. John Coates and Company, Limited, of London, England, have been awarded a contract by the municipal council for the supply and erection of a [illegible] The following were the tenders received and considered: Gorman, [illegible]

Edmonton, Alta.—On the recommendation of R. H. Par- [illegible]

Galt, Ont.—[illegible]

[illegible]

[illegible]

Amount involved is $[illegible]. Building of reinforced concrete finished with glazed tile.

Ottawa, Ont.—The Peter Lyall Company has been awarded the contract for the new custom house at Montreal, the figure being $[illegible].

Saskatoon, Sask.—The Board of Works have awarded contract to Messrs. King and McIndoe for the laying of sewer and water mains on 14th Street from Lansdowne Avenue 433 feet eastward.

Sherbrooke, Que.—School, $28,000; owner, Catholic School Commisisoners; architect, J. W. Gregoire, Sherbrooke; general contractor, Simoneau & Din; three stories, 132 x 55 ft.; concrete foundations, brick, with stone trimmings, gravel roofing.

Vancouver, B.C.—Store and rooming-house, $32,000; owner, Mrs. H. B. Hamilton; architect, Mr. Arthur J. Bird; contractors, Messrs. Wiles & Fisher; four stories, mill construction.

Vancouver, B.C.—Office and store building, $30,000; four stories, reinforced concrete, white terra cotta for exterior. General contractor, Mr. C. L. Williams; architect, Mr. S. B. Birds; owners, Messrs. Richards, Akroyd & Co.

Vancouver, B.C.—Contract for the erection of a five-story mill construction warehouse building for Mr. Charles Milne, was awarded to Messrs. Booker, Campbell & Whipple. Cost will be about $50,000. Mr. Thomas Hooper is architect.

Victoria, B.C.—Two small contracts for public buildings have been let by the Department of Public Works. At Quesnel a two-room school and outbuildings contract given to Mr. H. C. Joyce, of that place, the amount of tender being $5,400. At Fort George a new courtroom and a cell attached, contract for the work given to the contracting firm of Bronger and Flynn, of Fort George, the price to be paid being $2,750.

Winnipeg, Man.—The municipal fire, water and light commissioners have given instructions for the sinking of fifteen more wells in order that the water supply might be augmented pending definite action on the recent report of Prof. Slichter.

◆

RAILWAYS—STEAM AND ELECTRIC.

Preston, Ont.—The management of the Preston Car and Coach Company have secured the Canadian manufacturing rights of the gasoline electric cars recently tried out on the lines of the Canadian Northern Railway.

Province of British Columbia.—The officials of the Canadian Pacific Railway will call tenders for the construction of a portion of the line to extend from McBride Junction and Courtenay. The section to be constructed is in the Comox Valley.

◆

LIGHT, HEAT AND POWER

Galt, Ont.—A number of petitions, signed by ratepayers, [illegible] ornamental street lighting system.

Regina, Sask.—Messrs. Wm. [illegible] and R. J. Shimmin, of Calgary, have offered to supply this city with [illegible]

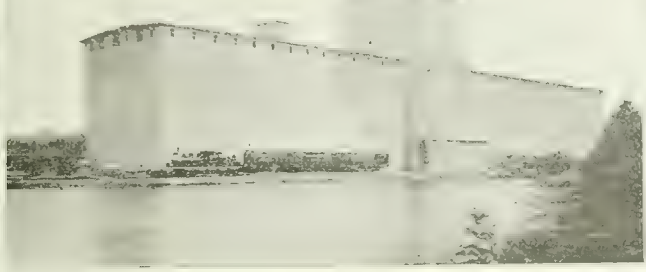
◆

GARBAGE, SEWAGE AND WATER.

Montreal, P.Q.—[illegible]

Moose Jaw, Sask.—[illegible]

Barrett Specification Roofs



On Four Great Granaries

To cover the four huge granaries illustrated herewith the Canadian Pacific R. R. engineers chose Barrett Specification Roofs for good and sufficient reasons.

These practical men know that these roofs will last *20 years or more.*

They further know that they will need no painting or maintenance expense of any kind and that the net cost per year of service will be infinitely lower than could be shown by any other type of roofing.

It is for these very reasons that Barrett Specification Roofs are used on more first-class buildings in the United States and Canada than any other kind

A big roof generally means a Barrett Specification Roof, for the reason that the cost of big roofs is carefully scrutinized and ultimate economy carefully considered. Small roof areas ought also to have Barrett Specification Roofs, because they are just as economical and satisfactory there.

Copy of The Barrett Specification with tracings ready for incorporation into building plans free on request. Address nearest office.

Special Note

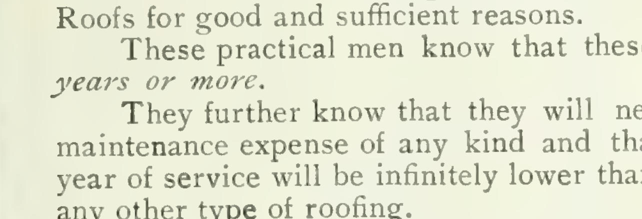
We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

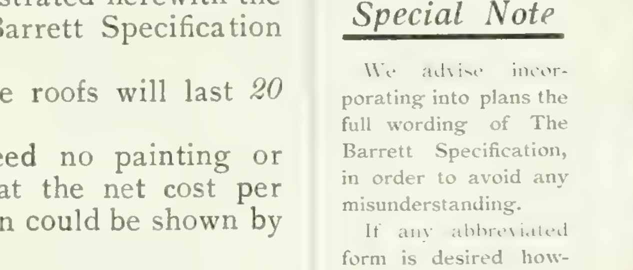
If any abbreviated form is desired however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., Limited

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.





BUILDINGS AND INDUSTRIAL WORKS.

Edmonton, Alta.—The municipal school board has decided to erect two temporary buildings and will call tenders in a few days for the construction of the same.

Fort William, Ont.—A newly-formed concern, taking the name of the Superior Brick Company, have selected a site and will erect a plant involving an expenditure of $250,000. Mr. A. A. Ayer is president and general manager of the new company.

Hamilton, Ont.—The Buffalo Brakebeam Company, a large Buffalo concern, which has a small branch in Brantford, has decided to establish a large branch in Hamilton. It has been awarded a large contract by the National Steel Car Company. A temporary plant will be opened on the property of the Hammant Steel Car Company.

London, Ont.—Plans have practically been completed in New York for the new $300,000 hotel which is to be erected in this city.

Medicine Hat, Alta.—Plans have been completed for the erection of a factory by the Canadian Fireproofing Company. The cost of this work is estimated at $75,000.

Moose Jaw, Sask.—The directors and officials of the Young Men's Christian Association have decided to erect a $250,000 building in this city.

Niagara Falls, Ont.—A report states that Mr. E. F. Pollard Company have purchased a site and will commence construction work on a factory to cost $15,000.

Port Arthur, Ont.—The Victoria Hotel will add two stories for accommodation to the travelling public. C. E. Tyner, proprietor.

The Superior Brick Company will erect a plant at Rosslyn, about six miles from this city, for the manufacture of pressed brick, tile, hollow block, etc. Capital paid [illegible]

Regina, Sask.—The management of the Capital Laundry Company intend to erect a building suitable for the needs of the business. Mr. Nevens is manager.

Saskatoon, Sask.—The Board of Works have approved the plans for the new city's stables. Tenders will be called for the erection of the building shortly. Estimated cost is $15,000.

St. Catharines, Ont.—Mr. Charles Taylor, of the Bishop Construction Company, Toronto, has purchased a block of [illegible] of the bungalow style.

Toronto, Ont.—A report states that the management of the Queen's Hotel may build an addition to their present [illegible]

Toronto, Ont.—According to a statement made at a re- [illegible] Postmaster General.

Tofield, Alta.—Mr. W. G. White, Industrial Commis- [illegible] machine shop will be erected here within a short time.

Vancouver, B.C.—The municipal council intend to call [illegible]

Victoria, B.C.—[illegible]

Winnipeg, Man.—[illegible]

◆

BRIDGES, ROADS AND PAVEMENTS.

Province of Quebec.—[illegible]

FIRES.

Vancouver, B.C.—The plant of the Vancouver Brass Foundry was destroyed by fire with a loss of $5,000. Mr. A. J. Brunk was the owner of this business.

◆

CURRENT NEWS.

Kamloops, B.C.—The ratepayers endorsed by-laws calling for expenditures as follows:—

Hydro-Electric	$250,000 00
Water	90,000 00
Electric light	65,000 00
	$405,000 00

The source of power will be the Barrier River, a distance of forty miles.

Levis, P.Q.—A statement was recently made during a banquet in this city to the effect that the site for the Quebec drydock had not as yet been selected.

Lindsay, Ont.—The ratepayers endorsed a by-law granting a loan of $12,000 to the Fitzsimmons Auto Supply Company.

London, Ont.—The municipal council have selected a site on which to erect a new city hall.

Montreal, P.Q.—There are six ten-story buildings now under construction in this city all within a short distance of each other.

Moose Jaw, Sask.—Builders in this city have offered competent carpenters the sum of 55 cents per hour in order that the pending strike may be averted.

Province of Saskatchewan.—Mr. R. O. Wynne-Roberts will prepare a report for the government of this province on the best methods of developing power from the lignite fields in this vicinity. In this connection he made a three weeks' trip through the United States.

St. Thomas, Ont.—The ratepayers recently endorsed three industrial by-laws, and by this vote Mr. Gerrard Noble will be granted a loan of $35,000 for the establishment of a biscuit company, Mr. A. J. Strough will be given assistance in the establishment of a steel grave vault, and Mr. W. G. Rogers, of the Erie Iron Works will be granted a loan of $15,000 for the extension of his plant.

Sydney, C.B., N.S.—The municipal council will consider the matter of erecting a new city hall at an early date. Mr. Kelly is mayor of this town.

Sydney, C.B., N.S.—The municipal council will consider municipality has recommended to the council that a food inspector be appointed.

Vancouver, B.C.—In the construction of the new Great Northern dock now under way at Burrard Inlet a number of piers are being used that are in many ways a novelty. They consist of frame work composed of steel rods covered with a herring-bone lath with concrete plastered over the outside to a depth of about three inches. This gives a hollow form very convenient for handling and shipping, but when placed in position on the dock site they will be filled with concrete and stones. The weight of the empty tube on a box car is about six tons.

Winnipeg, Man.—The cost of the recent water enquiry [illegible] Prof. Slichter's expenses of $100 per day.

◆

TRADE ENQUIRIES.

[illegible] of the High Commissioner [illegible] London, S.W. [illegible] the Canadian market.

[illegible]

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

DEPT. OF RAILWAYS AND CANALS, WELLAND

Superintending Engineer's Office,
Messrs. Wettlaufer Bros., St. Catharines, Feb. 7th, 1912.
No. 178 Spadina Ave., Toronto.

Dear Sirs: Replying to yours of the 6th, I beg to say that the two Mixers received from you last summer proved to be very handy, useful machines. They turned out excellent concrete and we had no trouble with them at all.

Yours truly, J. L. WELLER, Superintending Engineer.

CANADIAN NORTHERN RAILWAY

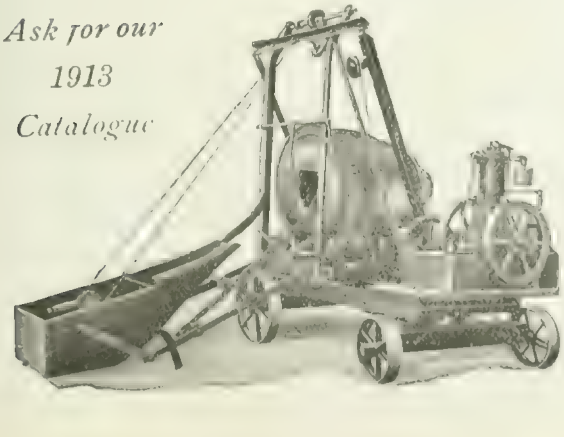
Belleville, Ont., Feb. 14th, 1912.
Wettlaufer Bros.,
178 Spadina Ave., Toronto, Ont.

Dear Sirs :—I think it is my duty to inform you that I am entirely satisfied with the two Concrete Mixers purchased from you last season. I have tested them in every way possible, and in every case I have found them capable of doing first-class work. Yours sincerely, J. O. GIROUX.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

Compare the thoroughness, simplicity and durability of our mixer with other makes. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing and the saving of power.

Ask for our
1913
Catalogue



WETTLAUFER BROS.

Head Office and Warerooms

178 SPADINA AVENUE,

WORKS AT MITCHELL, ONT. **TORONTO** DETROIT, MICH. BUFFALO, N. Y.

HOOTON & MOORE, 613 Ashdown Block, Winnipeg,
LAVALLE-ROSS, Alexander Block, Edmonton, Alta.
A. R. WILLIAMS MACHINERY CO. 15 Dock St., St. John, N.B.
WETTLAUFER BROS., 316 Lagauchetiere St. W., Montreal, Que.

CANADIAN PACIFIC RAILWAY EARNINGS IN AUGUST.

The Canadian Pacific Railway reported the heaviest gross earnings of any railroad in Canada, United States or Mexico. The list is as follows:

	1912.	Inc.
Buf., Roch. & Pitts	$ 399,994	$102,887
Can. North.	563,000	102,900
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Ten. & Rio Grande	736,300	5,900
Grand Trunk of Canada, Grand Trunk Western, Det., Gr. Hav. & Mil., [illegible]	[illegible]	[illegible]
In. & Ga. Northern	383,000	89,000
[illegible]	[illegible]	[illegible]
Mis., Kan. & Tex.	949,152	88,158
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
St. Louis & S.-W.	358,000	43,000
Southern Railway	1,803,325	74,310
Texas & Pacific	509,784	10,209
Tol. Peoria & West	55,170	*2,110

*Decrease

For the month of August the returns of 22 roads show gross earnings of $53,315,430, an increase of $5,518,095 over [illegible]

◆

PROMINENCE AS A COALING STATION.

[illegible] coaling station, measured by the quantity of bunker coal supplied. St. Lucia ranks first, and hitherto Barbados has been second. Last year, however, the quantity of bunker coal supplied at Trinidad rose above the best showing ever made in Barbados, and the position of the two islands as coaling stations is reversed. This rapid increase would make it probable that in a few years Port of Spain will be the leading port of call in the Caribbean for coal and ships' supplies [illegible]

◆

WOOD TANK HOOPS.

[illegible] American Railway Bridge and Building Association. The [illegible] per cent. of the round band is exposed when in use. This facilitates examination and painting.

◆

LABOR DISPUTE AT COBALT

[illegible]

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible] summaries of [illegible] Railway Commission- [illegible] easy filing. Copies of these orders may be secured [illegible]

[illegible] crossing where it crosses the Toronto Suburban Ry. on Keele St., near St. Clair Ave., [illegible]

[illegible] to run its tracks with [illegible]

[illegible] Rural Municipality No. [illegible], Sask., to construct [illegible] C.P.R. between Secs. [illegible]

[illegible] C.N.R. to construct across and divert [illegible] and Secs. 10 and 15, Tp. 16, [illegible]

[illegible] C.N.R. to construct across thirty [illegible] highways on its Calgary-MacLeod Branch.

[illegible] Ry. to construct across the [illegible] Parish of St. Dorothee, Co. Laval, Que., mileage 39.6, east of Hawkesbury.

17421—September 6—Authorizing C.N.O. Ry. to construct across public road at station 142.70, between Tps. of Bristol and Clarendon, Co. Pontiac, [illegible] railway over highway.

[illegible] C.N.O. Ry. to construct bridge across creek at station 754.15, Tp. of Ferris, Dist. Nipissing, at mileage 223 from Ottawa.

[illegible] C.N. Branch Lines Co. to construct across fourteen (14) highways on its Canora-Sturgis Branch.

17424—September 6—Authorizing the James Bay and Eastern Ry. Co. to [illegible] Lake St. John, mileage [illegible], from Roberval.

17425—September 7—Authorizing G.T.P. Branch Lines Co. to construct its Regina-Moose Jaw Branch across 4 highways between mileage 40.01 [illegible]

17426—September 6—Authorizing C.P.R. to use and operate bridge No. 68.0 on the Muskoka Sub. Div., Ontario Division.

[illegible] C.P.R. to reconstruct bridge No. [illegible] over Blind River, Algoma Sub. Div., Lake Superior Div.

17428—September 6—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible] highways from mileage [illegible] to mileage [illegible]

[illegible] Algoma Central & Hudson Bay Ry. to open for traffic its line of railway between Hawk Lake Junction and [illegible] (to connect with C.P.R.).

17430—September 6—Authorizing G.T.R. to construct branch line or spur into the premises of the Standard White Lime Company, Limited, near Beachville, Ontario.

[illegible] G.T.P. Branch Lines Company to construct across and divert highway on its Melville-Regina Branch, N.W. [illegible] Sask.

[illegible] C.N.R. to construct bridge over the [illegible] River, [illegible], Man.

[illegible] C.N.O. Ry. to construct across [illegible] Nipissing, mileage [illegible] from Ottawa.

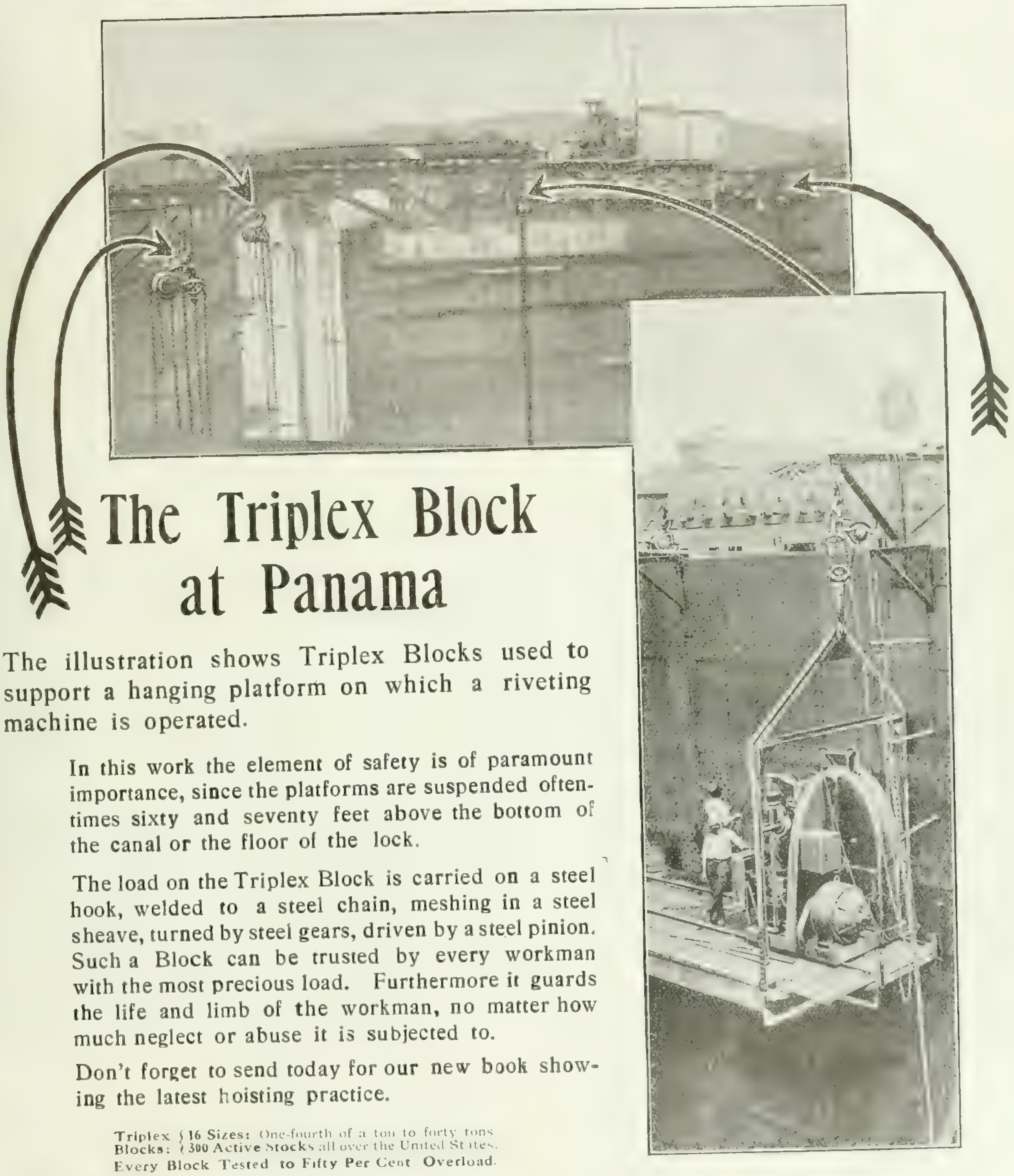
[illegible] C.P.R. to construct across two tracks [illegible] St. Johns, Que., mileage [illegible]

[illegible] C.P.R. to construct extension to the spur already constructed for W. J. Riley, at mileage 20.1 on Lac du [illegible]

17436—September 4—Extending the time within which the Walkerton & Lucknow Ry. (C.P.R.) construct spur for National Portland Cement Co., [illegible]

[illegible]

THE TRIPLEX BLOCK



The Triplex Block at Panama

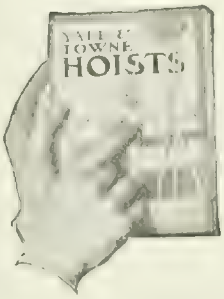
The illustration shows Triplex Blocks used to support a hanging platform on which a riveting machine is operated.

In this work the element of safety is of paramount importance, since the platforms are suspended oftentimes sixty and seventy feet above the bottom of the canal or the floor of the lock.

The load on the Triplex Block is carried on a steel hook, welded to a steel chain, meshing in a steel sheave, turned by steel gears, driven by a steel pinion. Such a Block can be trusted by every workman with the most precious load. Furthermore it guards the life and limb of the workman, no matter how much neglect or abuse it is subjected to.

Don't forget to send today for our new book showing the latest hoisting practice.

Triplex { 16 Sizes: One-fourth of a ton to forty tons
Blocks: { 300 Active Stocks all over the United States.
Every Block Tested to Fifty Per Cent Overload.



THE CANADIAN FAIRBANKS-MORSE CO., Limited *SOLE AGENTS FOR CANADA*

MONTREAL ST. JOHN OTTAWA TORONTO WINNIPEG
CALGARY SASKATOON VANCOUVER VICTORIA

[illegible] C.P.R. [illegible] Que.

[illegible] C.P.R. [illegible] ballast pit at Algoma, Coul location A, Con. 2, Tp. of Long, Dist. Algoma, [illegible]

17448—September 10—Authorizing C.P.R. to construct branch line or spur into premises of Gus Pech Foundry & Mfg. Co., Regina, Sask.

17449—September 10—Authorizing C.P.R. to construct extension to present spur for Taylor-Forbes Co., Ltd., Guelph, Ont.

17450—September 10—Authorizing G.T.R. to constrcut siding into premises of the Breakwater Co., on Lot 14, Con. 1, L. E., Tp. of Bertie, [illegible]

17451—September 7—Authorizing C.N.O. Ry. to construct across tracks of Nosbonsing & Nipissing Ry. Co., Tp. of Ferris, Dist. Nipissing, mileage 217.9 from Ottawa, with overhead bridge.

[illegible] du Fort, Que. (C.N.R.).

17453—September 12—Approving revised location C.N.O.R. Sudbury-Port Arthur line through unsurveyed territory in Dist. of Algoma, mileage [illegible] Port Arthur.

17454—September 12—Approving revised location C.N.O.R., Sudbury-Port Arthur line through unsurveyed territory, Dist. Thunder Bay, mileage 268.03 to mileage 269.3 from Port Arthur.

[illegible] truct across two highways on Lot 13, and Lots 10, 11 and 12, R. "A," Tp. Ouiatchouan, Co. Lake St. John.

17456—September 12—Approving C.L.O. & W. (C.P.R.), plan of subway on road allowance between Lots 8 and 9, Con. 4, Tp. of Scarborough.

17457—September 13—Amending Order No. 17190, in Re. C.P.R. expropriating lands for its Windsor Street Station, Montreal, Que.

17458—September 12—Approving C. N. Branch Lines Co.'s location through Tps. 19 to 24, Rgs. 1 and 2, W. P. M., mileage 36.58 to mileage [illegible]

17459—September 12—Authorizing C.N.O.R., to open for carriage of traffic its line of railway, in Tp. of Camden, Co. of Addington, mileage [illegible]

17460—September 12—Authorizing C.N.O.R. to open for traffic its line of railway, Tp. of Camden, Co. of Addington, mileage 145.83 to mileage 149 from Toronto.

17461—September 12—Approving James Bay & Eastern Ry. Co., extension from Roberval, Tp. of Dufferin, Co. Lake St. John, mileage 30.7 [illegible]

17462—September 12—Approving location Alberta Interurban Ry. Co., Ltd., from north line of Sec. 31, Tp. 24, R. 28, to east line of Tps. 27-28, [illegible]

17463—September 12—Approving location Alberta Interurban Ry. Co., Ltd., from east line, Tps. 27-28, R. 27, W. 4 M., to a point in Sec. 15, Tp. 29, R. 23, W. 4 M., from mileage 38.36 to mileage 66.80; and to construct along highways.

17464—September 13—Approving Dominion Atlantic Ry. Co., plans showing sub-structure of bridge to be constructed over the Gaspereaux River, at Horton Landing, Co. Kings, N.S.

17465—September 13—Approving revised location of Dominion Atlantic [illegible]

17466—September 10—Approving location G.T.P. Branch Lines Co. from [illegible]

[illegible]

[illegible] additional tracks across the public road south [illegible] Cadastral, No. [illegible] and change location of its station at St. Hyacinthe, Que.

17482—September 16—Authorizing C.P.R. to construct spur for L. Villeneuve & Co., Ltd., on Maude St., (not open), in city of Montreal, Que., at Mile End Station.

17483—September 14—Authorizing C.N.R. to construct across public road between Secs. 7 and 8, Tp. 31, R. 14, W. 4 M., on its Goose Lake Extension.

17484—September 17—Granting leave to Alberta Interurban Ry. Co. to cross G.T.P. Ry. [illegible] Tp. 24, R. 29, W. 4 M.

[illegible] September 17—Approving location Alberta Interurban Ry. Co. from mileage [illegible] to mileage [illegible]

17486—September 17—Approving location Alberta Interurban Ry. Co. from Fifth Meridian East to North Line of Sec. 31, Tp. 24, R. 28, W. 4 M., mileage 2.28 to mileage 9.93.

17487—September 14—Authorizing G.T.P. Ry. to construct its Calgary Boundary Branch across fifty-two (52) highways, from mileage 27.67 to mileage 111.29, Dist. South Alberta.

17488—September 16—Authorizing Michigan Central Ry. Co. to construct two passing tracks across concession road between Cons. 6 and 7, Tp. of Crowland, Co. Welland, Ont.

17489—September 16—Authorizing C.L.O. & W. (C.P.R.) to construct across four (4) highways, Tp. Sidney, Co. Hastings, Ont.

17490—September 17—Extending time until the 15th day of October, 1912, for C.N.R. to complete fencing, cattle guards, return fences and crossing signs, on its line from Grosse Isle, Man., to end of track, a distance of 31 miles.

17491—September 16—Varying Order No. 15449, dated Sept. 15th, 1911, to provide half interlocking plant instead of full interlocking plant, where Winnipeg Electric Ry. Co. crosses Selkirk Branch, C.P.R., on Selkirk Ave. and McPh[illegible] Street, Winnipeg, Man.

17492—September 16—Amending Order No. 17384, Sept. 4th, 1912, re express charges on cream, to make it apply between all points west of and including Port Arthur, within the Provinces of Ontario, Manitoba, Saskatchewan, and Alberta, instead of between all points west of Port Arthur.

17493—September 16—Suspending Supplement No. 10, to M.C.R. Co.'s Local and Joint Commodity Tariff, C.R.C., No. 1743, pending hearing. Application of Power City Stone Co., Ltd., Niagara Falls, Ont.

17494—September 16—Authorizing Commissioners of Transcontinental Ry. Co. to operate trains over crossing where it crosses C.P.R., near St. Leonards, New Brunswick.

17495—September 17—Approving Ontario & Quebec Ry. Co. plan of covered platform to be constructed at Windsor, Ont.

17496—September 17—Approving M.C.R. Co. plan of culvert to be constructed on West Town Line Road, Tp. Maidstone, over Mooney Creek Drain.

17497—September 17—Authorizing G.T.R. to construct siding with spur therefrom, for the Knechtel Furniture Co., Ltd., of Hanover, Ont.

17498—September 17—Extending, until the 30th Sept., 1912, the time [illegible] the Dominion Atlantic R[illegible] crosses highway short distance east of Berwick Station, Nova Scotia.

17499—September 17—Authorizing C.P.R. to construct spur into the premises of the Canadian Western Lumber Co., Ltd., on Lot 48, Group 1, New Westminster Dist., at Fraser Mills, B.C.

17500—September 16—Approving location C.P.R. station at Twin Butte, British Columbia.

17501—September 17—Authorizing C.P.R. to construct bridge No. 86.16, over Woman River, Chapleau Subdivision, Lake Superior Division.

17502—September 17—Authorizing C.P.R. to open for traffic that portion of its Kootenay Central Branch from Colvalli, mileage 0, to Fort [illegible]

[illegible] Approving revised location G.T.P. main line from [illegible] north line of Lot 4077 to east line of Sec. 22, Tp. 15, mileage 347.5 to mileage 372.4, east of Prince Rupert, Coast District, Range 5, B.C.

[illegible] G.T.P. [illegible] 449.18 to 452.94, east of Prince Rupert, Cariboo Dist., Range 4, B.C.

[illegible] C.P.R. [illegible] Blue, in S.W. ¼ Sec. 4, Tp. 18, R. 18, W. 2 M., at Pilot Butte, Sask.

17506—September 17—Authorizing C.P.R. to construct spur for city of [illegible] lanes, and along Lot 26, all in Block 13; across First, Second, Third and [illegible] Moose Jaw.

[illegible]

[illegible]—September 18—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible]

[illegible]

Volume 23. Toronto Oct. 3, 1912

Contents of this issue on page 549

The Canadian Engineer

An Engineering Weekly

NEW GRAIN ELEVATOR FOR THE HARBOR COMMISSIONERS OF MONTREAL.

The marine traffic of the port of Montreal is second only to that of the port of New York among all the ocean ports of North America. An important portion of the export traffic from Montreal is grain, which is, for the greater part, wheat from the Western provinces of Canada.

Prior to 1910 the export grain handling equipment in Montreal harbor consisted of a 1,000,000-bushel steel elevator, owned and operated by the harbor commissioners, adapted for unloading lake and canal vessels, but not designed for railway car traffic; a 1,000,000-bushel steel elevator owned and operated by the Montreal Warehousing Company (a corporation subsidiary to the Grand Trunk Railway), equipped for the unloading of both railroad cars and inland vessels; two obsolete wooden elevators, owned by the Canadian Pacific Railway, and since torn down; and a small fleet of floating transfer elevators of varying age and efficiency.

In the early part of 1910 the harbor commissioners of Montreal determined on the immediate construction of a new grain elevator of the highest class to provide (a) a rapid and efficient plant for the unloading of those railway cars for which the Grand Trunk elevator was not available; (b) extensive additional capacity for quick unloading of inland vessels, which were often being delayed for days in the harbor waiting to be unloaded; (c) sufficient additional storage capacity so that merchants could hold grain at the exporting point when it became advantageous to do so, and to eliminate the necessity for direct and almost direct transfer of inland cargoes to ocean vessels; (d) facilities for shipping grain from the new elevator, not only to the present vessel berths but to others under course of planning.

The harbor commissioners retained John S. Metcalf Company, Limited, as their constructing engineers for the new elevator. This company were the designers and builders of the Grand Trunk elevator in Montreal harbor, and of the great export grain conveyer system belonging to the commissioners, so that they were familiar with the developments of the port and the details of the problems to be solved.

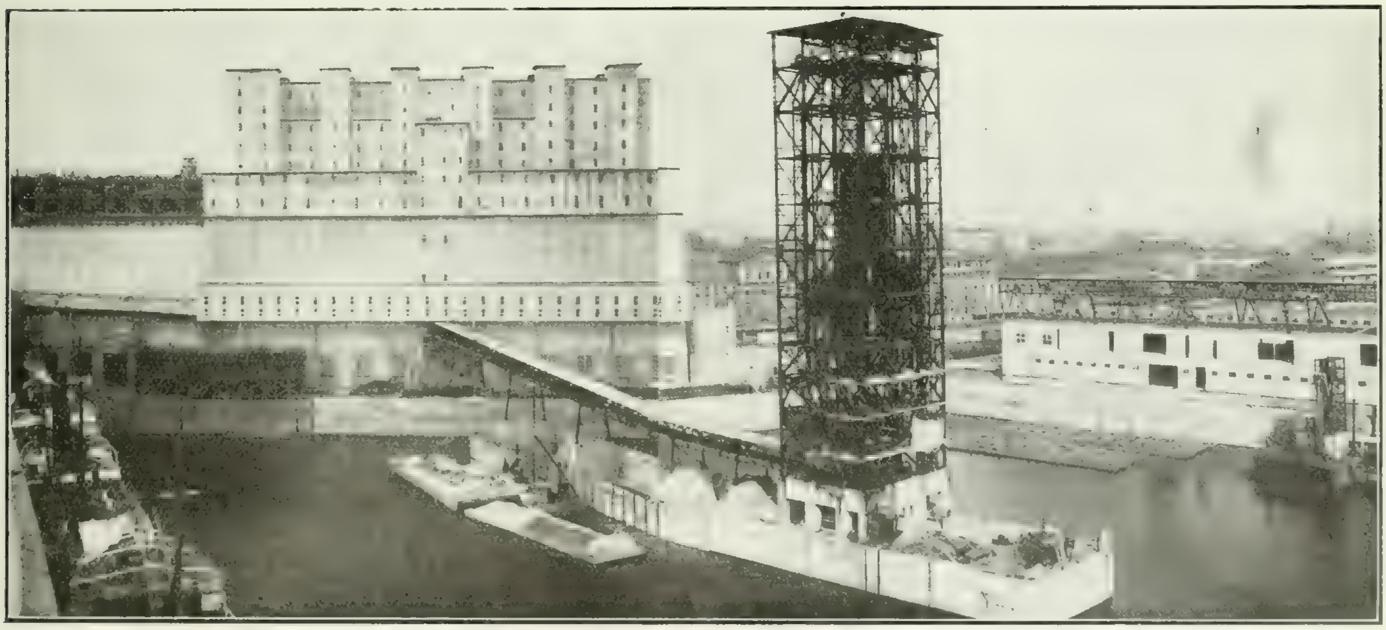


Fig. 1.—General View of Elevator from Outer End of Jacques Cartier Pier.

The instructions were to provide the best, in structure, equipment and efficiency. The commissioners were resolved that Montreal's export traffic in grain should not suffer through lack of thorough facilities.

In the summer of 1912 the elevator and a portion of the shipping conveyers were ready for the handling of car grain; and the marine unloading will be in operation October 1st.

Even though the capacity of the new elevator was to be 1,772,000 bushels, it was found in 1911 that the storage room of the port would still be inadequate; and as the elevator was to have machinery equipment suitable for taking care of several millions of bushels of storage capacity, the commissioners ordered the capacity of the elevator to be increased by 850,000 bushels, making the total capacity of the [illegible] bushels. The storage addition will be ready for grain this fall.

A description of the important features of the work follows:

Structures.

Dimensions.—The elevator, including the storage addition, is 456 feet 8 inches long by 100 feet wide, and 220 feet high to the tops of the leg towers.

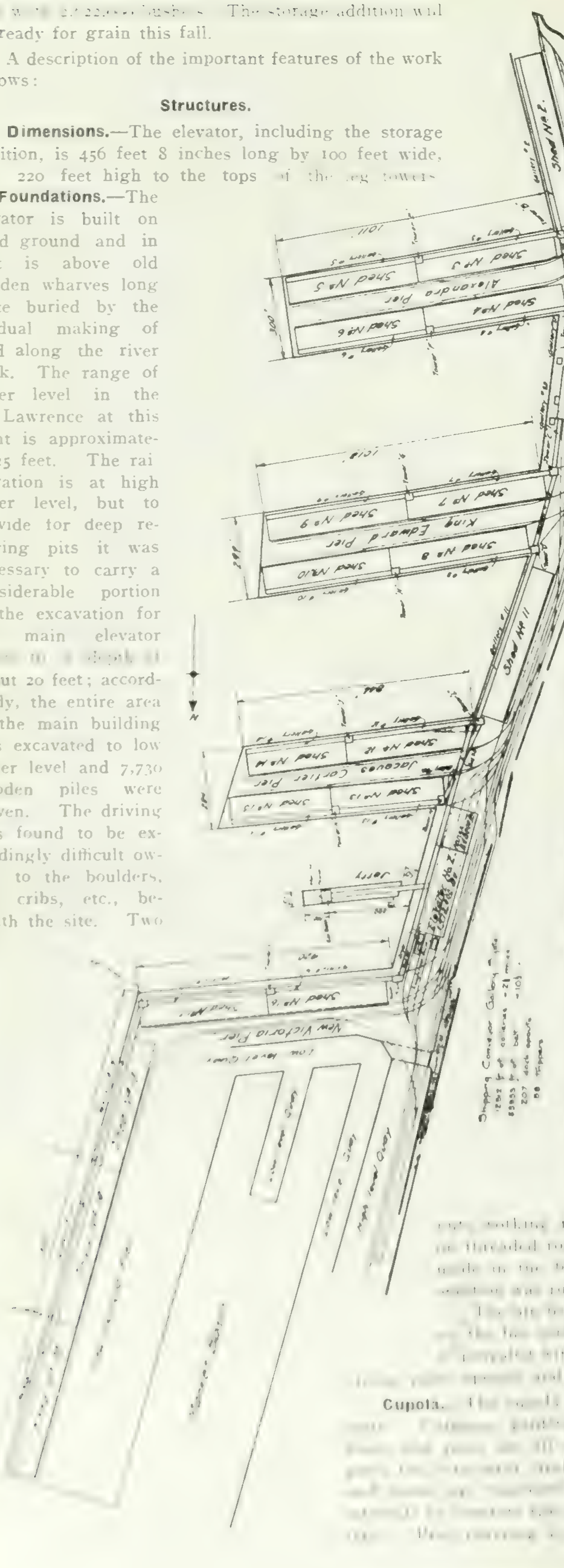
Foundations.—The elevator is built on filled ground and in part is above old wooden wharves long since buried by the gradual making of land along the river bank. The range of water level in the St. Lawrence at this point is approximately 25 feet. The rail elevation is at high water level, but to provide for deep receiving pits it was necessary to carry a considerable portion of the excavation for the main elevator [illegible] to a depth of about 20 feet; accordingly, the entire area of the main building was excavated to low water level and 7,730 wooden piles were driven. The driving was found to be exceedingly difficult owing to the boulders, old cribs, etc., beneath the site. Two large drivers with No. 1 Warrington steam hammers were employed. On top of the piles a reinforced concrete slab 3 feet 6 inches thick was laid, extending over the entire foundation area. An idea of the foundation problem may be gained when it is known that loads as high as 1,270 tons had to be carried on some of the columns.

Concrete piers and walls were built on top of the foundation slab and carried up to the track level. The track girders are of reinforced concrete, except over the receiving pits, where they are of steel. Boot tanks and track hoppers are of steel.

The foundations of the 850,000-bushel storage addition were differently treated. As there were to be no elevator legs, and consequently no boot tanks, in this portion of the elevator, the deep excavation necessary for the main elevator was not required. Consequently 1,535 reinforced concrete piles were used. These were of the Simplex moulded inserted type, with their tops about four feet below base of rail. Above them the foundation concrete was placed.

First Story.—Four railroad tracks extend through the entire elevator. The bin openings are 22 feet 6 inches above the tracks. The columns supporting the bins are of reinforced concrete, about 24 feet centres, in general, each way. Some of these columns are as large as 6½ feet by 5½ feet. They are surmounted by the heavy concrete girders supporting the bins. These main girders are 5 feet deep and 6½ feet wide. The first floor is of concrete except at hopper and grain openings, where steel gratings are employed. Curtain walls are of concrete, with a large area of fireproof windows. The track openings are closed by rolling steel doors.

Bins.—The bins are of reinforced concrete, are rectangular in form, and 86 feet deep. Bin walls are in general 8 inches thick. Bin capacities range from 6,800 bushels to 14,300 bushels; and the total number of bins is 278, exclusive of shipping bins. Along the water side of the elevator the upper portion of each bin is used as a shipping bin. An intermediate concrete bin bottom is placed about mid-height of the bin, the upper portion of the bin discharging to the shipping conveyors and the lower portion being used as an ordinary storage bin.



General Plan of Elevators and Galleries Grain Elevator No. 2, Montreal, Quebec.

Built by the John S. Metcalf Co. Ltd. for the Harbor Commissioners of Montreal.

The bins were constructed by the use of moving forms. The forms were raised by [illegible] working on jack castings attached to the forms, the nuts travelling on threaded rods set vertically in the concrete walls. Rapid progress was made in the building of the walls, the height of 86 feet in the storage [illegible] day and night work.

The bin bottoms are of reinforced concrete, in part supported directly on the bin girders and in part suspended from them. Each bin opening is equipped with a [illegible] turnhead, with rack and [illegible] from the floor above.

Cupola.—The cupola construction is a [illegible] example of reinforced concrete. Columns, girders, floor and roof [illegible] bracing, [illegible] curtain walls, [illegible] are all of concrete. [illegible] in the case of machinery supports [illegible] used. The lower side of floor and [illegible] Curtain walls are [illegible] thick, supported at short intervals by [illegible] connecting to the floor girders. Windows are of fireproof type. [illegible] except at the leg towers, where the concrete is waterproofed and covering omitted. The cupola is 107 feet high above the bin walls, and 220 feet above the base of the rail. This means that there are very few, if any, higher reinforced concrete buildings in existence.

Above the storage addition the cupola is but two stories high, as the only machinery above those bins is the conveyers and spouts for filling the bins.

Marine Tower.—A marine tower for unloading boats is placed on a jetty projecting into the neighboring slip. The tower is so placed in order that two vessels may be unloaded simultaneously, one lying along each side of the jetty. The tower is 340 feet from the elevator. It is built of structural steel, this material being adopted instead of concrete because it is expected that, in the event of the Georgian Bay Canal being built and 600-foot vessels being brought to Montreal for unloading it may be desired to extend the jetty farther and move the tower to such a distance from shore that 600-foot vessels may be unloaded without interference. As the shorter jetty is, however, better adapted to present congestion in the harbor, it has been adopted until such time as the increased size of lake boats coming to Montreal shall require its extension.

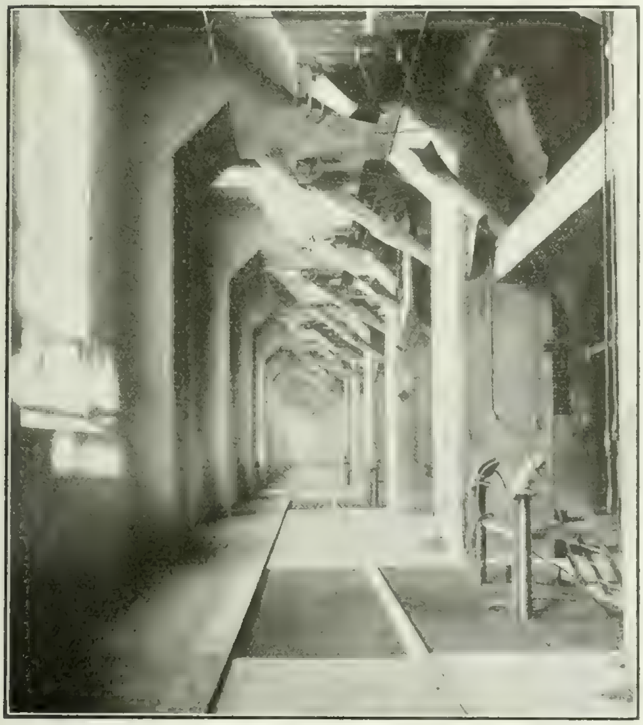


Fig. 2.—A View of the First Floor.

A steel gallery runs from the marine tower to the elevator, and contains the conveyer belts for taking grain received by boat to the elevator.

Shipping Conveyer Galleries.—Study of the accompanying diagram will show the extensive system of shipping galleries built and contemplated. Those already built in connection with elevator No. 1 were two miles in extent. Those to be added in connection with elevator No. 2 will bring the total to 2½ miles, using 10 miles of rubber belt. All galleries are of steel with concrete floors and roofs and corrugated steel side-covering.

Miscellaneous Structures.—A reinforced concrete building is provided for a grain dryer and its boiler plant, and a similar structure for the transformers and switchboard.

Equipment.

Receiving from Cars.—There are four receiving tracks, 24 track hoppers, and twelve receiving legs. Each leg is fed from two hoppers, one on either side, interlocking valves being used so that it is impossible for grain to reach the leg from more than one hopper at a time. Track hoppers are of large size, and a pair of power shovels is provided at each. Thus the unloading of a car on one side of the leg is independent of that on the opposite side, and unloading from both cars may proceed simultaneously, as the legs are of sufficient capacity (12,000 bushels per hour each) to quickly elevate the contents of either hopper as soon as the elevation of the contents of the other has been completed. The [illegible]

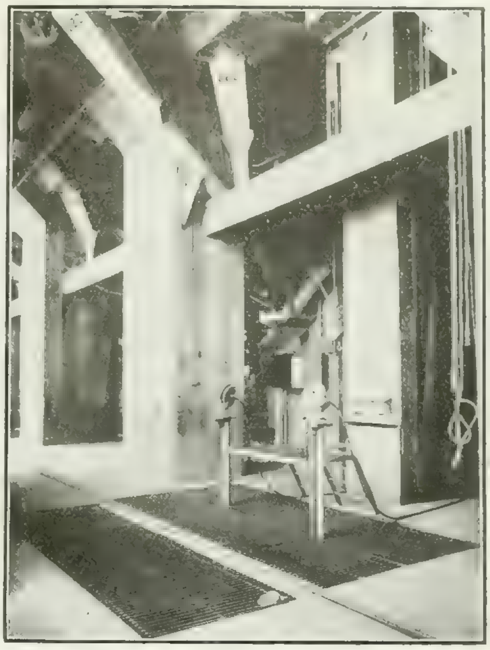


Fig. 3.—A Detail of the First Floor.

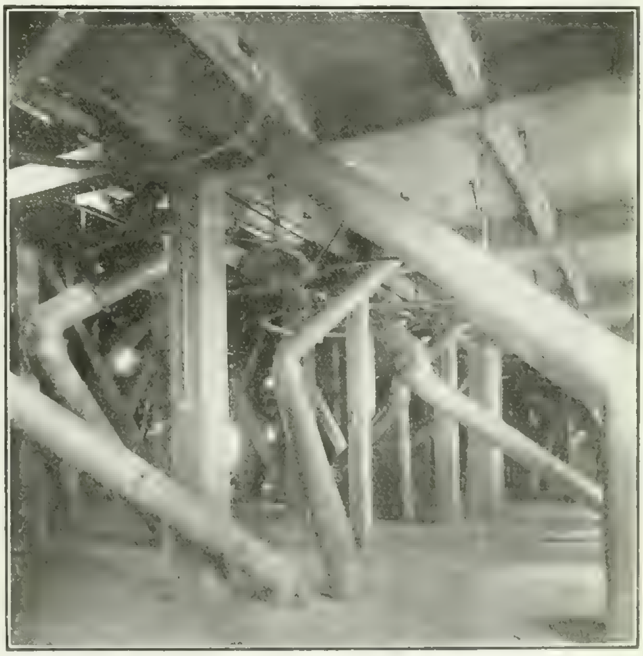


Fig. 4.—View of Distributing Spouts in Story Over Bin.

with the ordinary complement of men, and with extra men can better this in emergencies.

Cars are handled by heavy carpullers using ¾-inch wire cable.

Each receiving elevator discharges to a 2,500-bushel garner over a 120,000-pound Fairbanks hopper scale, whence the carload is sent by spouts, or belt conveyers and spouts, to the desired bin.

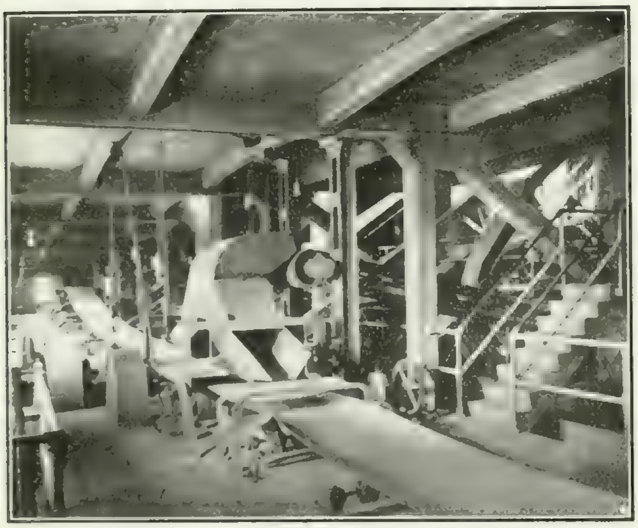


Fig. 5.—Belt Conveyers in Second Story Over Bin.

Receiving from Boats.—The marine tower is equipped with two marine legs, each of 20,000 bushels hourly capacity on the dip. One leg operates on each side of the tower, so that two boats may be unloaded simultaneously. The grain from the legs is weighed by two pairs of 6,000-pound Fairbanks continuous automatic weighing machines. Complete ship shovel and clean up shovel apparatus, operated by [illegible]

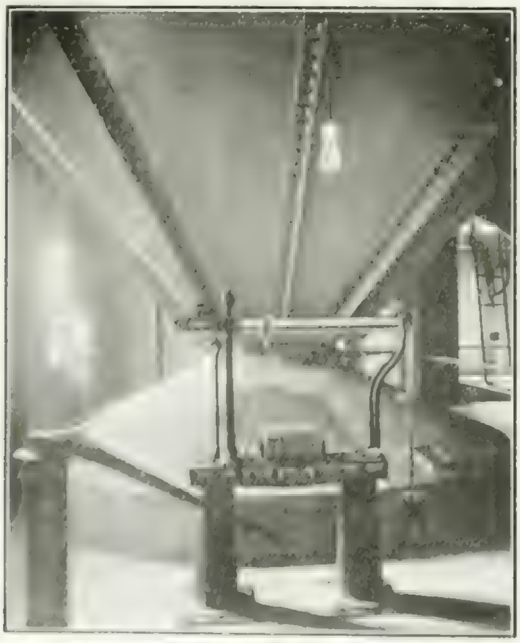


Fig. 6.—View of 2,000-Bushel Hopper Scale.

[illegible]

[illegible] constructed.

The 40-inch belt conveyers carry the grain to the elevators, where two lofter legs elevate it to the cupola. There a system of 40-inch conveyers distributes it to the double-jointed spouts leading to the bins.

The maximum hourly capacity for receiving from boats will be 40,000 bushels.

Distributing.—Two reversible longitudinal conveyers in the cupola receive from the scale and distribute grain longitudinally of the elevator.

Cleaning.—While Montreal is not a cleaning point, two large steel cleaning machines are provided for emergency cleaning and separating.

Shipping to Cars.—Four carloading spouts are provided so that cars may be loaded if desired. This sometimes becomes necessary in order to get grain to a winter port farther east after the port of Montreal has closed.

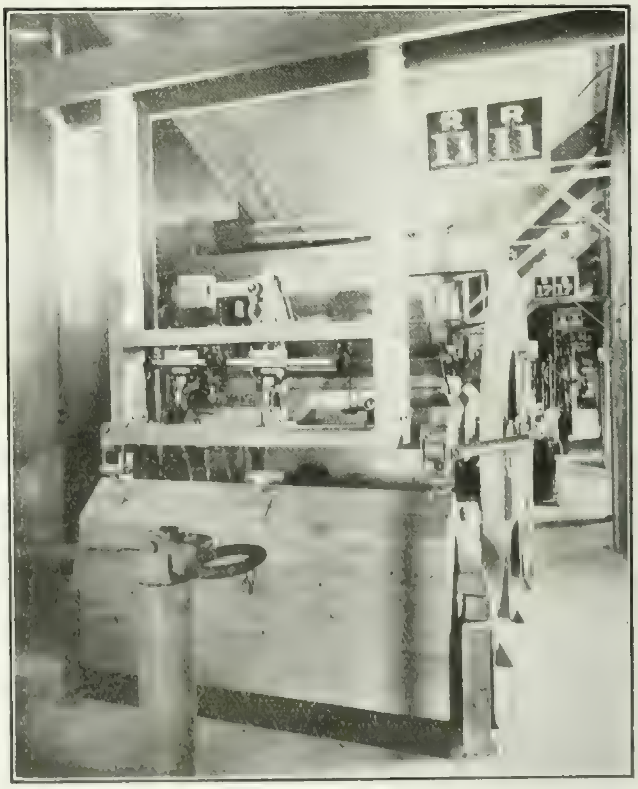


Fig. 7.—Automatic Weighing Machine, 5,000 lbs. per Draft.

Shipping to Ocean Vessels.—In connection with elevator No. 1 the shipping conveyers served 14 vessel berths on King Edward, Alexandra and Jacques Cartier piers and the neighboring shore wharves. Five berths are being added on the new Victoria pier.

The wide shipping gallery of elevator No. 2 contains six shipping conveyers. Two will extend north to serve the Victoria pier, and four will run south to connect with the conveyers to the present 14 berths. It will be possible for either elevator to ship to any of the nineteen berths.

The shipping system of elevator No. 2 will be served by five shipping legs, each with a capacity of 18,000 bushels per hour. The total shipping capacity of elevator No. 2, starting with the shipping bins full, will be 90,000 bushels hourly for ten hours.

Grain for shipment by boat is weighed through five pairs of 5,000-pound Fairbanks automatic weighing machines, each provided with automatic registers, printing devices, and electrical counters in the weighman's office. As shipping to boats and receiving from boats are continuous operations, automatic scales are used for this work, but as it is necessary in receiving from cars to keep each car weight separate, hopper scales are employed for car receipts.

Drying.—A Hess drying plant with a capacity of 5,000 bushels per day is included in the equipment. This has a separate leg so that interference with the main receiving and shipping legs is avoided.

Power.—All power is supplied by electric motors of the induction type. In the elevator, marine tower and the new shipping galleries the motors number 80, and total 4,680 horse-power.

An ingenious and efficient system of electric signals controls the operation of elevator legs and shipping conveyers. When the extent of the shipping system is remembered, and the interconnection of the two elevators, it will be seen that the signal system, particularly for shipping, must be instantaneous and sure; its design was accomplished with credit.

The harbor commissioners' grain storage and shipping system will now consist of: Two grain elevators with two marine legs each, and a conveyer system by which grain can be delivered from either elevator to any of 19 steamer berths. Everything is of fire-proof construction and all machinery is electrically driven. There is a storage capacity of 3,620,000 bushels and contemplated extensions for 3,790,000 bushels more; total, 7,410,000. Grain may be received from cars at a rate of 33,000 bushels per hour and at the same time from boats at a rate of 55,000 bushels per hour.

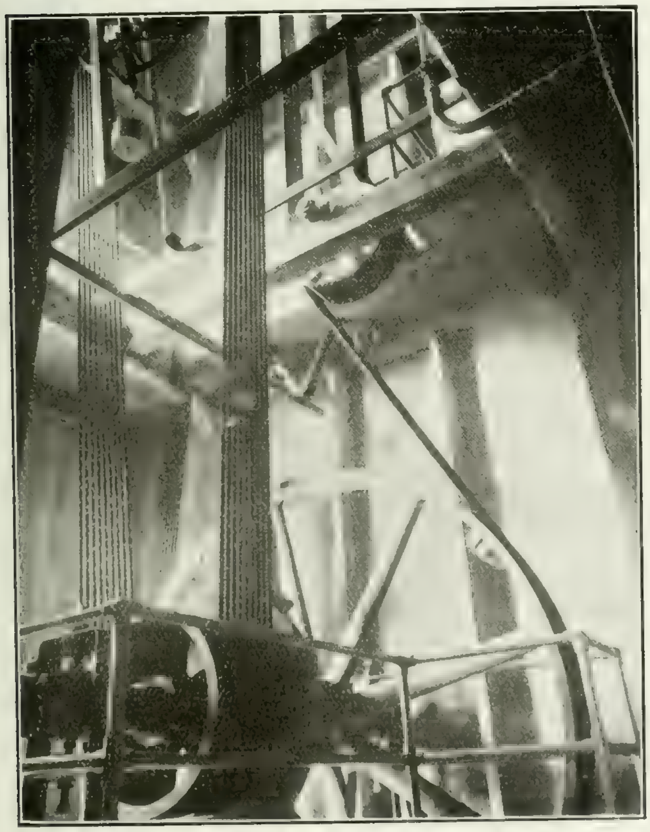


Fig. 8.—Drive to Receiving Elevator Leg.

Grain can be shipped by conveyer system to ocean steamers at their regular berths at a rate of 150,000 bushels per hour, equal to 4,500 tons per hour. It is possible to deliver grain to five steamers at the same time at a rate of 30,000 bushels per hour each, or it is possible to deliver to 10 steamers 15,000 bushels per hour each at the same time.

The present conveyer system comprises two miles of conveyer galleries and over eight miles of rubber belting. In addition to this there is under construction another half mile of gallery with two miles of rubber belting.

The constructing engineers for the Montreal harbor commissioners were the John S. Metcalf Company, Limited, Montreal, under Mr. F. W. Cowie, chief engineer. This company were also the designers of the conveyer system in connection with elevator No. 1.

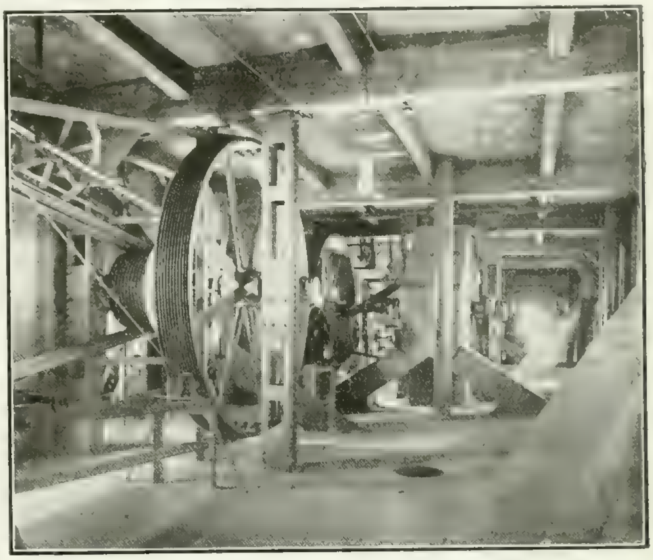


Fig. 9.—View of Top Floor Showing Elevator Heads and Drive.

It is easy to say that this building or that building is the best ever built, and that this elevator or that elevator can handle more grain than any other; the harbor commissioners responsible for the new work, Messrs. Stephens, Ballantyne and Geoffrion, with Mr. David Seath, secretary, are content to let the elevator and accessories speak for themselves.

◆

PHYSICAL PROPERTIES OF CONCRETE.

The National Bureau of Standards of the United States in its general investigation of structural materials is engaged, among other things, in the determination of the physical properties of concrete. At the suggestion of engineers and others, the Bureau of Standards is investigating the cause of cracking in concrete structures, where the necessity for expansion and contraction joints is questioned. For this purpose, reference marks were placed on some of the typical old and new concrete work in Wayne County, Michigan, also at Greenwich, Connecticut. Measurements will be taken from time to time during the summer and winter to determine the expansion or contraction in the concrete caused by temperature variations and the changes of volume which take place during the hardening of the concrete. Similar reference marks are being placed on the lock walls of the Panama Canal and various other structures, from which valuable information will be obtained.

◆

Steel on the Tofield-Calgary branch of the Grand Trunk Pacific has been laid as far south from the main line as Irricana, and that the grade is now ready for entry into the latter place. A bridge at the Bow River, about four miles out of Calgary, is likely to delay track laying a little. This bridge is of steel construction and is to be erected by the Canadian Bridge Company.

POWER PLANT OF MOUNT HOOD COMPANY.

The power plant of the Mount Hood Railway and Power Company (now owned by the Portland Railway, Light and Power Co.) is one of a number of similar plants that have been built within the last few years to supply light and power to Portland and other near-by towns and cities in Western Oregon and to Vancouver and other towns in Washington. The following description of the plant, now nearing completion, is given by W. P. Brereton, chief engineer of construction:

A dam approximately 100 feet high in the middle and about 400 feet long is in course of construction across the Big Sandy River for the purpose of diverting water. The water thus diverted is carried for a distance of about 9,700 feet with about 18-foot fall through 800 feet of timber flume having a capacity of 700 second feet, 4,200 feet canal of trapezoidal section, and then through a tunnel approximately 4,700 feet long, about 11 feet by 11 feet cross section, driven through the hill, and discharges into the Little Sandy River.

About 200 feet below this point of discharge a diverting dam has been built about 14 feet high and about 115 feet long. The water thus diverted is carried for a distance of about three miles along the hillside with a 34-foot fall, through a timber flume, having a capacity of 800 second feet, discharging into a reservoir. This reservoir has an area of 180 acres with a total capacity of 138 million cubic feet, and is formed by constructing an earthen dyke about 40 feet high on three sides and using the hillside for the fourth side.

Located inside this reservoir is the intake for the three penstocks, and for this purpose the ground has been excavated down to the lowest point of the reservoir, and the intake and gatehouse for the three penstocks built up of concrete from this elevation to a height of about five feet above high water, or about 40 feet high. The forebay is about 300 feet wide, excavated down to the lowest elevation of the reservoir. A spillway is provided in this dyke for taking care of 800 second feet with a 2-foot 6-inch depth of water on the crest.

Suitable racks and stop logs are provided at the entrance of each of the three penstocks and the penstocks themselves are controlled by 10-foot butterfly valves operated by hand or electric motor controlled from the power house.

Two penstocks, each 9 feet in diameter, are being carried through tunnels from this intake for about 400 feet, [illegible] and at that point a suitable standpipe, 5 feet in diameter, and tank is provided for each penstock. These 9-foot penstocks continue down to the power house. A third 9-foot penstock is being laid from [illegible] for future extension.

The general design of the pipe line is as follows: The [illegible] tunnelling in place having to be resorted to owing to the nature of the ground, [illegible]

[illegible]

[illegible]

[illegible]

Height, open, 23 feet 1⅞ inches, centre of valve.
Height, closed, 18 feet 5⅞ inches, to top of loop.
Face to face, 40 inches.
Diameter of cylinder, 40 inches.
Width over all, 37 inches by 73¾, bonnet flange.
Diameter of spindle, 4¾ inches.
Weight, 37,634 pounds.
Diameter of flanges on the run, 66 inches.
Thickness of flanges on the run, 3 inches.
Drilling, 48½-inch bolts on 62½-inch between centres.
Size of by-pass valve, 8 inches.
Working pressure, 140 pounds.
Test, 250 pounds for one hour.
Height over all from bottom of flange, closed, 21 feet 2¾ inches.

Each valve is located at the end of a steel penstock supplying water to turbines in the power plant near Bull Run River, Bull Run post office, about 27 miles from Portland, Oregon. The body, bonnet, disc, cylinder and piston are made of Ferrosteel, and the piston is equipped with bronze rings. The guide ribs in the bonnet and body are bronze lined, and the discs are furnished with bronze rollers. The stems are steel, encased in bronze tubing.

Twenty-four-inch branch pipes are taken from one 78-inch pipe on each pipe line for the purpose of supplying the exciters, these branches being governed by 24-inch gate valves. The 78-inch pipe lines are safeguarded both by automatic relief valves on the turbines and also by bursting plates on the pipes themselves.

The power house is being built on the south bank of the Bull Run River, the turbine tail races discharging directly into the river. The building at present being constructed is of reinforced concrete 191 feet long by 47 feet wide; height to crane rail 30 feet, one end being made temporary. Below the floor proper and above the tail races is a basement 11 feet high suitable for small machine shop, repairs, etc.

On the power house floor proper is located the machinery.

The switchboard and control gallery are located on the back wall of this building 11½ feet above the floor. Sufficient length of rails is laid into this building to enable a car to be brought in and unloaded by the crane, a 35-ton, three motor electric crane being provided for this purpose.

Immediately at the back of the power house is a small concrete building about 57 feet long by 33 feet wide in two floors, the lower floor, which is 12 feet high, being used for low tension switch room, and the upper floor, which is 12 feet high, being used for switches and bus structure. Direct access can be had from the control gallery in the power house with this latter room. The railroad track to the warehouse and depot are laid across the roof of this building.

Immediately behind this building, and on the same level as the roof of this switch room, is the transformer building, consisting of a room 18 feet wide by [illegible] feet long, equipped with a 40-ton, 3-motor electric crane for unloading the transformers from the cars, rails being laid right into the building for this purpose and also for repairs. Immediately behind this building, and adjoining it, is the transformer room proper in which will be installed seven transformers, each of [illegible] capacity. All the space above the transformer is taken up with the necessary bus structure [illegible]. All the necessary [illegible] is carried by pipe into the tail race.

In the [illegible] Type B Francis [illegible] Works, each of [illegible] oil pressure governors, pumps and tanks. These turbines are connected to steel penstocks through 60-inch hydraulic valves and work under a static head of 320 feet. Directly coupled to the shafts of these turbines are two Westinghouse alternating current revolving field generators, each 3,750 k.v.a. 3-phase, 60-cycle, 6,600-volt, 514 r.p.m.

One 6,400 horse-power horizontal, Francis type, single discharge turbine, manufactured by the Wellman-Seaver-Morgan Company, complete with N.S. 10 Lombard hydraulic governors, pumps and tanks, etc. This turbine is connected to a steel penstock through a 54-inch hydraulic valve and works under static head of 320 feet.

Direct coupled to the shaft of this turbine is a Westinghouse alternating current, revolving field generator 3,750 k.v.a., 3-phase, 60-cycle, 6,600-volt, 514 r.p.m. The fourth unit under option will be similar in all respects to the 6,400 horse-power Wellman-Seaver-Morgan, Westinghouse set.

Two 24-inch exciter wheels, manufactured by the Platt Iron Works, developing 300 horse-power each, when operating at a speed of 690 r.p.m. under 320-foot head, direct coupled to two 150 kw. Westinghouse direct current generators, 250 volts, 600 amperes, 6 poles, compound wound.

The engineers on this contract are Smith, Kerry and Chase, of Toronto, Canada. The chief engineer is W. P. Brereton; assistant engineer, J. S. Bodkin; chief draftsman, J. R. Carroll.

◆

HISTORY OF AN OLD IRON BRIDGE.

In a recent bulletin of the American Railway Engineering Association Mr. George K. Lowell, general manager of the Detroit, Toledo and Ironton Railway, gives a brief history of the Iron Railroad, together with the original construction of the Iron Bridge, spanning Storms Creek, on the line of the Iron Railroad, two and one-half miles north of Ironton, O.

Construction of the Iron Railroad was originally commenced in the year 1849, and the line was completed to the Vesuvius Mines, about six miles north of Irontown, during the year 1850. The track was laid with strap rail laid on wooden stringers, and the stringers laid on cross-ties spaced six feet apart. John Campbell, John Peters and others, of the Ohio Coal and Iron Company, were the original founders of the Iron Railroad.

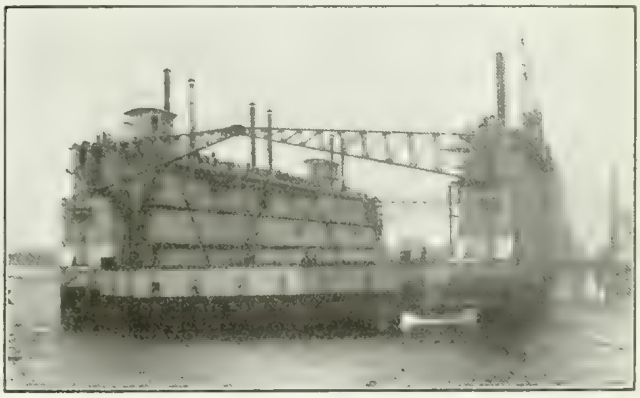
In the construction of the Iron Railroad it became necessary to span Storms Creek, two and one-half miles north of Ironton. In the original construction of the Iron Railroad, Storms Creek was spanned with a wooden trestle bridge, 97 ft. in length, but during the year 1857 the structure was considered insufficient to carry the increased loading of the road's equipment, and it was decided to construct an iron bridge of larger capacity, and more safe for the operation of the railroad. Thomas W. H. Moseley, a civil and constructing engineer, of Kentucky, was called upon to prepare a plan for the construction of a wrought-iron bridge to be placed on the site of the wooden structure spanning Storms Creek. The plans were prepared for what is known as Bowstring Construction Iron Bridge, patented February 8th, 1857, and constructed by Moseley & Company, of Cincinnati, O., in the year 1859, the bridge being constructed for the loading of 2,000 lbs. per linear foot, live load.

In the year 1905, the Detroit, Toledo and Ironton Railway, successors to the Iron Railroad, increased the weight of its locomotives and cars, and it was necessary to strengthen this bridge by placing timber trestle bents under the floor or track system. With this addition, the bridge, as originally constructed, is still in use, and over it passes as heavy tonnage as on any road in this section of the country.

THE MONTREAL FLOATING DOCK "DUKE OF CONNAUGHT."

There has recently been delivered at Montreal the floating dock "Duke of Connaught," which has been built by Messrs. Vickers (Limited), of Barrow-in-Furness, England. In *The Canadian Engineer* of August 15, 1912, we gave some details of the launching of the dock. We are now able to present a more complete description. This dock, one of the largest yet constructed, is capable of accommodating the largest existing vessel of the British navy. It is of the double-sided, self-docking type, and consists of a pontoon, or lifting portion of the dock, and two parallel side walls, built on to and forming part of the same, and the whole length is divided into three complete and separate sections, which, when bolted together, form the complete dock. These sections are so arranged that when the dock is separated into its three parts, any two of them can dock the remaining third between them. For this purpose each section is fitted with its own independent pumping machinery, so that it can also act as an independent unit. The general dimensions of the dock are as follows:

Length over platforms, 600 ft.
Length over pontoons, 550 ft. 6 in.
Width overall, 135 ft.
Depth of pontoon at centre, 17 ft.
Length of side walls, 470 ft. 6 in.
Height of side walls above pontoon dock, 42 ft.
Width of side wall at base, 17 ft. 6 in.
Width of side wall at top, 12 ft. 6 in.
Clear width between roller fenders, 100 ft.
Draught of vessel, 27 ft. 6 in.
Lifting capacity, 25,000 tons.



View of Dock.

The construction of the dock is such as to make it suitable for lifting a modern British battleship, the pontoon dock being specially stiffened to allow it to support a large portion of the weight of the vessel on side or bilge, as well as central keels. The pontoon consists of a rectangular structure plated in all round with the exception of the portion of the deck which comes directly under the walls, and stiffened internally by longitudinal and transverse girders. The two end sections have their outer extremities built in the form of a point or bow terminating in a working platform carried on plate and braced girders. The bottom plating, except under the walls, is arranged to run transversely, and is connected to the plating of the sides and points by chine angles; the top or deck plating, similarly arranged, is connected to the face of the side wall by chine angles. The pontoon is divided into four compartments by three longitudinal intercostal water-tight plate-bulkheads. Transversely the pontoon is divided into 54 bays, 20 in the central section and 17 in each end section by transverse girders, consisting of plate-bulkheads. In the compartments under the walls the plate-girders are replaced by special lattice-girders. In addition to the bulkheads, the deck and bottom platings are stiffened by means of a series of longitudinal frames which run fore and aft over the length of the pontoon, intercostal between the transverse girders. In addition to the transverse lattice-girder under the wall, intermediate transverse ordinary frames are fitted, 2 ft. 6 in. apart, and are prolonged upwards, forming the ordinary frames of the walls. The central bulkhead between the transverse girders is stiffened by vertical "breathing" plates, which are well stiffened and connected to a longitudinal curtain plate. Outside this framing of breathing plates and longitudinal curtain plate, the pontoon deck and bottom are stiffened by longitudinal framings consisting of angles, connected to the transverse bulkhead stiffeners by gussets and diagonals. These framings extend to the line of the face of the wall. In the centre section several of these frames are provided with plates riveted to them, to take the load from the side keel-blocks. The intermediate longitudinal bulkheads are formed of vertical plates, intercostal between the transverse girders, to which they are attached, as they are also to the top and bottom plating. To facilitate the complete withdrawal of all water in the pontoon, shallow troughs are fitted, which form a gutter. The walls of the dock are placed horizontally and have a batter on the face or inside wall. The top deck of the walls is plated longitudinally, and is connected to the side plating by double-chine angles. An engine-deck, on which is placed all the machinery of the dock, is fitted about 16 ft. below the top deck, and is arranged water-tight. Each wall is divided, in addition to the joint chambers, into ten water-tight divisions by plate-bulkheads, coming in line with the bulkheads in the pontoon, of which they are a continuation. At each end of the wall a docking land is formed, on which the central portion can rest when being self-docked. The framing of the walls is of two types, braced and ordinary. In line with the transverse girders of the pontoons, of which they form a continuation, the frames consist of single angles stiffened by vertical web-plates, the front and back plates being cross-connected by a series of diagonals and gussets. The ordinary frames of the walls consist of single angles back and front, cross-connected by a series of horizontal struts. Special stiffening is fitted in way of machinery. About one foot below the top deck a running deck is provided for enabling ropes to be easily handled and run from one end of the dock to the other outside the stanchions. Timber-heads and such fittings required in berthing vessels are fitted on this deck. At a distance of about 15 feet and 29 feet respectively below the running deck, two further stages, known respectively as painting and shoring stages, are provided. Each end of the central section and each square end of the terminal sections are provided with a joint [illegible], by means of which the sections can be joined together or parted. For the purpose of dealing with commercial vessels, which ordinarily will not have the length or [illegible] of the [illegible], the dock has been designed so that it can work when required in two independent units of unequal size, and to facilitate the rapid [illegible] of the two portions [illegible] docking [illegible] [illegible] are [illegible] at the level of the keel-blocks. The pumping machinery of the dock is driven by steam generated in boilers carried on the dock itself. Each section of the dock has its own complete pumping installation, and each [illegible] of two boilers and two engines and [illegible] located in specially constructed chambers in one of the walls. The pumps, which are of the centrifugal type, [illegible], are coupled to a main drain at the bottom of the dock, which is extended over practically the whole length of each section. From the main drain compartment pipes are led to each separate water-tight division of the dock. Each compartment is governed by its own separate valve, and the main inlet pipe and pump discharge pipe are governed by separate screw-down valves, and in addition have each a non-return flap-valve on the outside. The compartment valves of each section of the dock are all operated from a valve-house placed on the top deck of each section, by means of the Westinghouse electro-pneumatic system, which is based on the principle of operating presses by compressed air and controlling the same from a distance by means of valves operated by an electro-magnet. Each valve house is in telephonic communication with its respective engine-room and also with the others when the dock is working as a single unit. Each section of the dock is also provided with a direct-acting steam-pump, arranged to draw from the sea, and capable of providing a full stream of water for fire service or washing down vessels. These pumps are also connected to the main drain, so that they may be used as a drainage service for completely emptying the compartments. Two similar steam-pumps are also fitted on the opposite wall of the dock.

Steam heating is provided to prevent water in the compartments from freezing, and also for the mechanism that could be affected by frost. Each water-tight compartment is provided with the Gardner and Ferguson indicating system, to show, in the valve house, the level of the water inside it.

Similar gear is also provided for indicating the draft of water over the keel-blocks. The dock is provided with eight steam capstans, four on each wall. The spindles of the capstans are carried down vertically to the level of the pontoon deck, where, in a small chamber in the wall at this level, cable-lifters are fitted, so that the mooring cables may be hauled in or paid out when the dock is being moved about. Donkey boilers are provided on the wall remote from that in which the main boilers are fitted, to provide steam for the capstans and fire-pumps fitted on that wall. On the top deck of this wall a three-ton electric travelling gantry crane is fitted and arranged to traverse the whole length of the wall. At both ends of the combined dock a pair of flying gangways or swinging bridges are fitted, affording access from one wall to the other.

The dock will be lighted throughout the machinery compartments by means of electric lamps. The outside lighting consists of bracket standards, each supporting a cluster of lamps. Box terminals are also fitted on the walls, from which lamp clusters can be taken by flexible leads for lighting any particular portion of the ship on the dock. Electric current will be supplied through cables from the shore.

The dock is provided with the usual bollards and timber heads. Roller fenders are also fitted to protect the walls of the dock from an entering steamer. Eight mechanical side shores, four on each wall, are provided. These can be screwed in or out by a standard fitted in the top deck. Keel-blocks, side or docking keel-blocks, and bilge blocks are provided; the latter are arranged to pull in or out to suit the shape of the ship when she has taken the keel-blocks. The keel-blocks are strongly made and closely spaced, to enable them to take the weight of the heaviest and most modern ironclads. Ladders are fitted leading from the upper deck of the dock to the pontoon deck, and also into the various compartments of the dock. Suitable hand-rails are fitted all round the top deck. Ventilation by means of cowl and downcast pipes is arranged to each boiler and engine room, and also to the interior of the walls. A valve-house large enough to contain the valve-control table and the recording instruments is fitted on the top deck of each of the three sections, each valve-house contains the apparatus necessary for controlling the valves of its own particular section.

IRRIGATION LESSONS FROM THE OLD WORLD.*

By Sir William Wilcocks.

Living among Arabs for the last thirty years, I hesitated at first to say anything at this meeting, as they greatly respect silence in the East. "O man, God gave thee two feet, two hands, two ears, two eyes and one tongue, know thy destiny." However, I have remembered that I was born sixty years ago in a tent on an irrigation canal in Northern India, and have spent my life in those arid lands where, in ex-President Roosevelt's words, it is water and not land which measures production; and that therefore I might say something to-night on the subject of eastern irrigation.

The spirit of irrigation in the East is the spirit of the homestead. The intense cultivation, the need of many heads and many hands to weed, to care after live stock, to gather in the varied harvests, to manipulate delicately and to trim carefully, justify one in slightly changing the words of the Psalmist and saying that "irrigation and marriage meet together, children and prosperity kiss each other." Children in towns are a source of expense, on irrigation farms they are a source of wealth. In Egypt children four and five years old take out huge buffaloes to pasture and control them by a string tied to the horns and passed round one of the ears. Boys of eight and nine lead out sheep and guide them so that they clean the land of weeds and confirm the truth of that old English saying that "the feet of sheep are shod with gold." Girls and women cut and bring in clover, pick cotton, clear rice fields of weeds, prepare the fuel and look after the house. All are busy from morning to evening, and the larger the number of hands, the cleaner the crop and the more plentiful the yield. In the old world east a man is not considered fit to sit down among respectable people if he has passed a certain age and is unmarried. And although I did not know it then, I know it now, that it was this spirit of irrigation which prompted me in my younger and more romantic days to write down on the first page of my note book those delightful lines of Burns:

> "To make a happy fireside clime
> For weans and wife,
> Is the true pathos and sublime
> Of human life."

I know that in the younger West, book learning is considered the royal road to wisdom, even though it is only one child in ten who really benefits while nine are being brought up on indigestible mental food. In the old East, the brilliant children are allowed to learn books, while the others are brought up in intimate knowledge of their parents' professions. On farms where all the laborers are members of the house, there are none of the strikes, and none of the unrest in which the West lives and moves and has its being to-day. I was not surprised, therefore, to find that the home-loving Mormons had the only cozy, comfortable and settled villages I saw in Alberta. Raymond, Macgrath and Cardstone had a settled, sitting-down look about them which reminded me of villages in Egypt and India. I know that Mormonism has few friends in this country, but in all matters we should, I think, remember Shakespeare's sage words:

> "There is some soul of goodness in things evil
> Would men observingly distil it out."

We can even learn something from the Mormons, who are the nearest people here to the irrigators of the old eastern world. Their farmsteads are clustered together and they thus secure in the country some of those privileges which make town life so attractive. A man walks a little farther to work, and the ploughman homeward plods his weary way along a longer track, but then life is more sociable once he gets home. I wonder how many people in towns would drop in of afternoons and see each other if everyone had to walk across a square mile of country or half a square mile to see his or her neighbor. The solitary, homeless-looking houses which lay scattered over the bare veldt looked more like rogue elephants living their unsociable lives than anything I have seen in my life. Where I was straining my eyes for bunches of children, I saw only bunches of horses or bunches of pigs. And yet, you pay ten shillings a day for labor. Bunches of sturdy boys and girls are worth their weight in gold. While you people here are asking for colonists from home, the East produces its own colonists, better suited to the country and infinitely cheaper than imported labor.

A small, well-worked farm with irrigation pays much better than a large farm which cannot be kept in good tilth; and here comes the difficulty in this country with its severe winters. A farmer, however small he may be, could not exist in a farm house which cost less than, say £200 to build. Now, £200 spread over 160 acres is £1. 4. per acre, and spread over 40 acres is £5 per acre. It is the cost of the farmsteads which is the serious side of small farms in England and it is still more serious here. Agitators in England abuse both the English landlords and the so-called stupid agriculturists who stand by them, but the agriculturists know that it is not the price of the land, but the cost of the farm buildings which stand in the way of small holdings. Big holdings in irrigated land will be eaten up by their own weeds, and the only way to manage is with small holdings and comparatively expensive farm buildings. In Alberta the Canadian Pacific Railway charges very moderately for its irrigation water, but the price of the land is high for small holdings, and the rate of interest for borrowed money is excessive. Government land banks with very moderate rates of interest as they have them in paternal (falsely called retragrade) countries like Russia, are one of the needs of irrigated Canada. Such money would only be lent to bona fide settlers making themselves at home on their lands, and not to the "caterpillars of the commonwealth," who only buy either to half develop and then sell at a profit and clear out after skimming the cream off the lands by exhaustive crops, or to sit and wait for the unearned increment.

Rotation of crops and, whenever possible, the keeping of live stock, is the life of irrigated lands in the East. Cereal crops are always followed by leguminous crops. The leguminous crops are the mortal enemies of the weeds of the cereal crops and vice versâ. Good leguminous crops provide all the nitrogen required, while small quantities of superphosphate insure heavy yields of corn and tend to hurry up the ripening of the crop. Irrigated land in Egypt has been heavily cropped every year, and over large areas twice every year, and is as rich to-day as it was 7,000 years ago. Rotation of crops has secured this, backed up always with as many cows, sheep and poultry as the land can carry. The average holding of a well-to-do family in Egypt is two acres. When there is no work on the farm some members of the family are always working at earthwork or porterage somewhere. An entire family of men, women, children and a few donkeys will take a quarter of a mile of earthwork digging somewhere and finish it at some fixed rate and time. Seeing such folk one understands why Abraham's wealth was described as consisting of "man servants and he asses, female servants and she asses."

---

* Paper read at the Sixth Annual Convention of the Western Canada Irrigation Association, Kelowna, B.C., August 13th to 16th, 1912.

Every canal bank in India is a minature forest, and if the government forest department out here were to cover the banks of the canals in the bare and naked prairies with poplars, willows and suitable trees, the country would begin to look quite homelike. Wherever trees are growing in shingle they seem to flourish, and it has struck me that if holes some four feet deep were made with jumpers and filled with shingle and loose top soil and trees planted in them and watered once or twice they would soon have their roots comfortably housed out of the way of the frost. Lord Kelvin has proved at Glasgow that small meshed wire netting round a farmstead makes a better wind-break than any masonry wall, however high, and delicate plants can live behind it. I have promised my friends here to go to Glasgow as soon as I return to Liverpool and send them out full details of the netting Lord Kelvin has used. It might help many a farmer to secure a decent belt of trees round his farmstead.

All the regulating works on the rivers are much bolder here than in the East. When the welfare of millions of people is concerned we cannot afford to run any avoidable risks. Time alone can tell whether the boldness of the engineers here is justified or not. No one here has seen the tragedies the East has witnessed. In the Euphrates Valley I have walked down a canal 250 miles long, 400 feet wide, and 15 feet deep, which irrigated probably 1½ millions of acres of land, and where it is conjectured that over two millions of people must have died of hunger in a year or two when the head works holding up 30 feet of water on the Tigris River were swept away. By the time Canada is as densely peopled as that, the engineers will play for safety as we do in the East. None of our works on irrigation canals in the East are temporary. All the works are as solid and permanent as money can make them. We all say that the original works can be cheaply built in the dry; once the canal has begun to carry water and establish water duties, works are costly indeed and attended with risks.

The question of water rights has been settled in the East from the remotest antiquity. Water has attached to it duties as well as rights, and the state is the sole proprietor of every drop of water which flows in any stream, and of the channel in which the water flows, and it never concedes its rights to anyone. When Victor Emmanuel amalgamated all the Italian states, his government was face to face with hundreds of varieties of water rights by individuals and corporations. An ordinary man would have hesitated, but Count Cavour was no ordinary man. He was one of those strong men a country about to become great produces, just as coming events cast their shadows before. With a stroke of the pen the water was made the property of the state after the wise Eastern way, and commissions appointed to examine [illegible] holders of rights [illegible] prosperity to Count Cavour's action. If the government of British Columbia were to declare itself owner of all water rights and [illegible]

In the East to-day all the land needed for future canals and drains is taken up and the works begun before irrigation water is allowed to enter the canals. If the drainage system of a country is suited to a rainfall of 16 inches and you make the rainfall equal to 40 inches by artificial irrigation you must make provision for this extra water in the drainage lines. When a man buys a plot of land here he signs an agreement to allow his neighbors a right-of-way for their irrigation water. He should also sign an agreement to allow his neighbors a right-of-way for their drainage water. It is only in this way that you will be able to exorcize the demon of alkali efflorescence which is ever ready to enter the plot of land out of which the demon of drought has been driven by artificial irrigation.

In the East the irrigation farmer levels his land with a care and skill which testify to his long experience of the value of an even grade for securing the maximum of yield from the minimum of water. The economy of water to be gained by good surface tilth the East is learning from you western farmers.

Mr. President, ladies and gentlemen, I thank you for listening to what I have had to say on this subject of irrigation, the oldest and youngest science of the world. Here, in this new country, in this 20th century, A.D., the words of this most ancient poem are as true to-day as they were over fifty centuries ago in far distant Babylonia:

"O thou river, who didst bring forth all things
When the great Gods dug thee out
They set prosperity on thy banks."

◆

WATER POWERS OF BRITISH COLUMBIA.

The water-power resources of British Columbia are being investigated by the Commission of Conservation, and the resulting information is to be published, as soon as it can be made available, in a report to be entitled, "The Water-Powers of Western Canada," which the Commission have in course of preparation.

The securing of even preliminary field information in a territory like British Columbia requires much more time than in a country less mountainous. Good progress, however, is being made. The British Columbia Government's Department of Lands, under the Hon. W. R. Ross, has made a substantial contribution to assist the Commission in its water-power research.

This practical assistance from the Department of Lands has enabled parties to be detailed for investigation on the mainland coast. These parties have been in the field since the beginning of August, and are being directed by the Commission's engineer, Arthur V. White, who is in charge of the work.

The Commisison has three field parties investigating the watershed of the Fraser River above Lillooet, extending to Tête Jaune Cache and westward beyond the Fraser Lake district.

[illegible] a map of British Columbia and asks what are the power possibilities of the interior of the [illegible] After the Commission has completed its present reconnaisance survey, it will be possible, first, to form some reliable conception of the water-powers of British Columbia south of the line of the [illegible]

THE HARDINGE CONICAL MILL FOR FINE GRINDING.

By H. W. Hardinge.*

Crushing is not confined to the efforts of the metallurgist alone, but it has an equally wide range, or even wider range, as it finds its way into commercial industries, so numerous and varied that though we may have given years to the subject, in the same manner as have all metallurgical investigators, our learning is but slight.

Crushing or dividing may possibly be subject to two or three general mechanical principles. Dynamic action due to impact, when the energy forces rend along the lines of least cohesive resistance, or by pressure strains rending through slower separation of the crystals, deforming the mass; or by abrasion and separation from the surface inward. The first can be defined as a blow from a hammer, the second by compression in the jaws of a crusher, but the third is more difficult to define, because of its limited employment owing to its waste of energy, but might be likened to the wearing away of the faces of millstones. Nature in the manufacture of soil from the rocks has employed all three, but evidences would tend to show that in finest division she has been prodigal of her energy, for such fine division has been mainly produced through abrasion, except in the case of the chemical separation in the formation of the many clays. It is with this fine division that we, as metallurgists, are at present interested and how best economically it may be produced. For years the "California" stamp has been the most widely used device for the crushing of ores, and held its position in the first rank because fine grinding, as understood at present, was not a necessity, but with the advance from mechanical separation of the gold and silver content of ores, to that of chemical separation, the necessity for finer and finer grinding in order to liberate the mineral has progressed much faster than the mechanical means to do this fine grinding, so that to-day the stamp is slowly giving way to other applications of crushing energy. We very well remember when in 1895 and 1896 we were shown the first adaptation of the pebble or tube mill, and when told what it would do in the way of fine grinding, there was no hesitancy on our part in declaring that the claims were absurd, but shortly after the small mill was started, we were converted, and became the strongest of advocates of the pebble mill for still further reducing what at that time was considered fine grinding, mainly by stamps and rolls.

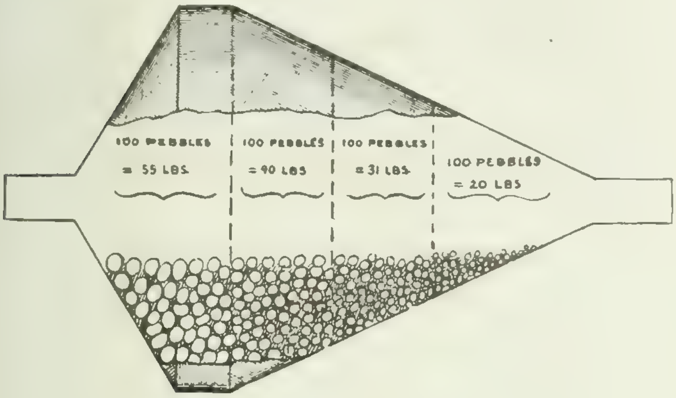


Fig. 1.

In this tube mill was a principal of step reduction not obtained by any mechanical device before that time. The stamp had reached its possible limit because it, with every blow, receded farther and farther from efficiency, owing to increasing disparity of size and weight, between reducer and particle. It has taken a long time to bring us to a recognition of the fact that to economize our energy, the units of force must correspond to the units of matter being acted upon. The well known rule of physics particularly applies here, i.e.: "Crushing strength of a body is in proportion to the area of its section."

We have many times been asked to explain the action within the conical mill, and the cause for its sizing action. Many articles have been written on the theory of the pebble and ball mill, which in turn have produced suggestions and practices resulting in changes of length, diameter, feed, discharge, speed of rotation, charge of pebbles, size of pebbles, etc.

Improvements have been left to the discretion of the machinery designer, who, as a rule, has but little knowledge of the specific technical requirements of the metallurgist, or of where the economic limit begins or ends. We could cite many instances where a lesser expenditure of energy would have improved metallurgical results, and it should be the aim of the metallurgist to fit his machinery to his ore, and not endeavor to adapt his ore to any specific machine. Realizing these conditions, we thought we saw in the conical form of mill a device which could be made more or less adjustable to many classes of ores—from granulation for concentration to sliming for cyanidation, for in the zone of largest diameter, we have all the features necessary for the greatest application of energy, e.g., the largest pebbles or balls, the greatest superincumbent weights, the greatest height of fall and impact due to greatest peripheral speed, and in this zone is found the largest particles of material to be reduced, thus admitting of a much coarser feed than would otherwise be possible if the crushing forces were not segregated. After a first division or reduction, these particles, through the action of the displacement, dependent upon their relative mass, travel up the cone, through constantly decreasing zones of size and weight of crushing bodies as well as decreasing energy due to reduction of peripheral rotation speed proportionate to the division of the particles in passing through successive zones, as illustrated in Fig. 1.

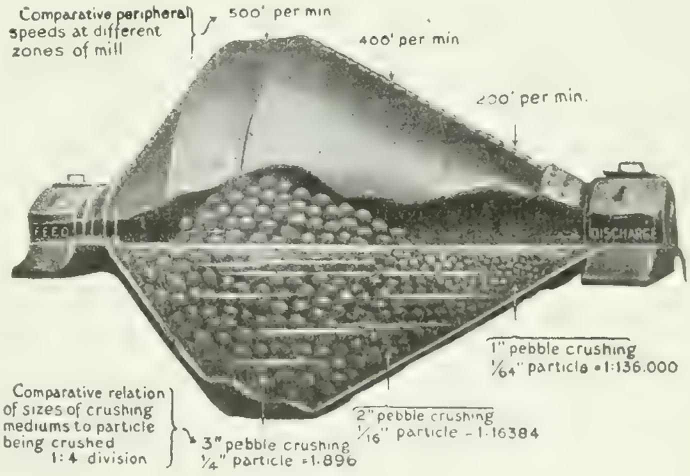

Comparative peripheral speeds at different zones of mill
500' per min
400' per min
200' per min.
FEED
DISCHARGE
1" pebble crushing 1/64" particle = 1:136.000
2" pebble crushing 1/16" particle - 1·16384
3" pebble crushing 1/4" particle = 1·896
Comparative relation of sizes of crushing mediums to particle being crushed 1:4 division

Fig. 2.

In addition to the automatic adjustments of work to mechanical energy, the device is subject to a still further regulation by changing the axis from the horizontal to different inclinations from the horizontal, which will cause the finer particles to travel toward the outlet much more rapidly, and consequently be subject to lesser action of the grinding bodies than when in the horizontal position, which latter position is assumed for the finer grinding. The working machine is provided with means for making these different adjustments.

---

* Abstract of paper presented at Toronto meeting of the Canadian Mining Institute.

For very fine grinding, it is found advisable to elongate the cylindrical portion.

Even the conical mill, subject as it is to varying adjustments, produces vastly different capacity results when working on different ores, as will be seen by comparing the following performance of 8-ft. Hardinge mills operating under similar conditions of power, pebble charge, r.p.m., etc., in three of the largest concentrating plants in the United States, under the supervision of experts of the highest metallurgical order, and though of widely different capacities, as shown, each plant manager reports the results as highly satisfactory.

Mesh	On 40	On 60	On 80	On 100	On 200	Through 200	Tons per 24 hours.
	Per cent						
Calumet & Hecla Mining Co......	2.0	2.1	6.5	6.0	43.0	40.8	45.0
Federal Mining & Smelting Co..	4.0	7.5	7.0	10.5	18.0	53.0	98.4
Miami Copper Co	16.0	15.5	8.9	7.7	13.8	38.1	180.0

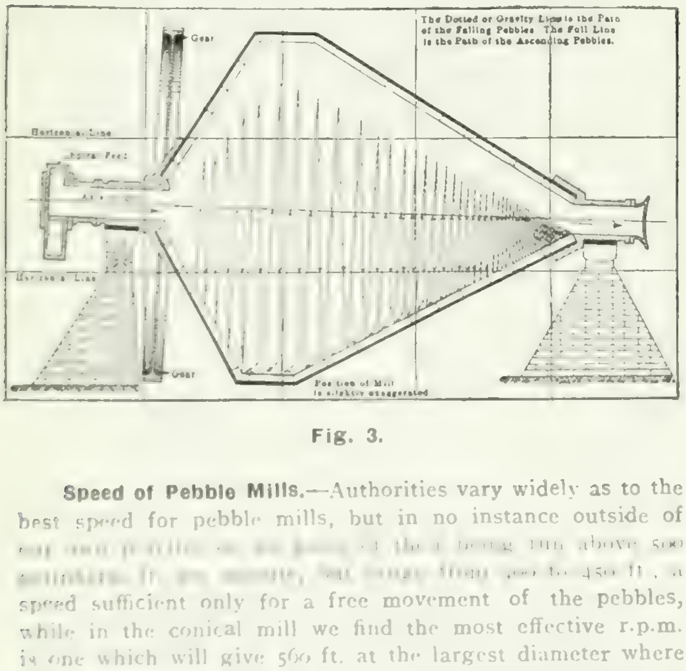

The Dotted or Gravity Line is the Path of the Falling Pebbles The Full Line is the Path of the Ascending Pebbles.
Gear
Horizontal Line
Spiral Feed
Horizontal Line
Gear
Position of Mill is slightly exaggerated

Fig. 3.

Speed of Pebble Mills.—Authorities vary widely as to the best speed for pebble mills, but in no instance outside of our own product do we find any of these being run above 500 peripheral ft. per minute, but range from 300 to 450 ft., a speed sufficient only for a free movement of the pebbles, while in the conical mill we find the most effective r.p.m. is one which will give 560 ft. at the largest diameter where the greatest work is being done by the largest pebbles on the largest particles, producing a cascading effect, relative to hundreds of small stamps. This maximum of peripheral speed and energy force gradually reduces, in stages or zones, foot by foot until its effective action is fairly commensurate with the work necessary to further divide the previously comminuted particles. Thus in the one machine is a step or stage reduction from kinetic impact to abrasive rolling. The proper and most effective speed is one where centrifugal force is [illegible] they [illegible] by gravity at about 60 deg. from the horizontal. The "proper speed" is much dependent upon the "mesh" of the material fed, for where [illegible] "cascading" action may not be necessary.

In the case of the conical mill the material undergoing division automatically travels forward at each reduction as though actuated by an Archimedes screw up and out the cone, while by the other style of cylindrical mill, of equal dimensions throughout its length, the travel is dependent upon displacement by the feed and the discharge through the same [illegible] of particles from end to end.

Perhaps the most reasons for the sizing and step reduction action can be evidenced by the following diagram (Fig. 3) in which it is shown that when the mill is operated on an inclination from the horizontal the charge is lifted at right angles to the axis, but in falling drops under the action of gravity, vertically and at an angle to the line of lift. The larger particles undergoing disintegration, according to respective mass content, will fall faster than the finer particles which must then, due to displacement, find a position nearer the outlet end of the mill. The material as well as the grinding bodies, through the acceleration due to their mass in falling, reach the lining of mill and continue a course down the cone or inclined surface, toward the larger diameter, forming more or less of a triangular line of travel. The finer particles, according to their size and, therefore, friction surface presented, are retarded in their travel down the cone by surface friction and tend to arrange themselves in zones or classified areas. It is to this zigzag action within the mill that the discharge of material as crushed becomes more or less positive and automatic.

A diagrammatic representation of the actual weights of the same number of pebbles, shovelled from four sections of a conical mill, as reported by an engineer who had just finished a test run for efficiency, is shown in Fig. 3.

In dry grinding the most effective peripheral speed is between 625 and 675 ft. per minute, of largest diameter.

The amount of water used in the conical mill should vary with results desired. For fine or slime grinding the best results are obtained with a relation of about 40 per cent. of water to 60 per cent. of solids, by weight. For coarser or granular grinding greater amounts of water are used to suit conditions and can only be ascertained by experiment.

The following results taken from screen tests covering a period of several days, operating with different amounts of water and inclinations of mill, upon the same (composite) mesh and weight of feed, will give a fair idea of possible results which may be obtained in the one mill:

Mesh	% on 8	% on 20	% on 40	% on 60	% on 80	% on 100	% through 100
Heads	16.7	51.1	13.9	6.8	4.4	3.0	7.0
Tails of 1st test		4.8	9.8	22.8	22.3	0.9	39.0
Tails of 2d test...	......	......	1.3	8.0	27.5	2.5	60.0
Tails of 3d test...				1.4	10.0	2.0	87.0

Lining.—The pebble mills are lined with silex blocks throughout or a combination of silex and ribbed steel or iron plates, the plates being fitted with a lifting bar of special design, which not only assists in lifting the mass of pebbles higher, affording greater impact in the central portion of the mill, but also prevents a slipping of the charge.

The conical ball mill is lined, as are the other types of ball mill, with steel plates, and various sizes of steel balls are employed to break up the ore or other material undergoing disintegration. Herein comes again the principle of the stage reduction, in that the balls in weight are approximately relative to the size of particle undergoing division, and automatically take positions in the mill relative to size and diameter of cone. To operate a ball mill of this type to best advantage, the preliminary feed should be reduced by rock crusher so that the largest pieces will not exceed 1½ to 2 ft., or a relative weight to the crushing body of approximately 50:1.

◆

Survey is being made for an electric line from Port Haney, on the main line of the Canadian Pacific Railway 26 miles east of Vancouver, and also on the Fraser River, to Lillooet Lake. It is presumed that this is being carried on by the British Columbia Electric which has water rights on the river and lake, and which it will develop. This company is rapidly extending its interests on the lower mainland and at Victoria.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, OCTOBER 3, 1912. No. 14.

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Montreal Harbor 549
Operating Results of a Double-deck Street Car.... 549
The Design of Irrigation Works 549
The American Road Congress 550

Leading Articles:

New Grain Elevator for the Harbor Commissioners of Montreal 537
Power Plant of Mount Hood Company 542
The Montreal Floating Dock "Duke of Connaught" 543
Irrigation Lessons from the Old World 545
The Hardinge Conical Mill for Fine Grinding 547
Testing New Cast Iron Water Pipe Lines for Leakage 551
Railroad Wrecks 552
Insuring Soundness in Steel Rails 554
The Plant of the Norton Company at Chippawa, Ont. 557
The Methods of Research 559
The "Booster" Pump Supplied the Great Western Railway Works at Swindon 562
Applications of Oil-Mixed Concrete 563

Personals 567
Coming Meetings 568
Engineering Societies 568
Market Conditions 24-26
Construction News 569
Railway Orders 72

THE MONTREAL HARBOR.

The Montreal harbor, as the gateway to Canada, is our most important port. The marine traffic of the port of Montreal comes second only to that of the port of New York among all the ocean ports of North America. The Harbor Commissioners have had in view the necessity for providing adequate facilities for taking care of the traffic flowing through the port. The government has been generous in the past in providing funds for the improvement of the St. Lawrence River channel and for placing the harbor in shape to compete with the ports in the United States. A great portion of the export traffic from Montreal is grain, and it is, therefore, necessary to provide plant for the unloading of the railway cars, capacity for the quick unloading of inland vessels, storage capacity for grain to eliminate the necessity for direct and almost direct transfer of inland cargoes to ocean vessels, and facilities for shipping grain from the elevators. In this issue of *The Canadian Engineer* will be found a description of the new grain elevator at Montreal, which has just been finished, having a total capacity of 2,622,000 bushels. The elevator represents the most modern design and development in this type of construction, and reflects a good deal of credit upon the Harbor Commissioners and the constructing engineers. It will, no doubt, have a thorough trial of its efficiency this coming season, and should do much towards relieving the congestion of last season.

◆

OPERATING RESULTS OF A DOUBLE-DECK STREET CAR.

We noted in the issue of August 29th the introduction of the double-deck street car into the transportation question of some of the larger American cities. Operating results on the Pittsburg double-deck car have been published, and, while these are only preliminary, as the car has been in service only for a month, they throw some interesting light on the ability of this type of car to handle traffic under city conditions without confusion in boarding and alighting, and without the slowing down of schedule speeds. The car is an open trailer, built single-ended for trial use, and the separate entrance and exit doorways are equipped with plain, swinging half-doors. These doors, however, have been re-designed, for a quick-acting door materially cuts down the delay in loading and unloading. The results so far indicate that for handling heavy traffic, where people are loaded at one point and are unloaded within a restricted area, having comparatively few stopping points, the car is undoubtedly a success. This applies especially to the case in which very large crowds have to be moved to or away from ball parks or racetracks, or where large factory forces are leaving their work, so that the entire load is presented at practically the same time.

◆

THE DESIGN OF IRRIGATION WORKS.

In his address to the sixth annual convention of the Western Canada Irrigation Association, Sir William Willcocks laid emphasis, among other things, on the boldness of the design of engineering structures in Western Canada. Sir William Willcocks, in addition to being a noted irrigationist, is the designer of the

Asouan Dam. He states that all the regulating works on the western streams are not so conservatively designed here as in the East. He adds that where the welfare of millions of people is concerned the engineer in the East cannot afford to run any risk; time alone will show whether the boldness of the engineers in Canada is justified or not. His statements are exceedingly interesting and deserve careful attention. It is true that irrigation conditions in Western Canada are very different from the far East. At the same time Sir William sounds a note of warning which should not be disregarded. It is perfectly right and proper to design economically, but where it is a question of safety or economy, safety, of course, must rule. He states truly when he says that the original works can be cheaply built in the dry; once the canal has begun to carry water and establish water duties, works are costly, indeed, and attended with risk.

THE AMERICAN ROAD CONGRESS.

The American Road Congress in Atlantic City this week will bring together everybody interested in the improvement of highways, from national and State officials down to the taxpayer. In fact, this last-named attendant will be particularly welcomed, for his vote decides the question of improvement, and one object of the Congress is to give him information which will enable him to reach a wise decision. The importance of good engineering and good contracting on road improvements will assume large proportions in his mind when the taxpayer learns how essential these factors are to the economical use of the money he furnishes. He does not appreciate this yet, and he is in danger of being misled by enthusiasts whose knowledge is not much greater than his own. At the Congress will gather the experts who have made a scientific study of road-building, the administrative officers in charge of the work, the users of roads who realize the necessity of intelligent improvement and adequate maintenance, and the men who produce the materials and machinery used in road-building. The original plans were developed jointly by the four national organizations representing those who foot the bills, the builders, the users, and the material and machinery manufacturers. Later, the road-builders' organization decided to withdraw. It is unfortunate that all of the organizations in the road congress coalition formed last year could not hold together, and so concentrate their efforts for the good of a cause which is more important than the individual advantage of any organization. However, the gap left by the withdrawal of the road-builders' association was taken by a number of its leading members and other prominent specialists, so that no change in the Congress programme originally announced has been necessary. A feature of the Congress which is likely to be particularly instructive is the exhibition in which the United States government, numerous States and the manufacturers of machinery and materials will co-operate. The details of this display have been worked out so [illegible], and the exhibits are so [illegible] that [illegible] the result will excel anything previously accomplished, even at the Brussels Exposition two years ago. Relatively few people, even among civil engineers, have a true appreciation of the extent of the road-building industry, and this exhibition will, therefore, emphasize the importance of the proceedings of the Congress by demonstrating the magnitude of the interests engaged in highway construction.

THE LAUNCH OF H.M.S. "AUDACIOUS."

One of the most interesting naval events of the year has just taken place at Birkenhead, England, where the new battleship of the super-dreadnought type, H.M.S. "Audacious" was successfully launched by the Countess of Lytton from the yards of the shipbuilding firm of Messrs. Cammell, Laird & Company. It is one of the most powerful ships under construction, and naturally attracted many people from all over the British Isles to witness the ceremony, and it was necessary for a special train to leave London in order to convey some of the 1,100 guests of the company.

Canada was represented by Colonel Sam. Hughes, Minister of Militia and Defence, who the night before had just returned from the French Manoeuvres, and who, the following week, was to be the guest of the King at the military manoeuvres, which this year were carried out near Cambridge.

As is the case at the launch of all units of the Royal navy, a religious service took place, after which Lady Lytton severed the silken cord with an ornamental axe of free rennaissance character, that had been specially designed, and the great vessel glided slowly into its native element.

The event was witnessed by many thousands of spectators, who crowded every vantage point, and thronged the special patforms that had been erected.

The chairman, Mr. W. Hichens, in his speech, made some interesting comparisons. He said:

"The present ship is not the first of that name in the annals of the British navy. So far as I know there have been two others. The first was a wooden frigate of 1,624 tons and 168 feet in length, built during the reign of George III. The second was built in 1869. She was an iron cased vessel of 3,774 tons and 280 feet in length. The present 'Audacious' would hold two comfortably, being 550 feet long and having a displacement of 23,000 tons."

The representative of the Admiralty, Captain H. B. Pellay, M.V.O., R.N., made another interesting comparison when he pointed out that a projectile from one of the 13.5 guns of the "Audacious" was heavier than the whole broadside of H.M.S. "Victory," of 1805.

H.M.S. "Audacious" is of the same type as H.M.S. "King George V.," and the group, when completed of the four vessels, will be the "King George V.," the "Centurion," the "Ajax," and the "Audacious."

The type is an improvement on the battleships of the "Orion" class, although similar in design generally. Whereas the "Orion" and her sisters have a displacement of 22,500 tons, the class to which the "Audacious" belongs displaces slightly over 23,000 tons, and has a length of 555 feet, as compared with 545 feet, with a beam of 89 feet, which is slightly in excess of the 88½ feet of the other class.

The Propelling machinery, as in the case of the Dreadnoughts, consists of Parson's turbines with Yarrow type boilers. There are to be ten 13.5 inch guns mounted in five turrets on the centre line of the ship, while the guns for repelling torpedo attack are twenty 4 inch calibre, that is four more than in the "Orion" class.

It is a notable feature in connection with this vessel that the armour plate is of exceptional thickness and this is already at the dock waiting to be placed in position, now that the launch has been successfully carried out.

Two interesting facts come to light in connection with the firm of Messrs. Cammell, Laird & Company in that they were the owners of the "Sirius," which was the first steamship to cross to New York, and in 1834-5 they built two iron steamers for the Honorable East India Company for the exploration of the River Euphrates.

TESTING NEW CAST-IRON WATER PIPE LINES FOR LEAKAGE.

The methods for testing new cast iron water pipe lines for leakage and the amount of leakage to be expected on good work, was discussed by E. G. Bradbury, of Columbus, Ohio, in a paper read before the Ohio Engineering Society, and published in the proceedings of the Society for 1912. A brief abstract of the paper follows:

A discussion of the methods of testing new lines of cast iron pipe for leakage, and an estimate of the amount of leakage to be expected in well laid lines, was given in a paper by E. G. Bradbury, of Columbus, Ohio, before the Ohio Engineering Society. The paper which is published in full in the Proceedings of the Society for 1912 is here briefly abstracted.

From experience with a number of pipe systems, the writer has become convinced that under ordinary conditions of pipe laying it is improbable that the leakage in a new system will be greatly less than 3,000 gals. per mile daily unless the same is carefully tested and all defects remedied. By testing in the open trench, under a pressure of at least 50 per cent. in excess of the maximum static pressure expected in the pipe, recalking all dripping joints and replacing defective pipe, it is possible to reduce leakage to an extremely low amount.

Reliance cannot be placed on the behavior of the pressure gauge in judging of the tightness of pipe. The gauge may, under certain conditions, drop rapidly when there is no leakage, owing to failure of the gates to close with absolute tightness, or perhaps to air contraction or absorption. It may stand up fairly well to pressure when there is considerable loss, if a large amount of air has become entrapped, and has reached its minimum volume.

Water is reduced by 1/21740 of its volume per atmosphere. Assuming the case of a 6-in. pipe of 1,000 ft. long as representing the average section under test, the volume of water contained is 1,470 gals., if the pipe is completely filled. If this water is under pressure, 1470/21740 or .065 gals. must be lost in order that the pressure may drop 15 lbs. Experiments by the writer indicate that 16,000 drops from metallic surfaces are approximately equal to 1 gal., and on this basis 70 drops would necessarily escape from the pipe referred to for each loss of 1 lb. pressure. With first-class calking, when the men know the work is to be tested in open trench, the average loss from 1,000 ft. of pipe before testing is about 200 drops per minute equivalent to about 90 gals. per mile per day. By going over the joints leakage may be reduced to a point where there is no visible dropping or escape of water, and pressure can then be maintained for a considerable length of time, if the pipe is free from air.

If there is air contained in the pipe, it is often impossible to maintain pressure. This may be due to any or all of the following causes: Air will undoubtedly escape through minute crevices that cannot be penetrated by water. In the compression of air heat is generated, expanding the air, and in the cooling process following, the air necessarily contracts and a loss of pressure results. To what extent this takes place in the comparatively slow process of increasing the pressure in a pipe test, or in other words whether all of the heat is radiated during the process of compression, is not known, but in view of the fact that air compressed to 150 lbs., and not cooled, is increased over 500 deg. F., and has a volume practically double that of the same air under the same pressure after cooling, it is possible that some slight action of this nature may occur. Further, as the pressure is thus reduced, the natural tendency is for the air to lose more of its heat, inducing further contraction. It is also probable that there may be an absorption of the elements of the air by the water. The amount of gas absorbed by water at a given temperature, is a function of the volume, regardless of pressure, and the weight of gas absorbed is therefore proportional to the pressure. Variation of temperature also effects absorption. A very complex action must necessarily result from these conditions, but the general tendency of the several factors is in the direction of reduction in volume of the pipe, with consequent loss of pressure. It is never possible to maintain pressure in a test made immediately after filling the pipe as well as a few hours later. This is undoubtedly partly, and in some cases wholly, due to the absorption of water by the yarn in the joints, but if air is present it often contributes to the trouble.

In reports descriptive of tests of this nature, appear frequent references to the difficulty of obtaining anything like uniform results with the pressure gauge, and the loss of presure often observed where no leakage is apparent is the occasion of considerable surprise. The writer is convinced that if all air is excluded from the pipes and all joints kept visible during the test this phenomenon will disappear. Owing, however, to the difficulty of getting rid of the air this is not always feasible in practice. Excellent results may be obtained, regardless of the behavior of the gauge, if all parts of the pipe are inspected under pressure and all visible leaks stopped. This method also eliminates possible trouble from minute gate leakage.

During the summer of 1911 the attention of the writer was particularly called to the subject of this paper by his connection, as designing and supervising engineer, with the water distributing system of the village of Grandview Heights, Ohio, a suburb of the city of Columbus. An arrangement was made by this village to purchase filtered water from the Columbus water works at a net price of $1.20 per 1,000 cu. ft. The necessity for the tightest possible work was obvious and specifications were drawn requiring that all pipe be tested in the open trench, under a pressure of 150 lbs., to the satisfaction of the engineer. The system comprises 5,719 ft. of 12-in. pipe, 7,701 ft. of 8-in., 16,508 ft. of 6-in. 75 valves, 36 hydrants and 2 air valves. Every section of pipe was tested and gone over until no evidence of leakage was visible with all pipe exposed. The record of tests shows that in many cases gauge pressure could not be held, though every pipe and joint was in plain sight and no leakage could be located.

After completion a number of observations of the water entering the system were made by means of a 1-in. meter. Two service pipes were connected with the system during these tests. The amount passing the meter varied, the minimum being 10 and the average 25 cu. ft. per day. It is perhaps not unreasonable to assume that the minimum metered quantity for one day expresses the leakage from the system, but the average figure was taken. The working pressure on the system varies from 45 to 90 lbs., averaging about 65.

On the completion of the system a 6-in. meter was installed at the Columbus water works pumping station for the measurement of all water sold to the village. This meter was new and was carefully tested by the city department and stated to register accurately down to the smallest stream provided by their testing apparatus, namely 1/32 in. It is, however, probable that there would be some under-registration in case of very small flow. During the first month's operation but two services were connected, and the quantity of water registered by the meter was 600 cu. ft., equal to a little less than 27 gals. per mile per day, including whatever may have been used by the two consumers. Soon after this 80 taps were made. After an interval of about two months the city meter and all individual meters were read. The amount of water passing the 6-in. meter for the period of 58 days was [illegible] cu. ft. and the sum of the readings of the house meters was 39,300 cu. ft. During this period an extension of 550 ft. was made and water was used to settle the trench to the amount of 1.2[illegible] cu. ft., leaving a quantity unaccounted for of 100 cu. ft. or 2.3 gals. per day per mile. The amount of water supplied to the village was equal to 17.5 gals. per consumer per day, figuring on the average number connected for the entire period. The population is suburban, and the use purely domestic. The writer believes that few complete systems have been installed with as low a leakage as this.

The value to this municipality of a tight system is, of course, much greater than to cities pumping their own water, the net cost of water being slightly over $0.16 per 1,000 gals.; for each 1,000 gals. per day per mile lost, the actual cost is about $320 per year, which, capitalized at 4 per cent., amounts to an investment of $8,000, or, in other words, if the system had a leakage of 1,000 gals. per day per mile (which is considerably below the probable average in similar systems), the village could afford to spend $8,000 if, by so doing, the leakage could be reduced to the present amount.

The value of tight water pipes to a city pumping its own supply is less readily computed. Fixed charges, attendance, etc., are not materially affected by moderate leakage, except as additional capacity is required at an earlier date. The fuel bill, and, in case of treated water, some items of the cost of purification, are chargeable in proper proportion to such leakage as may exist. It may safely be stated that the cost of careful inspection and testing is always more than justified by the saving that can be accomplished.

Regarding the amount of leakage permissible in new work, general practice would appear to justify anywhere from 60 to 250 gals. per day per mile per inch of diameter. Loweth proposes 60 to 80 gals. per inch-mile. Gregory, in the improvements to the Columbus water supply, specifies the limits of allowable leakage, under about 110 lbs. pressure, given in Table I.

Table I.

Size in.	Leakage allowable, gals. per hour per lin. ft	Equivalent in gals. per 24 hours per mile	Gals. per 24 hours per inch mile
20	0.08	10,138	507
24	0.10	12,672	528
36	0.15	19,008	528

These requirements would seem to lean far toward liberality. The writer is of opinion that except under particularly unfavorable conditions, it is possible to reduce the loss to a very low figure—so low indeed as to be almost negligible. Open trench testing, as above described, and rigid insistence on the closing of all visible leaks will accomplish this result, and by no other means can it be done. It is better to specify this test than to state figures of permissible leakage, as results far better than one would feel justified in specifying are possible, and it is impossible to demand better work than required by the specifications.

◆

NICKEL IN CANADA.

[illegible] of the world's supply of nickel. Practically all of the remainder [illegible] Pacific [illegible] France.

[illegible] the value of [illegible] from Canada to the United States was approximately [illegible]. At the [illegible] the United States [illegible] of the Canadian nickel [illegible] of the [illegible]. The refining [illegible] the value of this Canadian ore [illegible]. The [illegible] portion of the refined nickel is used [illegible] the manufacture of nickel steel.

RAILROAD RATES

"The only just method of determining the reasonableness of transportation charges is to measure them by the service performed." That was a recent statement of Mr. W. W. Finney, president of the Southern Railway Company. "This is all right as far as it goes," replied a newspaper editorial, "but will not Mr. Finney tell us how to apply this yardstick?" Subsequently, the railroad president did so, and in response to a request, he has forwarded his views on the matter

At the outset, he says, it should be borne in mind that the railways of the United States—although public highways, and, as such, properly subject to such governmental regulation as will insure to all citizens equality of rights on them, under similar circumstances and conditions, and as will prevent unreasonable or extortionate charges—have, nevertheless, been built with private capital and are the private property of their owners.

It is a fundamental economic truth that the investment of funds in any class of property is dependent on the safety of the principal and the rate of profit that may be expected as compared with the rate that can be earned on investments in other kinds of business. In other words, the flow of capital into any particular business will be retarded unless it may be expected to earn a reasonable profit as compared with the earnings of capital in other enterprises.

The question of what is a reasonable charge for a specific service is complicated by the fact that neither as a matter of transportation policy or of public policy can charges on all classes of traffic be uniform. Commodities of great weight or bulk in proportion to their value must be carried at rates substantially lower than those which may properly be charged for the carriage of commodities which are of high value in proportion to their weight or bulk.

As a result of the necessity for different rates on different classes of commodities, each individual rate or each rate applying to a class of commodities must be considered on its merits in its relation to the particular service performed. The cost of performing the service, as nearly as it can be ascertained, must certainly be taken into consideration. No rate should be made so low as not to pay something more than what Mr. Acworth, the eminent English economist, has aptly termed "the actual out-of-pocket cost" of moving that particular traffic. If it pays this cost and contributes, even in a small measure, toward the general expenses and fixed charges of the carrier, it is a profitable rate, provided the carrier has a considerable volume of traffic moving at higher rates. The low-class traffic moved at these low rates is not a burden on the higher-class traffic, for, by just so much as it contributes to general expenses and fixed charges, it reduces the amount which the higher-class traffic must contribute. In practical rate-making the question of the cost of the service has a controlling bearing only as determining the level below which a rate can not properly be made.

The value of the service is another important factor in rate-making and in determining the reasonableness of a rate that may be challenged. Transportation enables those engaged in any given industry to carry on their business in those localities best suited for it and to market elsewhere the surplus not needed for consumption at the point of production. By moving commodities from places where the supply exceeds the local demand to places where they are scarce and are wanted additional value is given to the whole volume of production, including the proportion consumed locally, as well as to that carried to other markets. As affecting the consumer of, let us say, cotton goods, by way of illustration

—the carriage of the raw cotton to the mill and the transportation of the finished goods to his market, is a process of production. This transportation gives added value to the raw cotton produced on the farm and to the goods procured in the cotton mill, and the carrier is, therefore, entitled to fair recognition for its service in the process of producing the finished cloth and placing it in the hands of consumers, just the same as is the farmer and the cotton mill owner.

The increased value given to a commodity by transportion is the measure of the value of the service to the owner of the commodity. It is not, however, the absolute measure of a reasonable rate, for, if the transportation charges were so high as to absorb all of this increased value, the owner would have no incentive to ship and the traffic would not move. This may be illustrated by referring to the rail movement of a very low-grade commodity, such as ordinary sand —a commodity which is found in abundance in most localities and the value of which, generally speaking, can be very little increased by transportation. It is manifest that it would be impossible to make a practical rate on sand for any such distance as from Philadelphia to Chicago, for the reason that the out-of-pocket cost of performing the service would be far in excess of the value of the service to the shipper.

As transportation has contributed all of the increased value which is given a commodity by its carriage to market, which, as we have seen, is a factor in effective production, the carrier is entitled to a reasonable share of that increase. The value of the service is, therefore, a most important factor in determining what is a reasonable charge for a specific transaction. Out of the intimate relation of the cost of the service and the value of the service to the reasonableness of a transportation charge grows the fact that, in an era of generally advancing prices, when both the cost of the service and the value of the service are increasing, the level of the reasonable charge for the service thus affected also advances.

In determining the proportion of the value of the service which the carrier may reasonably and justly charge for its part in creating that value, intelligent consideration must be given to comparison with rates charged by the carrier for other similar services, to comparison with the rates of competing carriers, to comparison with the rates at which carriers in other localities move the same commodity under similar circumstances and conditions, to comparison with the rates on similar commodities which might be substituted in use for the one in question, to the intrinsic value of the commodity, to the risk of breakage or other injury in transit, to the insurance risk, to the effect of the rate on the volume of traffic, and to the general condition of the business to which the special traffic is related. When the reasonableness of a rate is called into question, consideration and great weight must be given to expert testimony.

Of all these guides for determining the reasonableness of a specific rate, the effect on traffic is perhaps the most important, for an increasing volume of traffic is prima facie. and almost conclusive, evidence that the rate is not unreasonably high, though it may be unreasonably low.

It will be seen that, in the final analysis, the reasonableness of a transportation charge is largely a matter of expert judgment. So is the reasonableness of any price or charge that may be called into question. If one of you employs a lawyer, without any agreement as to what his fee shall be, and, after the service has been performed, you decline to pay his bill on the ground that it is too high, he sues you for the amount of his bill. The question raised is what would constitute a reasonable charge for the service performed. and, on this, testimony will be introduced to show, primarily and principally, the value of the service to you. Testimony will also be presented as to the usual fees which this lawyer and other lawyers receive for similar services, as to the amount of time consumed, and the skill which he displayed in rendering the service. Based on this testimony the jury will form a judgment as to what is a reasonable charge for the specific service performed.

The same method is followed in condemnation proceedings when a railway company seeks to acquire land for railway purposes and fails to reach an agreement with the owner as to the price to be paid. The question here presented is as to the fair and reasonable present value of the land to its owner and as to the fair and reasonable amount to be allowed him for the damage, if any, that may result to his remaining property by the construction of a railway through it. Evidence will be considered as to the value of that particular strip of land, as to the profitableness of the uses to which it has been put by its owner or of the uses to which it might be put. Evidence will also be considered as to the prices at which other tracts of land in the same locality have been sold, and on all these points expert testimony will be considered. The amount which the owner paid for the land, if bought sufficiently near the time of condemnation to be pertinent, may be introduced in evidence and will be considered, but it is not controlling on the jury, which, from all the evidence introduced, must determine what is the just and reasonable compensation to its owner at the particular time when it is taken.

◆

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended September 7th:—

	1911.	1912.	Increase or decrease.
C.P.R.	$2,230,000	$2,649,000	+ $419,000
G.T.R.	1,033,652	1,082,457	+ 48,805
C.N.R.	336,500	376,400	+ 39,900
T. & N.O.R.	39,787	29,610	— 10,177
Halifax Electric	8,553	5,627	— 2,925

The Canadian Northern Railway earnings and expenses for August with comparisons were as follows:—

	August. 1912.	August. 1911.	Increase.
Gross earnings	$1,745,800	$1,420,600	$325,200
Expenses	1,375,000	1,105,900	269,100
Net earnings	370,800	314,700	56,100
Mileage in operation	4,297	3,711	586

For the months of July and August net earnings of the road increased $189,100 over the same two months of 1911.

From July 1st to date gross earnings were $4,720,400, an increase of $753,500.

The net earnings of the Toronto and Northero Ontario Railway from the beginning of the financial year, November 1st, to the end of June, as reported to the provincial treasurer, have been $350,022, as against $314,814 for the same period last year. The gross receipts have been $1,178,839 against $1,024,382 for the same months of last year. The net earnings include or royalties of $98,436 this year, compared with $18,391 from the same source last year.

The increase in mileage for the period of nine months has been 264.24. The mileage increase last year in the same period was 174.28. The ore royalties for June this year were $26,427, while a year ago in the same month the ore royalties were nothing.

INSURING SOUNDNESS IN STEEL RAILS.*

By Robert W. Hunt.

While steel rails have been of great scientific and engineering interest from the day of their first experimental use, and much literature has been written upon them, there has never been a time, at least in America, when matters relating to their manufacture and service have received as much public and even governmental attention as during the past two years. I have been actively identified with the manufacture of steel rails from the rolling of the first commercial order for them in America up to and including the present time. As a steel maker I became thoroughly familiar with the theoretical and practical details of the business; and later, as a consulting engineer and inspector of all steel products, and especially of steel rails, I have endeavored to keep in touch with and cognizant of everything relating to the art.

All steel rails are made from steel ingots. Steel ingots are formed by pouring or casting liquid steel into cast iron ingot molds. The larger the cross section and the greater the length of the ingots, the greater the difficulty in obtaining sound castings, i.e., sound and homogeneous ingots. Without sound and homogeneous ingots it is impossible to produce sound and homogeneous rails; and, unfortunately, the most important unsoundness will be first in the centre of the ingot, and last in the centre of the rails produced from it, where it is frequently impossible to detect without destroying the rails. The large tonnage in each heat of rail steel (whether made in Bessemer converters or in open-hearth furnaces) under present mill practice, necessitates the casting of ingots of large cross-section and long enough to make several rails.

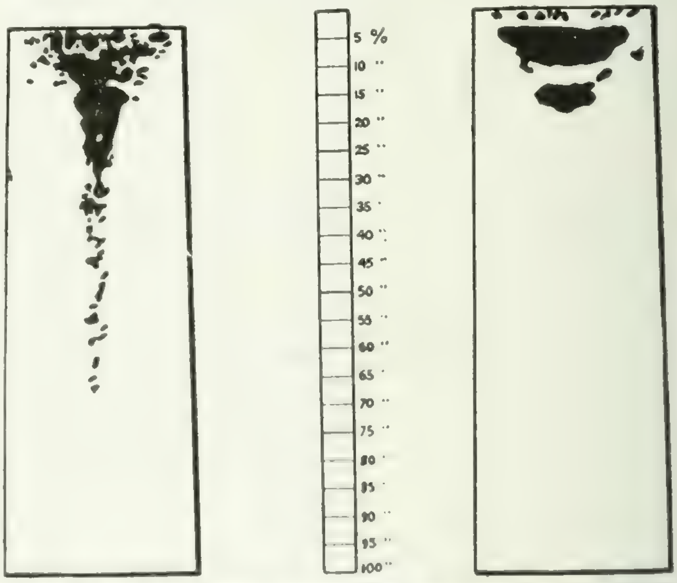
It is a long-known fact that the greater the mass of steel in a casting, the greater the tendency of the metalloids (carbon, phosphorus, sulphur and silicon, and particularly the hardening metalloids, phosphorus and carbon) to segregate at the part of the casting where the metal remains longest liquid, which, under normal conditions, is at the centre and toward the top of the mass. Again, it has long been known that the necessary cooling of the metal from the outside inward causes a contraction which results in the formation of a cavity or "pipe," which defect is increased by hasty and uncontrolled casting of the molten steel into ingot molds. Over twenty years ago Robert Forsyth, then chief engineer and manager of the Union Steel Company, Chicago, Ill., demonstrated that if rail-steel ingots were laid on their sides before the interior steel had set, the pipe would not be formed in the middle of the top end of the ingot, but upon the upper side and liable to extend toward the bottom end; and that, therefore, ingots should be left standing in a vertical position [illegible] (Journal of the Franklin Institute, Vol. 127, May, 1889).

Many times, labor and money have been expended in seeking to overcome the piping and segregation in ingots without greatly increasing the cost of production through expense of operation, lessening product, etc. Technically [illegible] all, more time. Unfortunately for success in casting sound [illegible] Therefore, the soundness of the resulting ingots is a matter entirely independent of the personal skill of the workmen. However, while the efforts to produce sound ingots have not been generally commercially successful, I am loath to believe that the difficulties will never be overcome. Such has not been the spirit under which the great successes of the past were accomplished, and I do not think it now exists. If a positive necessity for sound ingots be commercially established, a commercial way to produce them will be found.

As the general existing conditions produce ingots with the most undesirable steel in their upper part, it has been and is the practice in manufacturing steel locomotive tires, ordnance forgings, armor plate, large steel shaftings and other what are termed high-grade products, to reject arbitrarily at least the upper one-third of the ingot. It is true that even so great a discard will not always prove an absolute safeguard, but if the ingots are carefully made it will do so. Against bad or ignorant workmanship it is hard to find any absolute protection.

In rail purchases it has been found impractical to secure so great a discard. Personally, I believe the future will bring it, unless the insistence upon it shall lead to improved methods in casting ingots; until that time comes, I think that, through the railmakers developing other uses for the discarded steel, the decided increase of cost will be avoided.

Experience has proved that rails made by the basic open-hearth process are more liable to have interior pipes and segregated spots than Bessemer rails; no doubt principally because the ingots are larger and the size of the heats prevents slow casting. Of course the smaller contained percentage of phosphorus lessens the danger from its segregation, but the greater carbon content made possible by the law phosphorus increases the segregation of that element.

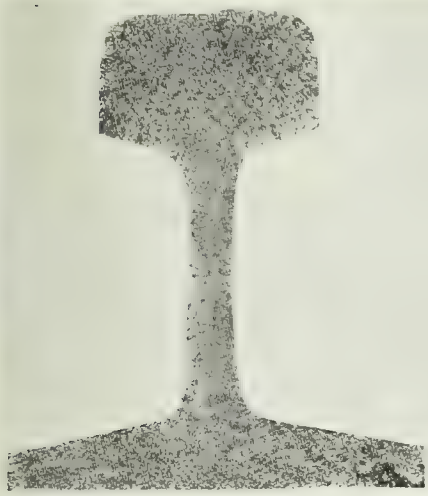


Figs. 1 and 2. Cross-Section of Ingots from the Same Heat Showing Different Depths of Piping.

Intelligent and careful investigation by a committee of the American Society of Civil Engineers, of which I had the honor of being secretary, resulted, August 3, 1893, in the recommendation of a series of rail sections which, while not adopted by all American railways, were used by so great a number that they became accepted as standard sections. In [illegible] another committee was appointed by the same society, of which also I was secretary. That committee, while deciding not to recommend any change in rail sections, did present certain specifications governing the manufacture of rails. Later developments resulted in that committee asking to be discharged in favor of one more directly representing the railway organizations of the country; and this committee (American Railway Association committee) recommended, under date of March 23, 1908, a series of rail sections which have, to a certain extent, displaced the so-called American Society sections; and, in my judgment, wisely so. The same committee has recommended rail specifications; several railway companies have adopted their own, and the rail manufacturers have what are known as Standard Specifications, all seeking to secure good-wearing and safe rails. All of this has been accompanied by much discussion, and I know has resulted in much good; but we are still away from the desired certainty of safety.

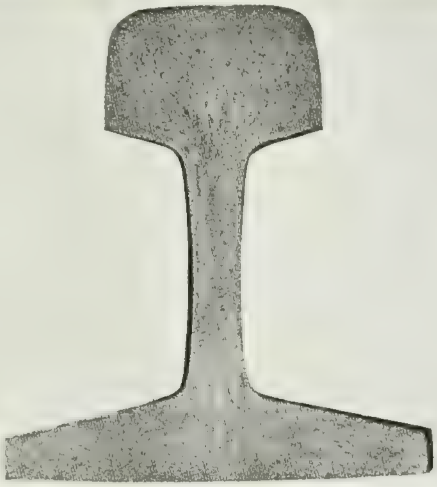
---

*Presented at the Sixth Congress of the International Association for Testing Materials, New York, September, 1912.



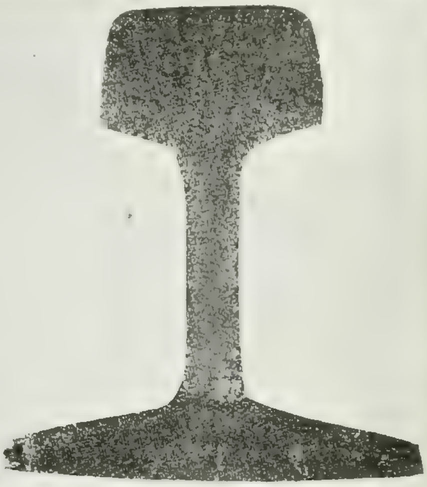
Analyses.
Corner of head: .674 Carbon, .023 Phosphorus
Centre of web: .895 Carbon, .047 Phosphorus

Fig. 3.—Photograph of Fracture Showing Evidence of Segregation Along Centre of Web.



Analyses.
Corner of head: .674 Carbon, .023 Phosphorus
Centre of web: .895 Carbon, .047 Phosphorus

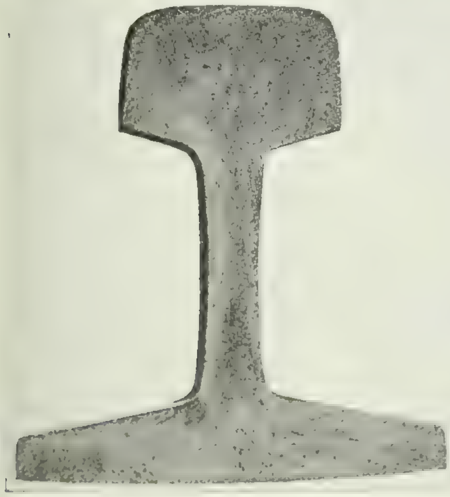
Fig. 4.—Photograph of Section in Fig. 3 After Being Etched.



Analyses.
Corner of head: .721 Carbon, .035 Phosphorus
Centre of web: 1.030 Carbon, .067 Phosphorus

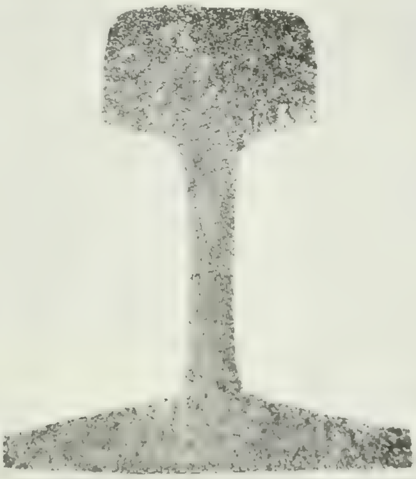
Fig. 5.—Photograph of Fracture Showing Evidence of Segregation Along Centre of Web.

I believe we can afford to let the chemical requirements remain as they are in most of the specifications. Their physical requirements as to finishing temperature also are sufficient, and most of them provide for sufficient drop-testing so far as determining the quality of the steel of the several heats as metal; but they do not go far enough to give protection against unsound castings (i.e., ingots). Practically all specifications require that the test piece shall be taken from the upper end of the rail made from the top of the ingot; and several require that after drop-testing if the piece has not broken it shall be nicked and broken to expose the interior, and if the interior of the rail shows any defects all of the A or top rails of the heat shall be rejected.



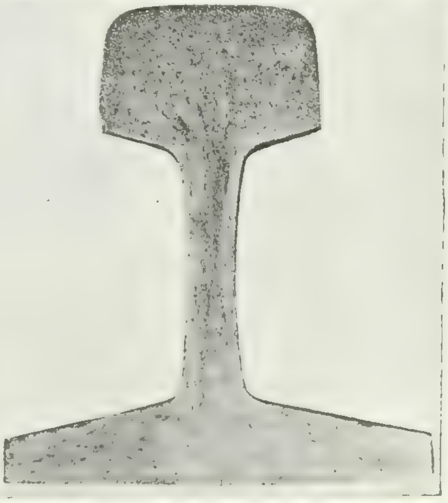
Analyses.
Corner of head: .721 Carbon, .035 Phosphorus
Centre of web: 1.030 Carbon, .067 Phosphorus

Fig. 6.—Photograph of Section in Fig. 5 After Being Etched.



Analyses.
Corner of head: .650 Carbon, .024 Phosphorus
Centre of Web: .888 Carbon, .045 Phosphorus

Fig. 7.—Photograph of Fracture Showing Evidence of Segregation Along Centre of Web.



Analyses.
Corner of head: .650 Carbon, .024 Phosphorus
Centre of Web: .888 Carbon, .045 Phosphorus

Fig. 8.—Photograph of Section in Fig. 7 After Being Etched.

So far, so good. But each ingot is an individual or separate casting; and because one is sound, it does not prove that the others (say 4 in Bessemer or 29 in open-hearth practice) are also good castings. As showing what does happen, I give diagrams (Figs. 1 and 2) of two ingots which were cut longitudinally through their centres. With such variation as here shown, it follows that the test piece from one ingot would not be representative of the other one. Therefore, I favor drop-testing as now, and nicking and breaking those test pieces, and also a piece from the rails made from the upper end of each and every one of the other ingots, and accept the seemingly sound and reject the proven unsound A rails. And I would go further and provide that, where unsoundness is shown, another test piece shall be cut from the lower end of the represented A rail and nicked and broken. If it also shows unsoundness, then the B rail of that ingot shall also be rejected, and another piece cut from the lower end of that B rail, and, if unsound, the C rails condemned; and so on for the remainder, if any, of the ingot. This makes a practical way of determining how far the pipe or segregation has extended down the ingot, with the minimum destruction of merchantable rail. Such a plan of testing is not entirely new in principle, and was in part suggested by the late William Metcalf in 1908, when he was consulted by the Rail Committee of the American Railway Association. The additional test pieces can be taken from the rail ends which are made in hot-sawing the rails, and can be broken under much less cumbersome tools than the drop testing machine and at small cost.

As to what constitutes interior defects, I unhesitatingly specify not only laps or pipes, but also silvery or bright spots, or other indications of non-uniformity. Etchings and analyses of a great many examples of the latter have proved them to unfailingly indicate segregation. I give in Figs. 3 to 8 views of the sections of nickel and broken rails, and of the same pieces after having been polished and etched; also analyses of drillings taken from the indicated positions. Table I. shows the results of other analyses of such spots. These tell their own story.

Rails with segregated centres do not always fail under the drops test, nor does the elongation test which is required by some specifications indicate their existence, but, unfortunately, it has been demonstrated that rails with such hard centres fail through the softer surrounding metal breaking down and thus producing split heads and often broken rails.

[illegible] commercially made, the safest procedure is to arbitrarily reject [illegible] Undoubtedly this harder steel would also yield good results [illegible] furnish a place for the use of a large part of the steel contained in the greater discard in the rail practice. Obviously its use would revolutionize the splice plate and tie plate making, but there have been many metallurgical revolutions and all of them have tended toward the betterment of the iron and steel industry.

It may be that present and future railway practice will require rails of heavier and otherwise different sections from the present ones, but we can never escape from the necessity of having them physically sound. As the section is increased, so must the work of rolling it decrease, and thereby the evil effects of want of homogeneity and unsoundness be augmented.

Table I.—Analyses of Segregated Rails.

Rail No.	Result of drop test.	Kind of steel.	Appearance of fracture on nick break.	Appearance of etching.	Cemical analyses Mill ladle C.	Mill ladle P.	Drillings from centre of web C.	Drillings from centre of web P.
1	O.K.	Bess.	Segregated	Unsound	.45	.10	.691	.165
2	O.K.	Bess.	Segregated	Unsound	.45	.10	.634	.152
3	O.K.	Bess.	Segregated	Unsound	.46	.10	.666	.138
4	O.K.	Bess.	Segregated	Unsound	.48	.10	.701	.173
5*	O.K.	Bess.	Segregated	Unsound	.45	.10	.797	.173
6	O.K.	Bess.	Segregated	Unsound	.47	.10	.722	.142
7	O.K.	Bess.	Segregated	Unsound	.5[illegible]	.10	.656	.145
8	O.K.	OH	Segregated	Unsound	.71	.029	.829	.043
9	O.K.	OH	Segregated	Unsound	.67	.040	.727	.059
10	O.K.	OH	Segregated	Unsound	.62	.022	.919	.042
11	O.K.	OH	Segregated	Unsound	.71	.039	.990	.060
12†	O.K.	OH	Segregated	Unsound	.64	0.28	1.000	.057

* Analysis drillings from corner of head gave carbon .439, Phos. .063.
† Analysis drillings from corner of head gave carbon .646, Phos. .023.

◆

Plans for a tunnel under the city of Vancouver, beginning at the foot of Burrard Street on Burrard Inlet and running to the False Creek yards are being drawn by the Canadian Pacific Railway preparatory to their being presented to the railway commission for approval. This tunnel has been mentioned several times in conferences between the Canadian Pacific Railway and the city. It is being considered as a means of doing away with the present street crossings in the middle of Vancouver.

◆

Early development of the coal resources of Central Alberta is expected. Mr. Andrew Laidlaw, of Spokane, and associates interested in the Jasper Park Collieries, have just returned from an inspection of their property. Over two hundred men are employed on the property, the entire output being taken by the Grand Trunk Pacific Railway for use on its locomotives. Mr. Laidlaw states that on completion of the installation of additional equipment at least five hundred men will be employed, and the output will be two thousand tons daily.

◆

The Canadian Talc and Silica Company, which owns a talc mine and mill at Eldorado, has purchased a property just east of the village of Madoc, Ont., owned by Mr. J. H. Curley, and known as the Conley property. The president of the company is Mr. H. Hungerford, of Chicago. The intentions of the company regarding the newly-acquired deposit are not made known, but it is supposed that another mill will be erected in Madoc, and ground talc shipped from there.

THE PLANT OF THE NORTON COMPANY AT CHIPPAWA, ONTARIO.

A very interesting plant for the manufacture of silicon-carbide was recently erected at Chippawa, Ontario, and has now been in operation about a year. Mr. Francis A. J. Fitzgerald has written an article which was published in Metallurgical and Chemical Engineering, describing this plant. We herewith present the description slightly re-arranged. We are indebted to Mr. Fitzgerald for the illustrations furnished.

In many ways the manufacture of silicon carbide is unique, the reason being that the properties of the substance itself are peculiar. If a piece of silicon carbide, consisting of an agglomeration of crystals just as they come from the furnace, is submitted to a sufficiently high temperature in an oxidizing atmosphere slow oxidation occurs, the silicon forming silica and the carbon burning to carbon monoxide gas. This may readily be shown by means of an oxy-hydrogen blow-pipe flame. If the flame is turned on the crystals for a short time and these are then examined they will be seen to be covered with minute globules of silica produced by the oxidation of the silicon carbide.

On the other hand, if the crystals of silicon carbide are heated to a sufficiently high temperature in a reducing or neutral atmosphere decomposition occurs without fusion, the silicon vaporizes and the carbon remains behind preserving the original form of the silicon carbide crystals. There is no evidence of fusion. Such an experiment may be performed in a carbon tube, which, of course, is heated electrically.

It is this peculiar property of silicon carbide which makes the conditions of manufacture unique and has thus led to the development of a furnace which to many appears at first sight rather a crude and inefficient apparatus. In most processes for the manufacture of carbides or other compounds which involve the reduction of an oxide, the resulting product is fusible and this simplifies in many ways the manufacturing process as compared with that of silicon carbide where the resulting product is infusible. In the production of a fusible material a moderately careful mixture of the reacting raw materials is satisfactory since slight inequalities or lack of homogeneity in the mixture will not cause trouble provided the proportions of the constituents are correct. The conditions of silicon carbide manufacture, however, are different.

The mixture used in the production of silicon carbide should contain theoretically 60 parts of pure silica sand and 36 parts of pure carbon. When these are thoroughly mixed and heated to a sufficiently high temperature a portion of the carbon combines with the oxygen of the silica forming carbon monoxide gas, and the silicon thus set free combines with the remainder of the carbon to form silicon carbide. During this process, however, the mixture as a whole is not fused. Certainly the sand fuses, but the volume of carbon mixed with the sand is sufficiently great to prevent the particles of silica from running together, but instead of that they react with the carbon in their neighborhood to form, first of all, a greenish-colored substance which shows no crystalline structure, and as the temperature is carried higher this is converted into the crystalline silicon carbide. There is naturally a considerable shrinkage of the mixture, for from a theoretical charge weighing 96 kg. only 40 kg. of silicon carbide are obtained, the remaining 56 kg. disappearing as carbon monoxide gas. The mixture then shrinks, but preserves generally its original form. If the heating is continued so that the temperature is raised still further the silicon carbide is decomposed, as already described, but still there is no fusion and ultimately the carbon which was in combination with the silicon is obtained as graphite.

If a mixture containing an excess of silica is heated a reaction occurs between the silica and the silicon carbide which results in the production of silicon, and this is just what happens in those parts of a silicon carbide furnace charge where there is an excess of silica, due to lack of homogeneity in the mixture.

A consideration of these facts leads to the conclusion that it would be difficult to manufacture silicon carbide in a furnace different in general principles from the well-known form that has been used for the purpose during the past 20 years. Moreover, it is not difficult to understand that the manufacture is one requiring very considerable care in order to obtain a satisfactory product and at the same time to get as large an output as possible.

In the design of the Norton Company's plant for the manufacture of "crystolon," the name given to its silicon carbide, the first consideration was the quality of product, the efficiency of the furnaces, by which is meant the output per kw.-hour, the labor cost and the cost of raw materials being deemed secondary matters. This must be remembered in considering the plant in order to appreciate it fairly.

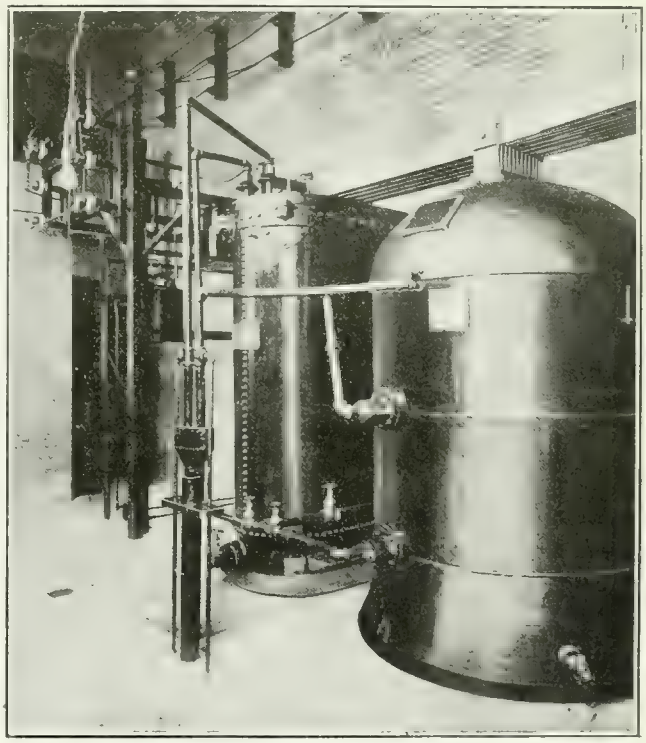


Fig. 1.—Arrangement of Electrical Apparatus in Crystolon Plant of Norton Company.

The Norton Company's crystolon plant is in Chippawa, Ont., about two miles above the Falls of Niagara. The current is supplied by the Ontario Power Company at 12,000 volts, three-phase. Since it was decided to use furnaces having a capacity of 740 kw. and to install only two units, it was necessary to use transformers with suitable taps for the Scott connection so that the three-phase current is transformed to two-phase. The transformers step down the voltage to 145. The secondary bus-bars then go to induction regulators by means of which the e.m.f. at the furnaces may be raised to 215 volts or lowered to 75 volts.

The arrangement of the electrical apparatus is shown in part in Fig. 1. The current enters the building in a room next the transformer room where it goes to the main circuit breaker and where the lightning arresters are set up. The cables from the main circuit breaker are then brought into the transformer room on brackets near the ceiling, as shown in the figure. A frame work, shown at the left, carries two single-pole double-throw switches so that the transformer, seen in the centre, can be connected to any one of the three-phases. The frame work also carries circuit breakers, of which one is connected in parallel with a water rheostat and can be tripped by hand, while the other is provided with an automatic tripping device. The reason for using the water rheostat is that it is frequently necessary to throw the current on at full load and this might cause dangerous surging if the circuit was closed by means of the oil circuit breaker.

To the right of the transformer in the figure is the induction regulator by means of which the voltage of the current is raised or lowered. The induction regulator is built like an induction motor and the secondary voltage varies with the position of the rotor. Its great advantage lies in the fact that there are no contacts as in other kinds of voltage regulators and the change of voltage is perfectly continuous. The disadvantage is that on account of the air gaps between the primary and secondary there is considerable magnetic leakage, and, consequently, the power factor of the circuit is apt to be low. This, however, is more than compensated for by the advantages which make a breakdown of the voltage highly controllable.

The busbars coming from the transformer and regulator are mounted and pass through the wall of the transformer room to the furnace room, which they travel transversely. On either side of the busbar line are three furnaces, these forming one unit, Fig. 2. Between the terminals of each pair of furnaces on opposite sides of the busbar line bars are arranged alike, those on one polarity going down into a concrete trough which passes under the foundations of the furnaces, the other bars terminating on a level with the furnace terminals. The bars going into the trough come out at the other ends of the furnaces and are then connected by means of cables to the terminals, as shown in Fig. 2.

The grounded side of the furnaces, that is, the terminals connected to the busbars through the trough are kept permanently connected, but the other terminal is only connected to the busbars when the furnace is running. In starting a furnace the resistance is adjusted so as to have the maximum voltage at the furnace terminals and this brings the furnace to full load in a few minutes. The resistance still keeps dropping rapidly as the temperature rises, but by means of the regulator the rate of generation of energy is kept constant. Finally the resistance becomes very nearly constant and there is only a gradual fall to the end of the run. Although it is possible to decrease the e.m.f. at the terminals to 75 volts it is customary so to construct the furnace that the resistance at the end of the run requires an e.m.f. of about 80 volts.

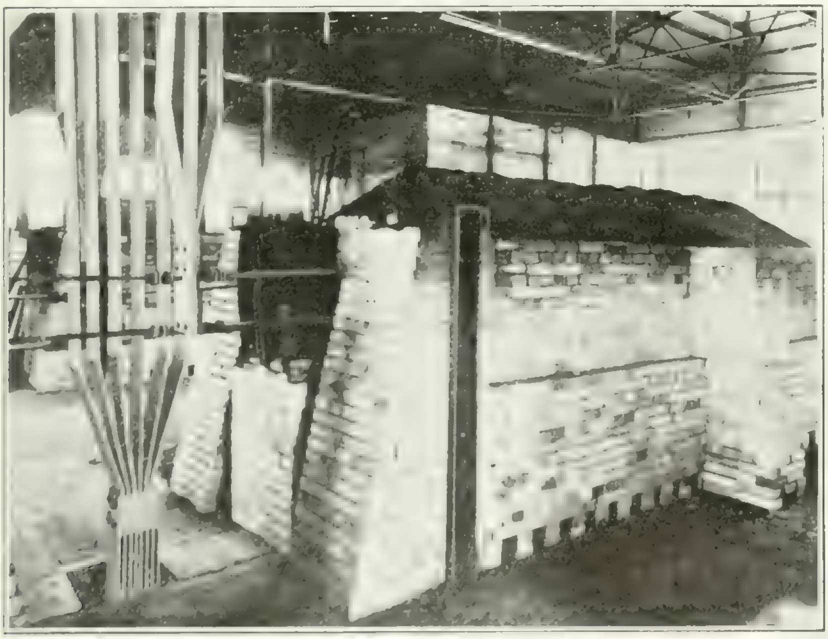


Fig. 2.—Electric Furnaces for Manufacturing Crystolon.

It has been pointed out that an objection to the use of an induction regulator is its influence on the power factor of the circuit. It is found, however, that even with the large current of 9,000 amp. used at the end of the run the power factor is about 0.9.

The raw materials for the manufacture are brought in on a switch at the side of the building opposite to the transformer room. The sand and sawdust are taken from the cars and conveyed to large concrete storage bins by means of elevators. The coke is thrown directly into a crusher, and when the granular carbon for making the resistor used in the furnace is required the coke coming from the crusher is passed over screens which separate particles of the required size. The under size and over size particles of coke are carried to a buhr mill where they are finally ground and thence conveyed to a concrete storage bin.

In making the charge for the furnace a mechanical mixer is used and the mixture is emptied at once into the hand cars which convey it to the furnaces. These are built in the usual way with the mixture surrounding the granular coke resistor. The furnaces have an electrical capacity of about 700 kw.

This question is sometimes asked: "Would not larger furnaces result in more economical working?" It is a fact that the consumption of energy in a small silicon carbide furnace, say of 75 kw., is very large, about 10 kw.-hours per pound, and that in going to a larger sized furnace, for example 200 kw., the reduction in energy consumption is very marked. Again, increasing the size of the furnace to 700 or 800 kw. makes the working still more economical, but about here a point is reached where still further increase in size is of doubtful advantage. This is easily explained when certain of the peculiarities of silicon carbide are considered.

It has already been pointed out that the substance is infusible and that it must be formed between certain temperature limits. The result of this is that when a charge has been partially converted into silicon carbide, the heating resistor is surrounded with a cylinder of the carbide and consequently, the heat which is supplied to the charge must be conducted through this cylinder to the surrounding mixture. It is obvious that there is a limit to the thickness through which it is economical to transmit heat and that very large furnaces would demand such a great increase in the thickness of the silicon carbide cylinder that they would not be practicable. On the other hand, if the thickness of the silicon carbide cylinder is kept the same and the length of the furnace increased so as to accommodate the increased rate of generation, there is nothing gained in heat economy, since the radiating surface of the furnace is increased in proportion to the rate of generation of energy.

Another objection to very large furnaces is the increased difficulty in building with the care necessary to obtain a product of the highest quality possible. Lack of uniformity in the charge or irregularities in the resistor all tend to bring about the production of an inferior abrasive. It is for this reason that the most elaborate care is taken in the mixing of the charge and the construction of the furnaces at the "Crystolon" plant. Analyses of all the raw materials are made as soon as these are received at the plant, then in the Chippawa factory analyses of the raw materials are made twice a day and the mixture adjusted accordingly.

The equipment of the plant is very complete both as regards apparatus and personnel for carrying on research work on the working of the furnaces and methods of manufacture. This research not only covers chemical and electrical studies but also important thermal experiments. Some of the results of this work have been published by Saunders in an interesting paper read at the last meeting of American Electrochemical Society[1] in Boston.

The temperature measurements of the crystolon furnace are of great interest in many ways. They show what exaggerated notions of the temperature of the furnace have been formerly entertained and also the comparatively small range of temperature which can be utilized in making silicon carbide. As determined by Saunders the temperature at which silicon carbide crystals begin to form is only 400 degrees below that of decomposition. There is no doubt that for some processes 400 deg. would be a large range of temperature, but for a substance like silicon carbide, on account of its other peculiarities, outlined before in this article, it is not.

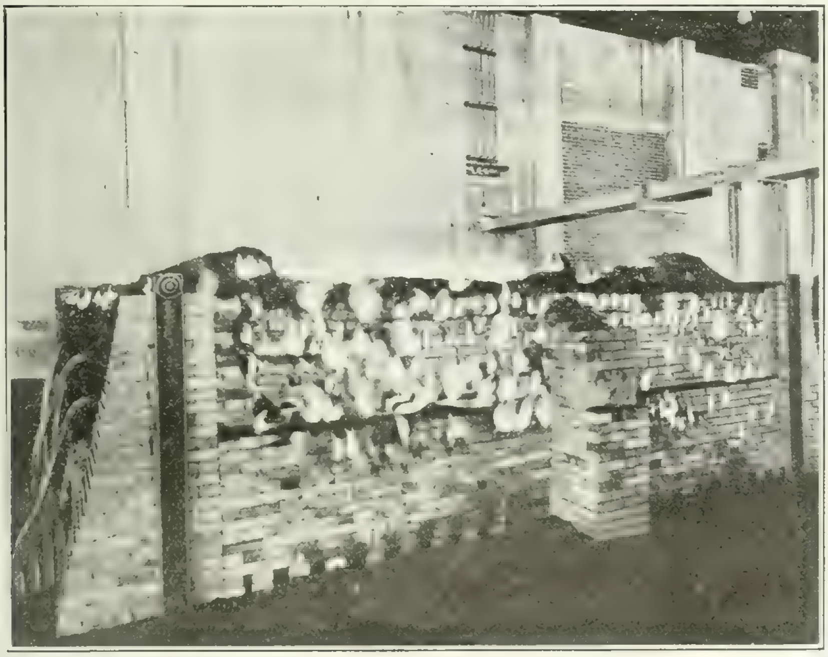


Fig. 3.—Electric Furnace for Manufacturing Crystolon.

The Norton Company's crystolon plant is used simply for the manufacture of silicon carbide, the material as it comes from the furnace being shipped to Worcester, where the crushing, grading and further manufacture is carried on. At first sight it might appear that the separation of the plant where the crude abrasive is manufactured from that in which it is made up into marketable form is not efficient, but experience seems to show that this view is not correct. The separating by no means interferes with active cooperation and at the same time permits of undivided attention to the production of a raw material of the highest quality without which the manufacture of a satisfactory finished article is possible.

---

[1] Met. & Chemical Engineering, Vol. X, No. 5, p. 287.

THE METHODS OF RESEARCH.*

By Edward P. Hyde.

The spirit of research now prevails. Research work is undertaken in our universities and colleges, both by faculty and by students; research departments are considered most important adjuncts to large progressive industrial organizations; research laboratories are being endowed by philanthropic citizens; and individuals everywhere, and in all branches of human knowledge are independently undertaking the investigation of problems of supposed practical importance or of personal interest. Inasmuch as effectual practice rests on the judicious application of established knowledge, whatever conduces to the enlargement or enrichment of our body of established knowledge is worthy of our highest respect and our most serious consideration. But side by side with this duty of encouragement and appreciation stands that other duty of careful discrimination between the research work that is thorough and genuine and the research work that is ill-advised and spurious.

Not long since the president and council of this society appointed a research committee to stimulate interest in the investigation of important illumination problems, to encourage sane and promising research, and to serve as a directive force in the development of the science of illumination. And it has seemed advisable to the papers committee of the society that a brief paper on "The Methods of Research" should be presented at this convention.

What is research? Knowledge comes to us at times unsought and unexpected. Discoveries are frequently fortuitous. But by research is meant the diligent, continued or laborious search after facts or principles. And the goal of research is truth. This is a most important point. Whatever may be the ulterior motive in the acquisition of truth, whether it is truth for truth's sake, as in the ideal of pure science, or truth as a firm foundation for judicious practice, as in the ideal of applied science, the immediate goal in all research work worthy of the name is truth. The methods of research must, therefore, be included in the methods involved in arriving at truth, and so we turn our attention for a while to a consideration of the methods by which we arrive at truth. Truths must be distinguished in two classes: (1) those truths which are known directly or of themselves, as our own bodily sensations and mental feelings; and (2) those truths which are known through the medium of other truths, as the theorems of mathematics. The former are the subject of intuition or consciousness; the latter, of inference. It is not the place here to discuss the metaphysical question of the dividing-line between truths which are known directly and those which are known by inference. Suffice it to say that practically all, if not quite all, of the truths of physical science are known through the medium of other truths and are hence the subject of inference.

What then are the methods of arriving at truth through inference? The logicians distinguish two methods, that of induction and that of deduction. Let us consider briefly first the inductive method. By induction is meant the process of drawing a general conclusion from particular cases. Thus the law of conservation of energy and the law of universal gravitation are great generalizations which cannot be proved, in the ordinary sense in which we speak of proving a mathematical theorem. They are expressions of our belief in the invariability of certain phenomena which have been found uniformly in a very large number of concrete cases. Many of us believe that so-called glare is deleterious to eye-sight. We have inferred this from observations of individual concrete cases. If true, it is an important truth in illumination arrived at by the method of induction. The exact verity of it, and the limits within which it applies, however, have not yet been definitely established.

---

*A paper read at the sixth annual convention of the Illuminating Engineering Society, Niagara Falls, Ont., September 16-19, 1912.

This last illustration suggests the two processes by which we arrive at truth by the inductive method. These two processes are observation and experiment. By observation, as used here, is meant the passive observation of phenomena without effort to control or modify the phenomena in any way. According to the above illustration, if we merely note that certain individuals have been exposed to strong glaring light and have subsequently had eye-troubles, and infer from this the generalization that glare is deleterious to eye-sight, we are making use solely of the process of observation in our induction. If on the other hand we are not content with the results of passive observation of cases as they occur, but seek rather to control to some extent the phenomena by isolating certain factors and eliminating others, our process becomes that of experiment. Certain phenomena are not subject to control and may only be studied by the process of observation. Other phenomena lend themselves readily to experiment. It should be remembered, however, that each process has certain advantages and disadvantages even in the case of phenomena to which both processes may be applied. Thus the process of experiment is peculiarly valuable in cases where we desire to determine the various effects of a given cause, and the process of observation has corresponding advantages in cases where we seek to find the causes of a given effect.

Unfortunately time does not permit an elaboration of the four ways in which the process of experiment may be used to arrive at truth, viz., (1) by agreement, (2) by difference, (3) by residues, and (4) by concomitant variations. I may only commend them to you for careful study and must then pass on to a brief consideration of the second method by which we arrive at truth through inference, viz., the deductive method.

We have discussed the inductive method first because it is the simplest and most direct method of arriving at truth by inference. Moreover, it precedes and underlies the deductive method, for the starting point of the latter consists of one or more generalizations which presumably have already been established. It is true, as John Stuart Mill says, that "If we had sufficiently capacious memories, and a sufficient power of maintaining order among a huge mass of details, the reasoning could go on without any general propositions; they are mere formulae for inferring particulars from particulars." But as we have not such memory or power of maintaining order among details, and as, in our processes of reasoning by the deductive method we start from generalizations arrived at by the inductive method.

The mode of investigation according to which we arrive at truth by the deductive method consists of three steps: the first, one of direct induction; the second, of ratiocination, or reasoning; and the third, of verification. The inductive method consists merely in inferring from the particular to the general, but in the deductive method, starting from previous generalizations the process of ratiocination is applied, and as a result of this operation conclusions are reached which are subject to direct verification. It is a mistake to suppose that the conclusions of deduction are distinctly new, in the sense that they were not contained in the underlying inductions involved in the reasoning, and yet the truths arrived at by the deductive method may be, and usually are new in the sense that they were not recognized in the inductions which formed the basis for the reasoning. As an example of this the science of geometry may be mentioned. The theorems of geometry are all deducible from the axioms or postulates which are inductions, but in which one fails to recognize a priori all the theorems deducible from them.

The third operation in the deductive method, viz., verification, is of marked importance as we shall see later on in the more specific consideration of the methods of research.

It is evident, from the hasty outline given above that these two methods of arriving at truth by inference are not independent. The basis of the deductive method is a previous induction. The two methods are interdependent. A young or complex science will partake more of the character of an inductive science, as compared with an older or simpler science. A new science has few inductions to serve as the premises of deduction, but even in a new science an effort is made to reason from the hypothetical generalizations already reached to conclusions which on being verified by observation or experiment, strengthen the inductions from which they were deduced. Thus science grows.

I regret the necessity of this somewhat academical discussion of the methods of inference, but I see no other way of prefacing the ideas which I desire to present in regard to "The Methods of Research." As has been said, the goal of research is truth, and hence the methods of research are none other, in their general character, than the methods of arriving at truth by inference. Let us now apply the principles, which have been presented, to the consideration of the methods of research.

There are two general methods of research; that of induction, and that of deduction. The former is the method of observation and experiment, and the inference from the concrete to the general. The latter is the method of hypothesis or theory, ratiocination and verification. Let us consider these two methods more in detail.

The inductive method consists of observation and experiment. In a new science little is known, the observations are limited, the experiments are few. There is little opportunity for ratiocination or reasoning; the greater need is for the accumulation and collection of facts in generalizations which may subsequently form the basis of ratiocination. To use the illustration referred to above, we are not prepared to reason from the induction that glare is deleterious to eyesight because this induction itself is scarcely out of the domain of empiricism. We are investigating the matter; we are making observations and carrying out experiments. We are collating facts. We are doing research by the inductive method. In the development of all science, but more particularly in the development of the newer or more complex sciences, this method of research finds most valuable application.

I would further distinguish two ways of carrying out research by the inductive method which I shall call respectively the definitive and the non-definitive methods. The distinction between these two methods is best shown by reverting once more to our illustration of the effect of glare. An investigator of this subject might carry out his research in either of two ways. He might, for example, lay out a definite scheme of attacking the problem. He might study experimentally first the effect of glare on visual acuity, then its effect on speed of reading, then its effect on fatigue, and so on. He might attempt to study by the process of observation the intensity of the glaring light, the angle at which it is incident on the eye, the period over which the patient has been subjected to the glare, and the relation of these elements to the resultant eye-injury. In either of these two cases, both of which are examples of research by the inductive method,—one by the processes of experiment and one by the process of observation—the investigation has proceeded according to a definite plan, has followed a definite scheme. Such research by the inductive method I would call definitive.

On the other hand many investigations are carried out by the non-definitive method, and many investigators have a tendency to work in this way. Thus, in the illustration of the study of glare, an investigator might set out to study the problem without any definite scheme of attack, or any preconceived notions of the casual relations between the resultant effects and the possible causes. He would, in a more or less random fashion, vary the conditions and note the result, and attempt ultimately to discover the important element in the problem. The method is haphazard, fortuitous, non-definitive. And yet at times it is most valuable. Moreover, it should be emphasized that in research by the inductive method the process is seldom entirely definitive or entirely non-definitive. The investigator with the scheme is ever alert, or should be ever alert, to recognize some unsuspected phenomenon which flashes out into prominence as important. And the schemeless investigator will always, or should always follow up any phenomenon which attracts unusual attention.

The two processes are interwoven, and very few, if any, researches are made exclusively by one or the other. And yet it is very easy to point to investigators who tend to work according to one or the other of the two processes. I am at a loss what to say regarding the relative merits of the two methods. The non-definitive method is at times, and in the hands of certain investigators, of the greatest value, but I see no way of laying down rules for procedure according to this method. Since it is more or less haphazard there can be no rules. We must rely entirely on the personal equation of the individual. The definitive method, on the other hand, is conformable to a formula of procedure. Inasmuch as the general scheme of procedure by the definitive inductive method has much in common with that of the deductive method, I shall give the formula for the two at the same time.

We now turn to a consideration of the deductive method of research. This is the method of hypothesis or theory, ratiocination and verification. We have seen that this method of arriving at truth consists in argument from previous inductions or generalizations to conclusions which are subjected to verification by observation or experiment. This is peculiarly the method of the mathematical sciences. The verification confirms the conclusion and strengthens our belief in the generalizations which served as premises. These generalizations may be generalized facts as in the classical illustration—All men are mortal; or they may be generalized principles such as the theory of gravitation or the nebular hypothesis. A general principle which possibly or even probably underlies or explains certain phenomena is frequently termed a hypothesis. Arguing or reasoning from this hypothesis certain conclusions are derived. These conclusions are put to test by observation or experiment. If the conclusions are not confirmed the hypothesis is shown to be false and not to be a true induction or generalization. If the conclusions are found to be true, the hypothesis is strengthened. If the deductions from the hypothesis are found consistently to be true the hypothesis becomes a theory, and is classed with the other great principles of the science.

Just as it is impossible to lay down rules for carrying out a research by the non-definitive inductive method, so it is impossible to lay down rules for deciding upon the scheme of a research according to the definitive inductive method, or of determining upon a specific deduction according to the deductive method. These things are matters of individual creative imagination and not subject to formula. Granted, however, a definite scheme of research (definitive inductive method) or a deduced conclusion (deductive method) it is quite possible to lay down a general formula which will be helpful in carrying out the experimental work. Such a general plan of procedure is outlined below:

1. Exact definition and statement of problem.
2. Study of literature pertinent to the problem.
3. Determination of experimental method.
4. Choice or design of apparatus.
5. Isolation of specific phenomenon to be studied, or of quantity to be measured, and elimination of complicating phenomena or quantities.
6. Preliminary investigation of instruments used.
7. Investigation and discussion of sources of error.
8. Careful analysis of results.
9. Justifiable conclusions.

In an early paragraph of this paper emphasis was laid on the fact that the goal of research is truth. Whatever may be the stimulus for the attempt to ascertain the truth, whether it be truth for truth's sake, or truth as the basis of sound practice, the immediate object in every true research is truth. It seems expedient in concluding the paper to return to this subject to reiterate the importance of the right attitude toward research, and to sound a word of caution against those two classes of investigators whose well-meant efforts serve rather to retard than to assist the development of science. The charlatan, the impostor needs no consideration, but there are genuine men whose contributions in the name of scientific research are more fundamentally and permanently harmful than the wild claims of the charlatan. I refer to the narrow, incompetent investigator and to the broad speculator. The former can see but one side of a problem, and his incompetency is further reflected in his restricted ability to impose the proper limitations on his conclusions. The latter is continually inferring generalizations from inadequate data, or deducing conclusions from non-established inductions. There is a place for hypothesis, and there is need of speculative imagination, but he who confuses speculative hypothesis with established principles and leads others into such error is inhibiting the development of science. And it is very difficult to counteract the effect of such unjustifiable speculation, for it is usually in the domain of limited knowledge, and his is a thankless task who urges the inadequacy of fact to justify the speculation, but who is unable himself positively to controvert the speculation. Let us all endeavor to be more severe critics of our own work, and more discriminating critics of the work of others.

HUDSON BAY RAILWAY RISKY.

"The Hudson Bay Railway undertaking is of so risky a nature and its ultimate success is so problematical that it should be operated by the Dominion Government until its real value has been demonstrated," said Sir Donald Mann at Winnipeg. "When the Canadian Northern started we had the choice of going north to the Bay or east and west. We chose to go east and west, and I think the result has justified our judgment. But you can never tell, and the result is uncertain. Undoubtedly, there will be a large fish trade from the north and valuable mineral deposits may be found along the right-of-way, as happened in the case of the Ontario Government road, making the line of incalculable worth. Add to this that there is bound to be considerable through traffic, freight and passenger, the element of risk is materially reduced. But I think that the right course is being pursued."

THE "BOOSTER" PUMP SUPPLIED THE GREAT WESTERN RAILWAY WORKS AT SWINDON.

We give below a brief description of an interesting plant which the Great Western Railway Company have just recently installed in their works at Swindon.

The plant consists of a "Victoria" turbo pump supplied by Messrs. Jens, Orten, Boving & Company, of 9½ Union Court, Old Broad Street, E.C., coupled up to a Bruce Peebles motor.

The pump takes the water from an elevated tank at a pressure varying up to 20 lbs. per sq. inch, and delivers into a pipe-line of more than one mile in length, to which the nozzles for the work's fire system are connected, boosting the pressure up to about 120 lbs. The pump is thus inserted into a pressure water, and is therefore constantly primed and always ready for immediate starting up. It is flexibly coupled up to a D.C. motor of the protected shunt wound, commutating pole type running at 1,300 r.p.m. and with an output of 90 h.p.

The pump and motor are erected in a separate station, as shown in the accompanying figure, and are operated from the central power house some considerable distance away, starting up being done by a hand-operated liquid starter fitted with field discharge resistance.

The pump is so designed that it requires no attendance whatsoever beyond the provision of the necessary lubricant for the bearings. There are no cocks or other regulating devices of any description fitted to the pump which would require adjustment in order to overcome endthrust and consequent heating of bearings [illegible] pumps, especially when they are working against a pressure different from the normal. The patent trust balancing device fitted in this pump adjusts itself automatically to such changes of pressure as will of neces[illegible] altered or in case other supplies are taken from the main.

It cannot be emphasized strongly [illegible] liability of such installations depend [illegible]

[illegible] running. These fluctuations of pressure continued for some time owing to the inertia of the long water column in the delivery pipe, but during all these changes of load, whch constitute the severest pressure test to which a turbine pump can be put, the Victoria pump did not show any signs of heating, but proved to be balanced perfectly.

Another feature, indispensible with pumps that should require practically no attendance, is the absence of a high-pressure stuffing box. Pumps containing high-pressure glands are unsuitable for this kind of work, as these glands often require tightening and careful attention, for if set too tightly, as is often done with a view to minimize the leakage inevitably connected with high-pressure glands, the shafts or shaft sleeves become unduly worn and troubles through heating of the gland may occur, [illegible]

View of Pump Station.

With this condition the "Victoria" turbo pump fully complies as there is no high-pressure stuffing box in this pump, as only low-pressure exists in the last chamber of the pump which, in fact, forms a self-contained unit.

[illegible]

APPLICATIONS OF OIL-MIXED CONCRETE.

About a year ago Mr. Logan Waller Page, director of the Office of Public Roads, United States, made public the results of certain investigations which he had been conducting into the properties of oil-mixed concrete as a waterproof material. A summary of his findings was published in *The Canadian Engineer* of October 12, 1911. Since that time the experimental work has been progressing steadily and the latest results are published in bulletin No. 46 of the Office of Public Roads, which was issued on August 8. The first part of the report deals principally with the laboratory and service tests which were covered in detail in the issue of this journal previously referred to. The results of these laboratory investigations may be summarized as follows:

The oils used were a fluid residual oil and a cut back oil asphalt. The damp-proofing properties of concrete mixtures containing oil have been demonstrated very definitely by laboratory and by service tests which establish this material as one of great merit for certain types of concrete construction. It has also been shown that the admixture of oil is not detrimental to the tensile strength of mortar composed of 1 part of cement and 3 parts of sand when the oil added does not exceed 10 per cent. of the weight of the cement used. The compressive strength of mortar and of concrete suffers slightly with the addition of oil, although when 10 per cent. of oil is added the decrease in strength is not serious. Concrete mixed with oil requires a period of time about 50 per cent. longer to set hard than does plain concrete, but the increase in strength is nearly as rapid in the oil-mixed material as in the plain concrete. Concrete and mortar containing oil admixtures are almost perfectly non-absorbent of water, and so they are excellent materials to use in damp-proof construction. Under pressure, oil-mixed mortar is very efficient in resisting the permeation of water. Laboratory tests show that oil-mixed concrete is just as tough and stiff as plain concrete, and furthermore its elastic behavior within working limits of stress is identical with that of plain concrete. The bond or grip of oil concrete to steel reinforcement is much decreased when plain bars are used. Deformed bars, however, and wire mesh or expanded metal will reinforce this material with practically the same efficiency as in ordinary concrete.

The remainder of the report is given over to a discussion of the proper uses of the oil-mixed concrete and detailed instructions are given for specific cases. There is also an appendix devoted to the results of physical tests of oil-mixed concrete:

Oil.—For oil-mixed concrete, petroleum residuum oils conforming to the specifications given below have been found to give good results in both laboratory and service tests:

(1) The oil shall have a specific gravity of not less than 0.930 nor greater than 0.940 at a temperature of 25 deg. C.

(2) It shall be soluble in carbon disulphide at air temperature to at least 99.9 per cent.

(3) It shall contain not less than 1.5 nor more than 2.5 per cent. of bitumen insoluble in 86 deg. B. paraffin naphtha.

(4) It shall yield not less than 2.5 nor more than 4 per cent. of residual coke.

(5) When 240 cu. cm. of the material is heated in an Engler viscosimeter to 50 deg. C. and maintained at that temperature for at least 3 minutes, the first 100 cu. cm. which flows out shall show a viscosity of not less than 40 nor more than 45.

(6) When 20 grams of the material is heated for 5 hours in a cylindrical tin dish 2½ in. in diameter by 1 in. in height, at a constant temperature of 163 deg. C., the loss in weight shall not exceed 2 per cent.

Mixing.—For most purposes where damp-proofing is required 5 per cent. of oil based on the weight of cement in the mixture is all that is necessary. A bag of cement weighs 94 lb., and consequently, for each bag of cement used in the mixture, 4.7 lb. or about 2½ quarts of oil are required. The sand and cement should be mixed dry. Water is added to the mixture and the mass again mixed to a mortar of mushy consistency. Oil is then measured out and added to the mortar, and the mass again turned until there is no trace of oil visible on the surface of the mortar. Particular care should be taken to continue the mixing until the oil is thoroughly incorporated in the mixture. The oil-mixed mortar is then combined with the stone or gravel previously moistened and the mass is again turned until all of the stone is thoroughly coated with the mortar and the mass is uniformly mixed throughout. Should only oil-mixed mortar be desired, the process is similar to that above described except that no stone is added.

In a machine mixer the cement, sand, and water are first mixed to a mortar when alternate batches of oil and stone are added until the required quantity of oil is mixed, and then the remainder of the stone is added and mixed.

Uses.—All of the laboratory and service tests thus far made on oil-mixed mortars and concretes are indicative of a wide future usefulness for these materials, principally in damp-proof construction. There are many types of structures through which the permeation of moisture is ruinous to either the appearance or the efficiency of the construction, or is seriously detrimental to the health of either animal or human life. The efflorescence due to the leaching out and subsequent carbonization of the lime on the surface of a concrete wall might well be prevented by the incorporation of an agent capable of excluding all moisture. Again, the dampness of many cellars, with its danger to health, could have been prevented had the walls and floors been damp-proofed. The following types of structures might be damp-proofed at an exceedingly slight extra expense by the incorporation of a small amount of the proper kind of mineral oil residuum with the mortar or concrete used in construction: Basement floors, basement walls, watering troughs, cisterns, barns, silos, concrete blocks, roofs, stucco, and numerous important engineering constructions.

Basement Floors.—There are many basement floors which are continuously damp, owing to the percolation of moisture from the underlying soil. Concrete and mortar, as ordinarily made, are neither perfectly non-absorbent nor waterproof, so that ground water readily finds its way through to the basement and causes a very insanitary condition.

A floor which will remain perfectly dry may be constructed at a cost but very slightly higher than that of the ordinary basement floor by the incorporation of a petroleum residuum oil with the ordinary concrete mixture. The following method of construction, using an oil-cement mixture, is suggested as one which will prevent the permeation of moisture even from a very wet subsoil.

It will be well, if the underlying soil is very wet, to lay a 6-inch foundation of sand, cinders, broken stone, or gravel, compacting these materials well by tamping. In addition it will be of advantage to employ drain tiles in this porous foundation, leading them to a sewer if possible. On top of the foundation should be laid a 4-inch layer of concrete mixed in the proportions of 1 part of Portland cement, 2½ parts of sand, and 5 parts of broken stone or gravel. Before the concrete base has hardened, a top or wearing coat of mortar mixed in the proportions of 1 part of cement and 2 parts of sand or stone screenings and containing 5 per cent. of oil (2½ quarts per bag of cement) should be laid. This top coat, because of its non-absorbent character, will give perfect protection from underlying moisture, and moreover it will build a floor which will dry out very quickly after washing, since practically none of the washing water will be absorbed.

It might be thought that the addition of oil to the mortar-wearing coat would tend to make the surface slippery. Such, however, is not the case; nor is the appearance very much different from that of an ordinary cement floor. Should joints be provided for expansion and contraction, it will be necessary to fill them with a good bituminous filler to prevent the entrance of water.

Many cellar floors now made of Portland cement concrete are giving trouble owing to the permeating moisture. They are continually damp and, owing in part to the constant evaporation from their surface, they are cold. Such a condition may be remedied by the application of an oil-mixed mortar coat to the surface of the old floor. Before attempting to lay the new wearing surface, the old floor should be scrubbed thoroughly clean and should be made thoroughly wet. The bond between the old and the new work will be improved if the old surface be roughened with a stone hammer. A wash composed of 1 part of hydrochloric acid and 5 parts of water may be used to clean the surface. This will dissolve some of the cement from the old work, leaving the aggregate exposed. The acid solution should be left on not longer than half an hour, when it should be completely removed with clean water. The surface should then be brushed with a wire or stiff scrubbing brush to remove any particles of sand which may have become loosened because of the dissolving of the cement.

A mortar composed of 1 part of cement and 2 parts of sand and containing 5 per cent. of oil will be sufficiently non-absorbent for the new wearing coat. To strengthen the bond it will be well to apply a wash of grout, made by mixing cement with water to the consistency of cream, before laying the oil-mixed mortar coat. For the ordinary basement floor a 1-inch layer of mortar will prove of sufficient thickness. It will be necessary to keep the new mortar damp for at least one week in order that it may attain its proper strength.

Cellar Walls.—The entrance of moisture through the walls is another common source of damp basements. The water pressure in the soil adjacent to the wall is very seldom of great magnitude, so that a non-porous material and one that is at the same time impermeable under moderate pressures is the logical one to use for this type of construction.

A concrete mixture in the proportions of 1 part of cement, 2½ parts of sand, and 5 parts of gravel or broken stone, together with 10 per cent. of oil based on the weight of cement in the mixture, should prove amply rich for most [illegible]. A wall of these proportions, [illegible] in. thick and provided with a spread footing, will withstand a pressure of 6 ft. of earth. When supported at the top by floor joists, a much thinner wall may be used with safety. A 6-in. wall [illegible] ft. high may be used to withstand 6 ft. of earth pressure. Generally speaking, such a thin wall should be reinforced [illegible] in both directions. Smooth rods should not be used in [illegible], however, [illegible] for reinforcing, may be used with perfect results. Care should be taken that the earth is not filled in against the [illegible].

[illegible]

The surface to which this mortar is to be applied should be roughened with a stone hammer, if the old wall is of concrete, or the mortar joints should be raked out to a depth of half an inch from brick or masonry walls. The acid wash previously described should be applied to cleanse the surface thoroughly, after which the loose particles must be removed with a wire brush or a stiff bristle brush. It will be impossible to obtain a water-tight coating if it is applied while water is seeping through the wall. It will be well to wait for the dry season, when the ground water is reduced to its lowest level, before attempting to waterproof by plastering. Should water appear to be coming through a well-defined crack in the wall, calking with oakum or cotton may be resorted to in order to stop the leakage until a plaster coat of oil-mixed mortar can be applied. It will be necessary to mix the mortar for plastering to a rather dry consistency, and it should be troweled hard in order to obtain a hard, dense waterproof surface. A wash of cement and water mixed to the consistency of thick cream and applied before the oil-mixed mortar coat will aid the new mortar in adhering to the old work. The old wall must be thoroughly wet before the new mortar coat is applied.

Watering Troughs.—The use of oil-mixed concrete in the construction of watering troughs will be found to give excellent results in maintaining them in an absolutely water-tight condition.

For this purpose a mixture of 1 part of Portland cement, 2 parts of clean coarse sand, and 4 parts of gravel, ranging in size from ¼ in. to 1 in. is recommended. The mixture should likewise contain 10 per cent. of oil based on the weight of cement and should be mixed to a jellylike consistency. It will be well to provide wire-mesh or steel-rod reinforcement for the bottom and walls. Care should be taken to puddle the concrete into place thoroughly and to trowel or spade the material adjacent to the molds. This flushes the mortar to the surface, making it smooth and dense, and rendering a finishing coat of plaster unnecessary. Should a very smooth surface be desired, an effective finish may be obtained by applying several paint coats of oil-mixed cement grout made as follows: Enough water should be mixed with cement to form a paste of soft, putty-like consistency. To this paste should be added 3 per cent. of oil, based on the weight of dry cement in the mixture (a 10-quart bucket of dry cement requires about a pint of oil for this purpose), and the whole should be mixed until the oil is entirely combined with the other ingredients. The paste may now be thinned down with more water to the consistency of cream, after which it may be applied with a stiff brush to the previously dampened concrete. A second coat of this oil grout should be applied after the first coat has hardened. care should be taken that it does not dry out too quickly by applying it to the dry concrete or exposing it to the direct rays of the sun. A tank built as described will be absolutely water-tight, and, furthermore, the waterproofing will have cost almost nothing in comparison with the costs of the other materials.

Cisterns.—For waterproofing cisterns, oil mixed concrete will prove of great benefit. It is absolutely necessary that cisterns which are buried in the ground be waterproofed to prevent contaminated ground water from seeping in, as well as to prevent the cistern water from escaping. Buried cisterns of rectangular shape should be reinforced to resist the earth pressure, which tends to bulge the side walls inward when the water runs low. The reinforcement should, therefore, be provided on the inside or tension side of the walls. The earth pressure will prevent the tank from cracking when it is full of water.

For cistern construction a mixture composed of 1 part of cement, 2 parts of sand, and 4 parts of gravel or broken stone, together with 10 per cent. of oil, is effective. The inner faces of the cistern should be painted with an oil-mixed cement grout applied with a stiff brush and rubbed well into the face of the wall. Two coats of this grout, containing about 3 per cent. of oil, should be used.

Barns.—Barns constructed of concrete are gradually coming into use, because of their durability, cleanliness, resistance to fire, and economy. It is essential that the interior of these structures be kept free from moisture, and for this reason it is well to waterproof the concrete mixture entering the side walls and flooring. The side walls, unless waterproofed, have a tendency during a long beating rain to absorb and retain much moisture, and this moisture penetrates to the interior.

If oil in amount to 5 per cent. of the weight of cement be mixed with the concrete used in the side walls, this damp condition of the interior becomes impossible, because the admixture of oil prevents the penetration of the moisture.

Barn floors should be waterproofed by the addition of oil as previously described. A damp-proof floor has the advantage of remaining dry and hence warmer, because there is no evaporation from the surface. It is likewise more sanitary than an ordinary concrete floor because of its non-absorbent character.

Concrete Blocks.—The use of concrete blocks in the building trade is yearly increasing. Much criticism has been heaped on the building block, and in many cases the criticism has been just. It is recognized that many concrete block houses are damp, owing to the fact that the walls are very porous, and absorb and retain much moisture after a heavy, beating rain. A building block generally need not be waterproofed against water pressure, but it should, however, be rendered proof against the permeation of water by absorption. The use of a small quantity of mineral oil in a concrete block renders it extremely non-absorbent, so that even after a hard rain there is no danger from damp walls. In a 1:2:4 mixture, 5 per cent. of oil is a sufficient quantity to waterproof properly against absorption.

Roofs.—Portland cement mortar mixed with mineral oil and reinforced with steel-wire mesh may be advantageously used in the construction of roof slabs. These slabs could be assembled in place on the roof after they had attained sufficient hardness. Reinforced concrete tiles may also be advantageously made with Portland cement concrete mixed with a small percentage of mineral oil residuum.

Stucco.—Portland cement stucco is widely used in the construction of many residences. This type of canstruction is economical, and, moreover, with it many beautiful effects are possible. The term "stucco" is given to the exterior finish coat, which may be applied to brick, stone, concrete, hollow tile, or frame construction. According to the finish desired and the kind of surface to be covered, the stucco is applied in two or three coats. The first, or scratch coat, should be mixed in the proportions of 1 part of Portland cement and 2 parts of clean, coarse sand, with enough water to form a good, stiff mortar. If 5 per cent. of oil is added to this mixture, the scratch coat will be permanently waterproof. While this coat is still wet, it is roughened with a stick or trowel over the entire surface. The second coat, which may be of the same proportions, is plastered on after the first coat has set sufficiently to support it. The use of oil in this coat may be omitted if desired, and it may be given a rough-cast finish by using a trowel covered with burlap or carpet.

This second coat may also be applied by throwing it on with a wooden paddle. This produces a rough surface known as a slap-dash finish. A pebble-dash surface may be obtained from the use of pebbles ¼-in. in diameter, mixed with cement in the proportions of 3:1, with a mixture that is quite wet. This mixture is thrown on the second coat while it is still soft and the result is a very pleasing surface. When a pebble-dash finish is used, the second coat, as well as the scratch coat, may be mixed with oil. In most constructions the second coat will be found superfluous, because a sufficiently thick coating is usually obtained from the first application of oil-mixed mortar.

When stucco is applied to stone or hollow tile, care should always be taken to have the surface well moistened or otherwise a great deal of water will be absorbed from the mortar coat, and so greatly weaken it and cause contraction cracks to form.

Engineering Construction.—There are many important engineering constructions in which oil-mixed mortar or concrete may be advantageously employed. Among them may be mentioned aqueducts, buildings, burial vaults, boats, foundations, gutters, mausoleums, roofs, sewers, trough, tanks, and wells. In some constructions a coat of oil-mixed mortar is effective, while in others oil-mixed concrete may be used throughout.

It is confidently believed that, if carefully prepared, oil-mixed concrete is used in structures of any kind requiring damp-proofing—and in such structures careful work is a very important factor in the result—there will be no difficulty experienced from leakage and the structures will have been damp-proofed at very little extra expense.

Summary of Conclusions.—The following conclusions as to the effect of the oils used in cement and concrete may be drawn from the investigations into the physical properties of oil-mixed concrete:

(1) The tensile strength of 1:3 oil mixed mortar is very little different from that of plain mortar, and shows a substantial gain in strength at 28 days and 6 months over that at 7 days.

(2) The times of initial and final set are delayed by the addition of oil; 5 per cent. of oil increases the time of initial set by 50 per cent. and the time of final set by 47 per cent.

(3) The crushing strength of mortar and concrete is decreased by the addition of oil to the mix. Concrete with 10 per cent. of oil has 75 per cent. of the strength of plain concrete at 28 days. At the age of 1 year the crushing strength of 1:3 mortar suffers but little with the addition of oil in amounts up to 10 per cent.

(4) The toughness or resistance to impact is but slightly affected by the addition of oil in amounts up to about 10 per cent.

(5) The stiffness of oil-mixed concrete appears to be but little different from that of plain concrete.

(6) Results of tests for permanent deformation indicate that no definite law is followed by oil-mixed concrete.

(7) Oil-mixed mortar and concrete containing 10 per cent. of oil have very little absorption and under low pressures both are waterproof.

(8) Oil-mixed mortar containing 10 per cent. of oil is absolutely water-tight under pressures as high as 40 lb. per square inch. Tests indicate that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete.

(9) The bond tests show the inadvisability of using plain bar reinforcement with oil-concrete mixtures. The bond of deformed bars is not seriously weakened by the addition of oil in amounts up to 10 per cent.

◆

EUROPEAN DEMAND FOR COPPER.

For the past few days Europe has been buying copper metal, and one of the large selling agencies in New York has sold 10,000,000 pounds at 17¾ cents per pound.

A NEW WATER PURIFICATION PLANT.

The city of Fargo, North Dakota, has recently installed a new water purification plant, the water supply being drawn from the Red River.

Originally water was used from the Red River for all purposes. It was hauled about the city and sold as a commodity. At a later date, about 1879, a pumping station was installed and water supplied through mains laid under a franchise by a water company. This source of supply and method of distribution was satisfactory until the water shed became settled and the river became contaminated by the run off from farms and possibly from sewage from the growing cities situated on the river above this city.

There were other objectionable features of the water for a domestic supply and in the early 90's a number of artesian wells were put down in the western part of the city. These wells produced a supply of good water but it was exceedingly hard, and considerable discussion was carried on from time to time as to the desirability of using a water carrying a large amount of mineral solids in solution.

The difficulty of obtaining a satisfactory supply of water led to many investigations as to ways and means of bettering it. At length the city engineer, Mr. Frank L. Anders, was directed to prepare plans and specifications for a rapid sand filtration plant. A brief description of the plant adopted, based on matter contained in Mr. Anders' latest report, is here given.

The river intake is substantially constructed of cedar piling faced with fir sheet piling to prevent any movement of finely divided silt into the wet well. The outer end of the intake is constructed so that water will be taken from as near the surface as seems desirable. It is also fitted with a screen made of flat boiler plates, which will prevent any leaves or sticks from entering the intake. The intake is connected to a wet well by two 18-inch cast iron pipe lines. The well is constructed of concrete, and in two sections. Either section may be cut out of service for cleaning for one of the purposes of the well is to catch mud before it enters the suction line. The well is fitted with the necessary valves for changing the course of the water from one chamber to the other.

From the wet well to the low lift pumps the distance is about 800 ft. and connection is made between the two by an 18-in. suction line. This line is cast iron flanged pipe and at the upper end is connected to two low lift pumps. These pumps comprise that part of the plant that lifts the water from the river and delivers it to the purification plant. The pumps are the centrifugal vortex type, built by Lawrence manufacturing Co., and are driven by Sturtevant turbines directly connected to them. The combined capacity of the two pumps is [illegible] gals. per 24 hours. The low lift [illegible]. Ample [illegible] for the installation of another [illegible] if necessary.

Upon leaving the low lift pumps the water is conducted through a [illegible] discharge line connected to the mixing chamber. [illegible] The mixing chamber is [illegible] of reinforced concrete and is [illegible] wide, [illegible] long and [illegible] deep. It is fitted with vertical baffles that cause the water to flow up and down through them, traversing a distance of [illegible] and [illegible] so that the chemical reactions may be completed. This chamber is one of the most important [illegible] in the plant and one that will have the greatest bearing on the [illegible] of the purified water.

Upon leaving the mixing chamber, the water passes into sedimentation basin No. 1. As it enters this basin a coagulant may be added which also has a very important function to perform. The coagulant, which may be either sulphite of iron or sulphite of aluminum, decomposes and forms a hydrate, also known as floc. This is a light snow-flakelike material, which makes its appearance soon after the addition of the coagulant to the water. The cross section of the basins are such as will give a very low velocity to the water, and this is necessary in order that the floc may settle and leave the water clear. The proper design of these basins is an important part of the work, for the greater part of water purification is done in them. As the floc forms and settles, it enmeshes and carries with it most of the turbidity and a great part of the bacteria, thus relieving the filters of a heavy load they would otherwise have to carry.

There are two sedimentation basins, each with a capacity of about 1,000,000 gals. In case the chemical reactions and subsequent settlement is completed in basin No. 1, the water may be conveyed to basin No. 2 and thence to the filter. Or, if the reactions are completed in No. 1, the water can be conveyed from it directly to the filters. The mixing chamber can be cut out entirely and the basins used with it or the two basins used in parallel. In order to prevent after deposits from the lime action, raw water can be added as the treated water passes from the basins. This is sometimes necessary and is the most effectual device known for this purpose.

A conduit constructed of concrete conveys the water from the sedimentation basins to the filter house and thence along the centre lines of the pipe gallery in front of the filters. Connecting the conduits to the filters there are inlet chambers fitted with proper valves to conduct the flow of water into the proper chambers.

The filters are four in number, completely installed, and two more can be completed at a small additional cost. They are constructed of reinforced concrete throughout, and are 17 ft. by 21 ft. in area. Each will have a capacity of 1,000,000 gals. per day, exclusive of wash water.

The filters are furnished with a cast iron manifold system set in concrete. On top of the manifold there is laid 10 ins. of a carefully graded filter gravel and 30 ins. of a carefully prepared silica sand. Wash water boxes, two in number, run longitudinally with the filters.

The treated water passes on to the sand from the inlet chamber, thence through the sand, gravel, manifolds, drains and controllers to the clear well, where the purified water is stored until required for use. The clear well is underneath the filters, protected from all contamination and fitted with baffle walls to keep the water in circulation.

The filters need cleaning at certain periods, and this will be accomplished by reversing the flow of water through the sand and conveying the dirty water through a sewer to the river below the dam. The sand is agitated during washing by air conveyed to it by a suitable pipe system.

The most important parts of the plant installation are the filter controllers. Careful consideration was given to all the types of controllers now in use and it was decided to use the [illegible] filter controller. The advantages of this piece of apparatus are many, and it has no equal for the duty it is called upon to perform. Its action is such as to keep the clear well full of water at all times and it will meet the varying rates of consumption without the attention of the operator.

The head house is located directly west of the filter house, and is a two-story structure of brick and concrete. In the basement there are located the wash water and air pumps, bathroom, machine shop, etc. The laboratory, superintendent's office, chemical controllers and part of the solution tanks are on the first floor, while the second floor is devoted to storage of chemicals and their preparation for addition to the raw water.

No function of a water purification plant is more important than that of properly adding the chemical solution to the raw water. The rate of consumption of water in the city of Fargo varies from about 500,000 gals. to probably about 4,000,000 gals. per 24 hours. The raw water has to be treated to meet this varying rate, and the usual method is to pass the chemical solution through an orifice having a known discharge. This orifice needs the attention of the operator in order to meet the varying rate of raw water discharge. It is at once apparent that the operator cannot do this, however faithful he may be, for he does not, at all times, know what conditions he has to meet. The whole problem is satisfactorily solved by the installation of the Earl chemical feed controller. This device automatically meets, at every instant, the varying rate at which the raw water may be passing into the mixing chamber and the proper chemical is at all times fed to the raw water at a rate proportionate to the consumption. By the use of this device over-dosing and its ill effects are eliminated, as is also under treatment of the water. The operator can rest assured that the water is at all times being properly treated.

The plant is constructed throughout of reinforced concrete, except the buildings, which are faced with Twin City terra cotta tile and lined with common brick. The roofs are trussed with steel, sheathed with fir and finished with green glazed tile.

NATIONAL STEEL CAR COMPANY.

The National Steel Car Company has been incorporated for the purpose of building and operating a plant for the manufacture of wood and steel freight cars. The location of the plant will be at Hamilton, Ont., and the head office at Montreal. The authorized capital is three million dollars seven per cent. cumulative preference stock, and three million dollars common stock, of which $1,500,000 par value preference and $2,000,000 par value common will be issued. The amount issued is considered adequate for the building, equipping and operating of a thirty-car plant, while sufficient stock is retained for future growth. The principal Canadian railroads experience considerable difficulty in placing orders with existing firms for a quick delivery, and this the National Steel Car Company begins business with an existing demand for its products. The estimated average earnings working at sixty per cent. of its capacity is given as $400,000, which is sufficient to pay the 7 per cent. dividend on the preferred stock, and leaving $295,000 available for common stock dividend.

The management of the company will be in the hands of Mr. Basil Magor, president of the Magor Car Company, Passaic, N.J., who is resigning that position which he made a success, believing in the possibilities offered in Canada. Mr. A. Butze, for many years purchasing agent of the Grand Trunk Railway, will act as the company' purchasing agent.

The cost of construction of the plant has been estimated by Messrs. Barclay, Parsons and Klapp, consulting engineers, as $649,730. The house of issue is Messrs. Brouse, Mitchell, members Toronto Stock Exchange, Colborne Street, Toronto. Sir John Gibson, Sir Henry Pellatt, C.V.O., Toronto; Messrs. W. K. Price, New York; C. H. Cahan, Montreal; M. H. Coggeshall, New York; M. Davis, Montreal; Basal Magor, Montreal; W. Barclay Parsons, New York; W. G. Ross, Esq., Montreal; J. J. Scott, and W. Southam, Hamilton, have consented to act as directors.

TO USE LOCAL WOODS IN BRITISH COLUMBIA

An idea with regard to wood creosoting was laid before the forestry branch, province of British Columbia, by Mr. Skinner, who has charge of the construction of the C.P.R. docks in Vancouver.

These docks are being built of eucalyptus wood brought from Australia. This wood is preferred because its gummy quality enables it to resist the teredo longer than will any of the native woods of British Columbia. The Douglas fir, however, if properly creosoted, will last longer than the eucalyptus. Moreover the Crow's Nest coal, it is said again, on Mr. Skinner's authority, is the best in America for creosoting purposes. These two factors combined seem to him to offer opportunity for a new industry. The idea is especially interesting to the forestry branch because if creosoted blocks can be introduced as paving material, there will be a chance to utilize much of that part of the tree which is now left in the bush and wasted.

MUNICIPAL POWER PLANT FOR GRAND MERE, QUE.

The corporation of Grand Mere, Quebec, has awarded to Allis-Chalmers-Bullock, Limited, Montreal, the contract for the complete hydro-electric power plant for municipal lighting and power purposes. The plant will include a single horizontal turbine 500 h.p. 600 r.p.m. under 100 feet head and an alternating current generator 300 k.v.a.; 3-phase, 60-cycle, 2,200-volt, 600 r.p.m. with direct connected exciter 125-volt, 600 r.p.m. The turbine will be in cast iron spiral case with quarter turn and single discharge. The runner will be of bronze cast in one piece, the guide vanes of steel and the inside parts bronze lined. The unit will be compact, easily operated and thoroughly up-to-date and will have an over-all efficiency of 80 per cent. The contract also includes an oil pressure governor, step-up transformers from 2,200 to 11,000 volts, step-down transformers from 10,000 to 2,200 volts. Service transformers 2,200 to 110 volts. Switchboards and other auxiliary apparatus. Messrs. Surveyer and Frigon were the consulting engineers.

PERSONAL.

MR. R. B. LAMB has resigned his position as consulting engineer with the Crown Chartered Mine.

MR. RALPH STOKES has been appointed as assistant to Consulting Engineer Mein, of the Canadian Mining and Exploration Company.

MR. L. S. COCKBURN, a graduate of the University of Toronto in engineering, and MR. E. L. WENGER, B.Sc., have become partners under the firm name of Wenger & Cockburn, consulting engineers, with headquarters in Regina, Sask.

MR. R. D. BROWN, city engineer of St. Catharines, Ont., has resigned from his position in order that he may be free to accept a position offered him in the services of the government, under Mr. Weller, superintendent of the new Welland Canal.

MR. E. S. JENISON, formerly with the Henion & Hubbell Company, of Chicago, Ill., has been appointed manager of the pulp department of the Canadian Fairbanks-Morse Co., Limited, who are now the exclusive sales agents in Canada for the triplex and power pumps, as well as the other lines manufactured by the Goulds Manufacturing Co., of Seneca Falls, N.Y.

MR. A. H. BERGER, until recently the secretary-treasurer of the American Spiral Pipe Works, has organized the Standard Spiral Pipe Works of Chicago. The latter company will manufacture reinforced spiral steel pipe with interlocking seam and smooth inside, for water supply, irrigation, derdging, pulp mills, etc. Mr. Berger made a trip West recently and demonstrated the merits of his pipe to a number of prominent engineers in British Columbia.

MR. C. M. WATERMAN, treasurer of The Eugene Dietzgen Company, manufacturers of drawing materials and mathematical and surveying instruments, left Toronto last week for a six weeks' tour of Western Canada, in the interests of his firm. The Canadian business of The Eugene Dietzgen Company has been growing very rapidly within the past year and, while West, Mr. Waterman will undoubtedly find many further opportunities for expansion.

COMING MEETINGS.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, TORONTO SECTION.—First regular meeting will be held at the Engineers' Club, 96 King St. West, on Friday evening, October 4th, 1912, at 8 p.m. Secretary, W. E. Young, [illegible] King St. West, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE CANADIAN HIGHWAY ASSOCIATION.—Meeting will be held in Winnipeg, Man., October 9th to 12th. Secretary, P. W. Luce, Room 4, Cunningham Block, New Westminster, B.C.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE. Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the [illegible]

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill [illegible]

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-[illegible] October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Hamilton, [illegible] Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible] Indian Head, Sask.; Sec.-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; [illegible]

THE UNION OF CANADIAN MUNICIPALITIES.—President, [illegible] Hon. Secretary-Treasurer, W. D. Lighthall, K.C., ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, [illegible] Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Sec.-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Sec'y-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr, G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263 Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box [illegible], Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Brockville, Ont., wharf	Oct. 2.	Sept. 12.	67
Cobourg, Ont., breakwater extension	Oct. 16.	Sept. 26.	67
Franklyn Point, P.E.I., wharf	Oct. 8.	Sept. 12.	67
Fairhaven, N.B., pierhead to public wharf	Oct. 8.	Sept. 19.	71
Goderich, Ont., breakwater	Oct. 10.	Sept. 19.	71
Lanorail, P.Q., extension wharf	Oct. 10.	Sept. 19.	71
Massett, B.C., pile wharf	Oct. 15.	Sept. 19.	71
New Westminster, B.C., ladder dredge	Oct. 8.	Sept. 19.	80
Niagara Falls, Ont., centrifugal pump	Oct. 1.	Sept. 19.	80
Northern Ont., right to cut pine	Oct. 1.	July 25.	68
North Toronto, Ont., Avenue Road subway	Oct. 5.	Sept. 26.	76
Ottawa, Ont., designs for monument	Nov. 1	Aug. 1	67
Ottawa, Ont., bridge	Oct. 9.	Sept. 26.	67
Quebec, P.Q., grain elevator	Oct. 21.	Sept. 19.	80
Seaforth, N.S., breakwater	Oct. 7.	Sept. 19.	72
St. Pierre les Becquets, P.Q., wharf, approach and dredging of berth for headlock	Oct. 15.	Sept. 19.	72
Toronto, Ont., pavements	Oct. 1.	Sept. 19.	72
Toronto, Ont., shelter, Ketchum Park	Oct. 8.	Sept. 26.	67
Toronto, Ont., work on windows, etc., City Hall	Oct. 8.	Sept. 26.	67
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78
Vancouver, B.C., installation of light standards	Oct. 17.	Sept. 26.	68
Vancouver, B.C., department store	Oct. 24.	Sept. 26.	68
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., school desks	Oct. 3.	Sept. 19.	72
Willow Point, B.C., wharf	Oct 11.	Sept. 19.	72

◆

TENDERS.

Brantford, Ont.—Tenders for extensions to the Brantford General Hospital, including new ward building, service building, boiler house and laundry, will be received until noon of October 7th, 1912, by C. H. Waterous, president, B.G.H., in care of Messrs. Taylor & Taylor, architects. Plans, etc., at the office of the architects, Brantford.

Edmonton, Alta.—Tenders for plastering of Government House, Edmonton, will be received until October 7, 1912, by John Stocks, Deputy Minister of Public Works, Edmonton. Full particulars at the office of the provincial architect, New Parliament Buildings, Edmonton.

Hanover, Ont.—Tenders for the laying of about 16,000 sq. ft. of cement concrete sidewalks in the town of Hanover, will be received by John Taylor, clerk, town of Hanover, until October 7th, 1912. Full particulars at the town clerk's office.

Port Colborne, Ont.—Tenders sent to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until October 22nd, 1912, for the repair of the headblock of the east breakwater at Port Colborne, county of Welland, Ont. Plans, etc., at the office of the secretary, and office of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto, Ont., and on application to the postmaster, at Port Colborne.

Regina, Sask.—Tenders for the construction of drain in townships 31 and 32, to be received by H. S. Carpenter, acting Deputy Minister, Department of Public Works, Government of the Province of Saskatchewan, until October 8th, 1912, at whose office plans and specifications may be had.

Scott, Sask.—Tenders for the supply of 1,000 feet of fire hose with couplings and nozzles complete, will be received by James N. Forrest, secretary-treasurer, Scott, until October 7th, 1912.

Toronto, Ont.—Tenders for the construction of storm overflow sewer, Main Garrison Creek Division, Section No. 3, will be received until October 22, 1912, addressed to the Chairman of the Board of Control, City Hall, Toronto. Specifications, etc., at the office of the Commissioner of Works, Toronto. G. R. Geary (Mayor), Chairman, Board of Control. (See advt. in The Canadian Engineer).

Vancouver, B.C.—Tenders for grading and bridging of the Comox extension of the Esquimalt & Nanaimo Railway, from Big Qualicum River, mile 15½, to Union Bay, mile 34.79, will be received by H. J. Cambie, chief engineer, Vancouver, up to October 10th, 1912. Plans, etc., can be inspected at the office of R. A. Bainbridge, division engineer, of the E. & N. Railway, Store Street, Victoria.

Victoria, B.C.—Tenders to be received until October 4th, 1912, for a four-story reinforced concrete Odd Fellows' temple on View Street, Victoria. Plans and specifications may be had at the office of D. C. Frame, 1011 Government Street. Wm. Jackson (Chemist), secretary, Douglas Street.

Victoria, B.C.—Tenders for supplying 50,000 railway track ties, and distributing same on the grade of the Comox extension of the Esquimalt & Nanaimo Railway from McBride Junction to Big Qualicum River, will be received by H. E. Beasley, general superintendent, Victoria, until October 10th. Specifications can be secured on application to the superintendent, or from any station agent on the E. & N. Railway.

Whitby, Ont.—Tenders will be received until October 22nd, 1912, for the construction of a stone and concrete esplanade wall at Whitby harbor, township of Whitby, county of Ontario, Ont., at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, specifications and form of contract can be seen and forms of tender obtained at this department and at the offices of J. G. Sing, Esq., district engineer, Confederation Life Building, Toronto, Ont.; H. J. Lamb, Esq., district engineer, Windsor, Ont., and on application to the postmaster at Whitby, Ont.

Winnipeg, Man.—Tenders for supply of labor and materials required in the erection of a frame building covered with corrugated iron sheeting to be used as a power sub-station at Transcona, Man., will be received until October 9th, at the office of M. Peterson, secretary, Board of Control office, Winnipeg. Plans, etc., at the office of the City Light and Power Department, 54 King Street.

Winnipeg, Man.—Tenders addressed to the chairman, Board of Control, will be received until October 9, 1912, for the manufacture and delivery f.o.b., Winnipeg, of 100,000 feet of No. 6 B. and S. twin conductor arc lighting cables, lead covered and armored in accordance with specifications, which may be obtained at the office of the City Light and Power Department, 54 King Street. M. Peterson, secretary, Board of Control office, Winnipeg.

Yorkton, Sask.—Tenders will be received by T. F. Acheson, secretary-treasurer, until noon of October 31st, 1912, for one 500 B.H. Diesel engine, direct coupled to alternator and exciter, and one switchboard with auxiliary panel and series tungsten street lighting apparatus. Specifications to be obtained on application to the office of M. M. Inglis, electrical engineer, Yorkton, Sask. (Advt. in The Canadian Engineer).

◆

CONTRACTS AWARDED.

Berlin, Ont.—Mr. W. Lytall has been awarded the contract to extend the lighting system from Ellen Street at a cost of $1,494.00. He is at present working on the system below this point.

Province of British Columbia.—The contract for the construction of about forty-two miles of railway between Coalmont and Coquahalla Summit was let by the V. V. & E. Railway Company, which is one of the titles of the Great Northern in British Columbia, to Guthrie, McDougall & Company. The work will cost about $1,500,000.00.

Edmonds, B.C.—The contract was awarded by the council for the laying of the pipes for the second unit of the water system of the municipality, the successful tenderers being Messrs. T. R. Nickson and Co., the amount being $40,492. Nine tenders were presented to the committee, the lowest being $38,595 and highest $48,657.

Edmonton, Alta.—The management of the Edmonton Leather and Shoe Company awarded a contract for the erection of their plant to Messrs. Congdon and Oliver. This work will cost about $25,000.00.

Montreal, Que.—The Chicoutimi Pulp Company have entered into a contract to supply the Edward Lloyds Co., of London, with 50,000 tons of pulp annually for a term of ten years.

Ottawa, Ont.—The government have decided to enlarge the government-operated elevator at Port Colborne from a capacity of 1,000,000 to 2,000,000 bushels, the contract for which has been awarded to the Dominion Bridge Company. Cost will be $201,000.

Ottawa, Ont.—A contract for a retaining wall in the harbor of Owen Sound was let, the price being $18,900.

Mr. James Bogue, of Peterboro, has been awarded the contract for the construction of a retaining wall for the Rideau Canal at Smith's Falls. The work will cost $8,190.

A suitable site has been purchased for the new public building to be erected in Fort Francis, Ont.

Council has approved of the contract for the erection of new mounted police barracks at Banff, to cost $13,865.

Port Alberni, B.C.—The contract for the construction of the Port Alberni waterworks system has been awarded to the Municipal Construction Company, Limited, of Vancouver, and work is to be commenced immediately. The estimated cost of the work is $[illegible].

Other tenders received were as follows: M. P. Cotton Company, Limited, without specials, $89,693; complete with specials, $94,559. John D. Campbell, without specials, $90,060; comulete with specials, $95,979. T. R. Nickson & Company, Limited, without specials, $98,301. Broley & Martin, without specials, $98,672. Naylor Bros., without specials, $104,398. McGillivray & Edwards, without specials, $116,336. Canadian Pipe Company, Limited, without specials, $[illegible].

Toronto, Ont.—The Department of Public Works have awarded Messrs. Gearing Brothers the contracts for masonry and carpenter work for the new Veterinary College on University Avenue. [illegible] work has been completed and [illegible] at once. [illegible] plumbing and [illegible] for some time. Cost of college [illegible].

Vancouver, B.C.—Mr. J. J. [illegible] has received the contract to erect an apartment house for Mr. L. C. Marshal at a cost of $[illegible]. [illegible] are the architects.

Victoria, B.C.—The contract for the erection of the [illegible] will be let to Mr. Edward [illegible] whose tender of $[illegible] was the lowest of several submitted.

Winnipeg, Man.—The Mitchell-[illegible] Electric Company [illegible] the contract for the supply of material and installation required for the lighting system of the Arlington Street bridge. The cost of the work is $4,175.

Winnipeg, Man.—Elevator equipment and finishing hardware required for the King George Isolation Hospital at a total cost of $10,075, will be supplied by the Otis-Fensom Elevator Co., Limited, and the Winnipeg Paint and Glass Co., Limited, respectively.

◆

LIGHT, HEAT AND POWER.

Berlin, Ont.—The following is a statement of the financial results of the operation of the municipal gas and electric light plants for the month of August last:

Gas—	
5,724,000 cubic feet @	$3,724.00
126 tons of coke @	630.00
2,240 gallons tar @	33.60
Total	$4,387.60
Operating expenses	$2,809.33
Surplus	$1,578.27
Electricity—	
Incandescent lights	$2,317.16
Power	2,173.71
Arc lights	1,072.49
Total	$5,563.36
Operating expenses	$3,139.33
Surplus	$2,424.03

Brantford, Ont.—The municipal council has prepared a by-law calling for a bond issue of $115,000.00 for the installation of a hydro-electric plant in this city. The ratepayers will vote on this on October 25th next.

Windsor, Ont.—The Edison Illuminating Company, of Detroit, have commenced construction work on a plant to supply Essex, Leamington and Amherstburg. These towns are at present supplied by small local plants, but the United States company plan to undersell them and also in time to enter Windsor and compete against Windsor, Sandwich and Amherstburg Street Railway Company.

Peterboro, Ont.—A by-law calling for the installation of hydro-electric power into this municipality will be submitted to the ratepayers at an early date. The estimates for this work are placed at $88,000.00.

Regina, Sask.—The municipal commissioners have practically decided to introduce the standard pillar arc light to the business section of the city.

Regina, Sask.—The municipal electric light plant of this city is on a paying basis. The estimated surplus for 1912 was $48,900. Up to the present the net earnings have been $46,800, and if this rate is kept up will reach $70,000 for the twelve months.

St. Thomas, Ont.—The municipal council have adopted a report prepared by Messrs. Ruth and Sumner regarding the heating system of the city hall and will spend about $6,000.00 on improvements to the present equipment. The work includes the installation of automatic stokers and asbestos covering and a considerable amount of two-inch pipe.

Wichester, Ont.—The by-law in favor of the hydro-electric power carried in the village, [illegible] voting for, and 14 against.

◆

GARBAGE, SEWAGE AND WATER.

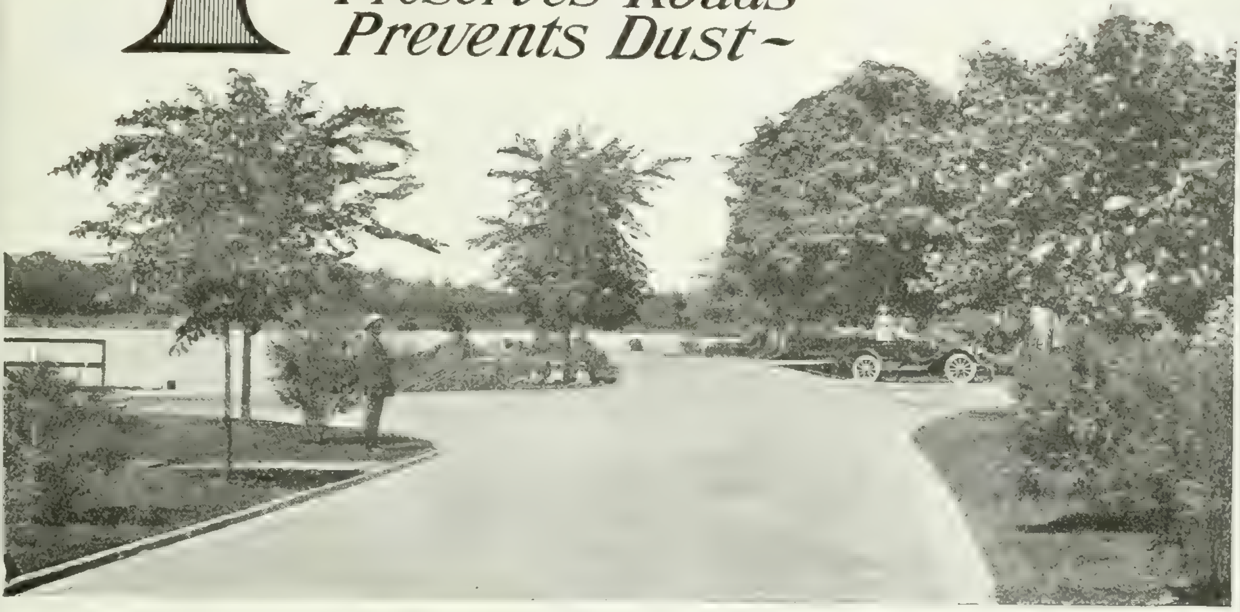
Kingston, Ont.—The Roberts Filter manufacturers of Philadelphia have made an offer to the civic utilities committee to erect and operate a filtration plant to care for the city's water supply for 8 years. The proposition will be considered.

Leaside Junction, Ont.—A report states that the Canadian Northern Railway engineers engaged on the construction of the model city are considering the installation of a private waterworks system.

Montreal, Que.—Owing to several complaints from citizens regarding the erection of a sewage pumping station on

Tarvia

Preserves Roads
Prevents Dust



Section of Government Parkway, Ottawa, Canada, treated with Tarvia B.

The Property Owners' Investigation.

IN the City of St. Thomas, Ont., the property owners on Gladstone Avenue contemplated petitioning the City Council to improve the roadways. They commissioned one of their number to visit various American cities, inspect pavements and make a report. Their investigator, Mr. E. A. Horton, visited various cities in New York and New Jersey. In his report he made the following statements:

> "I saw a 'Tarvia X' road in Rochester which extends from the city to the lake front, a distance of about six miles. It had been in use for eighteen months, and when I saw it, it was in excellent condition, with heavy traffic over it every day. I........inspected a piece of road in Newark........the surface when finished was smooth, and to my mind was one of the finest pieces of road it was my privilege to see. We then inspected another piece of 'Tarvia X' which had been done by the Road Commission two years ago........Constant heavy traffic passes over this road every day, and trucks have loads of from 6 to 8 tons Steel-tired drays were used with most of their heavy traffic. This piece of road, as I saw it, did not show any wear whatever, and was apparently in as good condition as when it was put down.
>
> "I did not confine my attention to Tarvia roads as I saw (here he mentioned five of the commonest types of road treatment) and every other kind of road that is known.
>
> "I must say after making enquiries from people who were in no way interested, nor did they know I was seeking information, that everyone had a good word to say for the Tarvia road. I have no hesitation in recommending it for use on our street, and at the estimate cost that has been given us, after seeing the many pieces of road that I have seen, I think it is the cheapest road that can be built."

The foregoing is quoted from the St. Thomas, Ont., Journal on February 20th, 1912. Since that date Gladstone Avenue has been constructed with Tarvia X.

Anyone who will investigate the road problem with the same thoroughness will reach similar conclusions. Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B" (applied cold) for dust prevention and road preservation.

Booklet describing the latest developments in methods for building tarviated roadways and pavements will be sent free on request. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST JOHN, N.B. HALIFAX, N.S.

Place Royal the municipal council have given an order for a new site to be selected. This is a small park and the only green spot for many blocks.

Montreal, P.Q.—The municipal council have ordered the opens of the trunk sewer enlarged in order that snow taken off the streets may be dumped in and disposed of. If the scheme should work with satisfaction there will be a saving of $150,000 per year in the cost of removing snow.

North Toronto, Ont.—The council will endeavor to secure permission from the government authorities to issue $85,000.00 in debentures for a sewage system without referring the matter to the ratepayers.

Winnipeg, Man.—The Board of Control have appropriated the sum of $15,000 to defray the expense of a survey and cost of the estimate of the Shoal Lake water scheme recently reported upon. Col. Ruttan will be in charge of this work.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Province of British Columbia.—Colonel A. D. Davidson, president of the Canadian Western Lumber Company, states that a cedar mill having a capacity of 125,000 feet daily, will be erected near the Fraser Mills of the company. It will cost $350,000, and will be completed in time for the spring trade.

Edmonton, Alta.—The specifications of the Grand Trunk Pacific Hotel call for 12,000 barrels of cement, 6,000 yards of sand, 10,000 yards of gravel and 1,500,000 bricks. The contracts for mill work, plumbing, heating and ventilation, roofing, sheet metal work, and iron work, will be awarded in the near future. Mr. E. Wilman, of the Canadian Stewart Company, Montreal, will receive the tenders.

Fort William, Ont.—Another storage elevator is announced for Fort William, also a seventy-five thousand dollar warehouse.

Moose Jaw, Sask.—The municipal council have sold a site on which a number of Winnipeg business men will erect a 200,000-bushel grain hopper and a 1,000,000-bushel elevator. The company will take the name of the Great West Grain Company.

Stratford, Ont.—The plant of the Canada Iron Corporation is to be enlarged in order that the manufacture of car wheels may be increased from 150 per day to 225. The addition will be of reinforced concrete 75 x 75.

Toronto, Ont.—A report states that the directors of St. Andrew's College will erect a new educational building at York Mills, Ont., and will dispose of their present holdings in Rosedale for residential purposes.

Toronto, Ont.—The management of the Christie-Brown Company, biscuit manufacturers, will erect a large addition to their present plant.

Toronto, Ont.—According to a report the new post office will be erected on the corner of Spadina Avenue and College Street. The building operations are to be commenced next spring.

Toronto, Ont.—The plans for the new military barracks [illegible]

Vancouver, B.C.—A report states that Mr. L. C. Gilman, [illegible]

Victoria, B.C.—Mr. Wm. Jackson, secretary of the building [illegible] ber 4th.

Welland, Ont.—[illegible]

Windsor, Ont.—[illegible]

BRIDGES, ROADS AND PAVEMENTS.

Edmonton, Alta.—Ratepayers have presented a large petition calling for the paving of Alberta Ave. from First Street to the railway tracks.

Leaside Junction, Ont.—A large gang of roadmakers has started work on the Canadian Northern Railway model city site.

Peterboro, Ont.—The council have asked the ratepayers to endorse a debenture issue to the amount of $70,000.00 for the erection of a new traffic bridge across the Otonabee River. The by-law will be submitted in January next.

Winnipeg, Man.—The engineering department of this municipality will expend the sum of $8,800 on plank sidewalks and $10,500 on granolithic walks.

◆

FIRES.

Almonte, Ont.—The shoddy mill of Mr. R. W. Lees was destroyed by fire with a loss of $25,000.

Galt, Ont.—The plant of the Galt robe factory was totally destroyed by fire with a loss of $150,000. Mr. Stauffer is the manager of this company but is at present in Vancouver.

Gananoque, Ont.—Fire in the plant of the St. Lawrence Steel and Wire Company caused sufficient damage to the plant to cause a suspension of manufacturing for a few weeks.

Halifax, N.S.—The premises known as the George C. Cook warehouse was destroyed by fire with a loss of $60,000. The chief occupants were offices and groceries. George C. Cook is the owner.

◆

CURRENT NEWS.

Province of British Columbia.—A company is under formation for the purpose of working the kelp on the Pacific Coast. This is a seaweed and exists in abundance along the coast of semi-tropical countries and is gathered in great quanties by coastal dwellers in Europe. It is often a profitable source of potasium salts and iodine.

Province of Manitoba.—Over $10,000 of an increase in net revenue in August over the preceding month is shown by the first monthly report of condensed earnings of the Manitoba Government telephones.

Montreal, Que.—It is understood that three new pulp mills will be started in Canada next year, one in Ontario and two others on the St. Lawrence.

Montreal, P.Q.—The Chicoutimi Pulp Co. have just entered into a pulp contract. This concern has agreed to supply Edward Lloyds Co., London, with 50,000 tons of pulp annually for a term of ten years.

Moose Jaw, Sask.—The city engineer, Mr. J. Antonisen, has prepared a report on the municipal engineering work conducted in this city during the past few months. It is shown that a tremendous amount of sidewalk and pavement work has been accomplished. The excavation for the high-pressure dam has been started and 725 building permits were issued with a combined representative value of $1,48[illegible]

Northern Canada.—Engineers and surveyors in the employ of the Alberta, Peace River and Eastern Railway Company, which proposes to build a new transcontinental line from Hudson's Bay to the Pacific Coast by way of Edmonton, have started on ponies on a trip of more than 2,000 miles into the north country to survey the route. They will meet the [illegible] party at Lesser Slave Lake and tramp [illegible] miles, finishing the trip on dog trains and return in twelve months. The party is in charge of M. Edwards.

Ottawa, Ont.—The tenders for the construction of ships to operate between Canada and the West Indies have proved a disappointment to the department of trade and commerce. Only one tender was received.

Regina, Sask.—Bricklayers in this municipality have caused considerable inconvenience to local contractors by de-

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

'CARLTON' SPRINKLERS AT LINCOLN (ENGLAND)

The City Engineer, R. A. MacBrair, Esq., writes

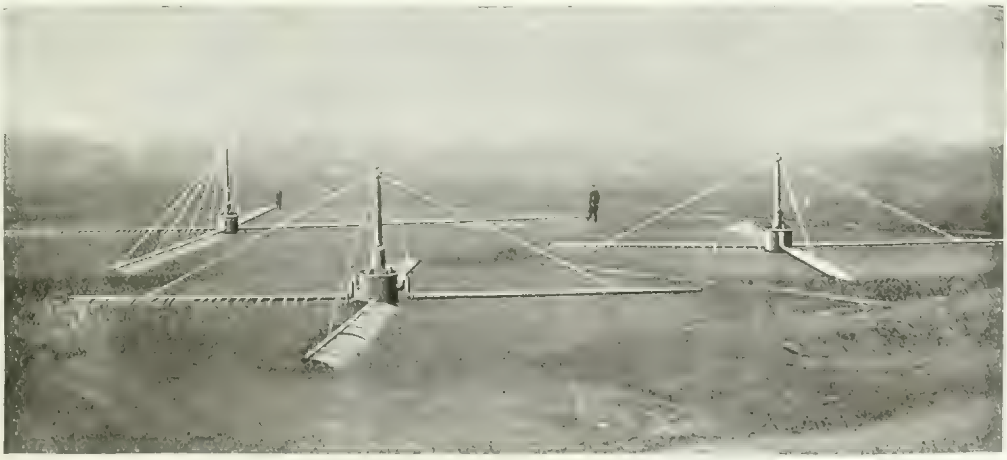
April 18th, 1910

DEAR SIRS,

I have to inform you that the three sprinklers, one 107 ft. 6 in. and two 45 ft., which you supplied us with and fixed in November last, are working well and giving me satisfaction.

Yours sincerely (Signed) R. A. MACBRAIR.

A Detailed Specification giving thicknesses of metal, is sent out with every estimate.



Every machine is guaranteed to be of the best workmanship and material.

TUKE AND BELL, LTD., 69 LEADENHALL STREET, LONDON, E.C.
AGENTS FOR CANADA:
LAURIE AND LAMB, 211 BOARD OF TRADE BUILDINGS, MONTREAL

claring a strike for higher wages. They were receiving 67½ cents per hour and struck for 70 cents.

Toronto, Ont.—Estimates for the widening of Teraulay Street call for an expenditure of $600,000.00.

Winnipeg, Man.—The government of Manitoba have awarded a prize of $10,000 to Mr. F. W. Simson, of Liverpool, England, for his plans of the proposed new government buildings. Mr. Simson has been spending a holiday in Banff but will confer with the government committee in a few days.

TRADE INQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the high commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending September 16th, 1912:

A South Wales firm of coal exporters are desirous of communicating with actual buyers in Canada.

A correspondent in Ireland is in the market for large supplies of cardboard sections, such as are used in packing eggs, and would like to hear from Canadian manufacturers.

A South of England firm of motor, electrical and general engineers desire to get into touch with buyers of petrol, gas and oil engines.

An Anglo-Canadian company recently formed to supply British-made engineering appliances to the Canadian market, desire to get into communication with purchasers and users of machinery in the Dominion.

A firm in Portugal wish to hear from Canadian importers of bottle corks.

From the branch for city trade inquiries, 73 Basinghall Street, E.C.:

A company operating a number of well-known building stone and granite quarries, chiefly in the West of England, would like to do business in Canada.

A firm in East Anglia wish to get into touch with Canadian firms who can contract for regular supplies of prime Quebec birch squares or scantlings, to specification. They also desire quotations for beech and maple square.

CANADIAN PATENTS.

The following is a list of Canadian patents secured through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto:

Canada: F. H. Headley, bassinette or perambulator; F. H. Headley, spring mountings for vehicles; J. S. Campbell, production of artificial leather and rubber from seaweed; F. J. Pike and H. Neville, apparatus for operating bulkheads; W. F. Gunson and W. Park, tellurian; D. W. Rees and W. G. Moreton, drawgear of railway vehicles; S. C. Caddy, skipping appliances and physical exercising devices; [illegible] Recklinghausen, apparatus for sterilizing liquids (ultra-violet rays); Gatland Gilberd, oil lamp stoves; Henry Atkinson, chain feed mechanism.

GREAT PLANS FOR PACIFIC COAST

News comes from Ottawa that the Department of Marine [illegible] development on the Pacific Coast. In this connection it is announced that False Creek is to be dredged from the mouth to Main Street, that is the whole length of the creek [illegible] South Vancouver [illegible] Burrard will be cleared for navigation purposes. [illegible] department [illegible] West [illegible] development has [illegible] Vancouver has [illegible] False Creek [illegible] Captain [illegible] when he entered the Creek. And as the tide had turned and [illegible] that the outgoing current betokened a large river which might indicate the existence of the northwest passage which was much sought for about that time. He named it False Creek, but if the dredging is carried out as proposed it will have to be called Vancouver's Second Harbor. With industries and warehouses on either side of it, this harbor will be as busy as Burrard Inlet, with its larger interests.

Ten years ago, when the city began to develop, interest in False Creek was renewed. Mr. Roy, engineer from the department of works, made a complete survey, and it was thought at that time that the department had realized Vancouver's future needs and was about to make a channel in False Creek for low tide. Mr. Roy has been forgotten, and talk of False Creek development has recurred a dozen times. The recent decision of the present department of works may be the cumulative effect of all this discussion and preliminary work. Anyway, there is no necessity now to make a survey or seek for information. All this is ready. The announcement is that a channel 300 feet wide and 20 feet deep at low tide will be dredged. This will give excellent fairway for the craft that seek the creek, and will enable warehouse and property owners to construct wharves.

Moreover, the Canadian Northern has signified its intention to co-operate with the city and the government in the dredging of False Creek. It is almost a certainty that the city and the railway company will get together in the matter of the latter securing the remainder of the land in the False Creek basin at its head, namely 114 acres, for the company has shown that it is willing to meet the city in almost any way. It will mean an immense change in the large area lying directly east of the Main Street bridge, for all improvements must be completed within five years and three-fifths in three years. It looks as if this new railway, young and aggressive, will beat the Great Northern to it, despite the fact that the Great Northern has had a good start. It is beginning to find that it has to rush things along.

Sir Thomas Shaughnessy was on the coast recently and announces much development on the part of the Canadian Pacific Railway. Sir Thomas is no more prone to talk than most railway presidents, but now that a start has been made on what it is proposed to do, he is not unwilling to tell something. Three or four years ago, when The Monetary Times announced that a new Canadian Pacific Railway depot was planned for Vancouver, a vigorous denial came from Canadian Pacific Railway officials, yet to-day work is being pushed on the exact site then mentioned. Perhaps these things are kept in the background that other railways might not know what their competitor has in view. Anyway, this work is being done, the line is being double-tracked to Calgary, and Sir Thomas announces that more steamers are to be supplied for the coastwise business, equipment will be installed here to take care of grain for export, and new steamers are in hand for the trans-Pacific route. When the Grand Trunk Pacific was first talked of, the remark was heard that that railway might outshine the Canadian Pacific Railway. At the rate the Canadian Pacific Railway is going, the Grand Trunk Pacific will be quite a small little line compared with its older competitor. It will, however, have a fine territory to itself and what is being done in the southern part of the province will doubtless be duplicated in the north as development proceeds and occasion warrants.

Now that Point Grey has settled the tram franchise question, Burnaby is having a tilt with the British Columbia Electric. Point Grey, or rather a certain section of its people, insisted upon their rights, with the result that the municipality lost a season's development and in the end started again just where it left off. Burnaby has not so much to lose if it wins out in the court in its attempt to invalidate the franchise granted by the council, since it has not so many miles of railway to be stilled. An interesting point in connection with the Burnaby test case is advanced, namely, that the British Columbia Electric has no right to operate lines in any part of British Columbia. Counsel for the municipality is arguing that the British Columbia Electric is an English company which has obtained a license to carry on business in this province and therefore comes under the Provincial Companies Act and is restrained from operating street railways or trams in the province. The defence is that in the early days of Vancouver when tram companies were formed, a charter was obtained from the provincial government. Another charter was secured for the interurban line, and when the British Columbia Electric bought out the stock it took over all the privileges awarded in successive acts.

THE TRIPLEX BLOCK

REASONS FOR SENDING TODAY FOR THIS BOOK.

Triplex Block built into a 10 ton geared trolley and used for loading on floats lying alongside a pier in New York City.

A Book on the Handling of Loads, the Latest Practice Here and Abroad.

The change is coming fast. Modern plants today are equipping throughout to give each workman easy mastery over any load up to 20,000 lbs.

The new practice is to reduce all loads to one-man manageable loads, from the raw material coming in to the completed material going out. This frees the factory from an enormous waste. The primitive way of pitting time-paid muscle against stubborn weight, soon costs any manufacturer who stands for it a fortune in wages and restricts his output.

Months of research were spent by Yale and Towne engineers to make this book cover a wide range of conditions, so the man who sends for it will find it the most practical and helpful book that ever came to his desk.

Send for a free copy now, before
the thought is out of your mind.

Triplex Blocks { **16 Sizes:** One-fourth of a ton to forty tons.
{ **9 Active Stocks** all over Canada.

Every Block Tested to Fifty Per Cent. Overload.

The Canadian Fairbanks-Morse Co., Limited

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured [illegible] fee.

17516—September 10—Authorizing C.L.O. & W. (C.P.R.) to construct across G.T.R. by overhead crossing, in Lot 23, Con. A, Tp. Hamilton, Co Northumberland, Ont., mileage 121.52, from Glen Tay.

17517—September 17—Directing G.T.R. to protect William Street, Lon- [illegible]

17518—September 18—Authorizing G.T.P. Branch Lines Co., to construct its railway between its Battleford and Cutknife Branches; to cross highways; and establish terminals at Battleford.

17519—September 18—Authorizing C.L.O. & W. (C.P.R.) to construct road allowance between Lots 2 and 3, Con. 1, Tp. Hope, Co. of Durham, Ont., mileage 125.36, from Glen Tay.

17520—September 18—Authorizing C.L.O. & W. (C.P.R.) to construct across ten (10) highways, from mileage 110.96 to mileage 121.26, and from [illegible]

17521—September 17—Authorizing C.N.O.R. to construct bridge across Ottawa River, at Portage du Fort, mileage 59.8 from Ottawa.

17522—September 18—Amending Order No. 17221, August 13th, 1912, by substituting plan "A."

17523—September 19—Authorizing C.P.R. to construct siding 500 ft long, connected with its railway near Bryce Avenue, Toronto, Ont.

17524—September 18—Authorizing C.N.O.R. to construct across C.P.R. by overhead structure, on Lot 6, Con. 4, Tp. McKim, Dist. of Sudbury, Ontario.

17525—September 18—Approving location C.P.R. station at Jeannette, on Lot 6, Con. 4, Tp. Tilbury East, Co. Kent, Ontario.

17526—September 19—Relieving C.P.R. from further protection at crossing [illegible]

17527—September 18—Authorizing C.P.R. to construct spur for Milverton Furniture Co., at Milverton, Tp. Mornington, Co. Perth, Ontario.

17528—September 18—Approving change in location of C.P.R. station building at Batiscan, Que., on Lot Cadastral, No. 443, Range 1, Parish St [illegible]

17529—September 18—Authorizing G.T.R. to construct two (2) additional tracks across the Cote St. Paul Road, Montreal, P.Q.

17530—September 18—Approving revised location G.T.P. Ry. through Noon-La Indian Reserve, mileage 395 east of Prince Rupert, Coast Dist., Range 5, B.C.

17531—September 18—Approving revised location G.T.P. Ry. from east line, Lot 478, to west line N.W. ¼ Lot 6028, mileage 49.26 to nileage 58.17, Range 4, Dist. Fort George, B.C.

17532—September 20—Authorizing C.P.R. to open for traffic double track from L'Acadie to point just north of diamond crossing of G.T.R., at St. John's, Que., about 3.60 miles.

17533—September 21—Extending time within which G.T.R. complete new station and rearrange yard at Hensall, Ont., for a period of sixty [illegible]

17534—September 19—Authorizing C.N.O.R. to construct across public road on Lot 18, between Ranges A and 1, Tp. Westmeath, Co. of Renfrew, [illegible]

17535—September 19—Authorizing C.N.R. to construct across public road between Secs. 3 & 4, Tp. 31, R. 12, W. 4 M., on its Goose Lake Ex- [illegible]

17536—September 19—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible]

[illegible]

[illegible] mileage [illegible]

[illegible]

17548—September [illegible]—Directing G.T.R. to construct station at Whitehall, Ont.

17549—September 21—Rescinding Order No. 16460, which authorized C.P.R. to construct branch line for Inland Coal & Coke Company, Limited, at Merritt, B.C.

17550—September 20—Authorizing Rural Municipality of Progress No. 351, Saskatchewan, to construct highway over tracks of C.P.R. Macklin-Kerrobert line, where said line intersects the boundary line between Secs. [illegible]

17551—September 20—Granting leave to corporation of city of Edmonton, Alta., to open Eighth St., East, across Edmonton, Yukon, and Pacific Ry., in city of Edmonton, Alberta.

17552—September 21—Directing G.T.R. to restore joint rate per ton on brick charged from Bradford, Pa., to Windsor, Ont., prior to April 20th, 1912.

17553—September 24—Approving location C.L.O. & W. (C.P.R.) from mileage 125.5 (from Glen Tay) in a south-westerly direction through portion of Tp. Hope, thence across town Port Hope, Co. Durham, Ont., to mileage 127.32; and rescinding Orders 16977, July 6, 1912, and 17330, August 2nd, 1912.

17554—September 24—Authorizing C.P.R. to open for traffic Nakusp and [illegible]

17555—September 23—Authorizing C.P.R. to construct spur for Maple Lake Lumber Company, in W.½ Lot 27, R. 12, West of Township of Spragge, Dist. Algoma, Ont.

17556—September 24—Authorizing C.P.R. to construct spur 436 feet in Northwesterly direction across Outremont Yard, and across property of Montreal Light, Heat & Power Company, being Lot Cadastral No. 634, Parish of St. Laurent, Counties of Hochelaga and Jacques Cartier, Que.

17557—September 23—Approving location C.N.O.R. station grounds at [illegible]

17558—September 23—Authorizing C.N.O.R. to construct across public road, Lot 9, Con. 2, Tp. Gibbons, Dist. Nipissing, mileage 266.5 from Ottawa.

17559—September 23—Authorizing C.N.R. to construct across public road between Secs. 3 and 4, Tp. 29, R. 7, W. 4 M., Goose Lake Extension.

17560—September 23—Authorizing C.N.O.R. to construct bridge across Stony Creek, Tp. of Fitzroy, Co. Carleton, mileage 34.4 from Ottawa, and to divert Jimmy's Creek.

17561—September 24—Temporarily approving Standard Freight and Passenger Tariffs, C.R.C., No. B. 4, and C.R.C., No. A. 1, respectively, of the Western Canada Power Company, Ltd.

17562—September 25—Authorizing T.H. & B. Ry. Co. to construct spurs [illegible] Ltd., Hamilton, Ontario.

17563—September 25—Authorizing G.T.R. to construct siding for the Campbell Flour Mills Co., Ltd., Toronto, Ontario.

17564—September 25—Extending time, within which the Central Vermont Ry., ballast line between St. Lambert and Waterloo, Marieville and St. Cesaire, Farnham and Frielsburg, and Iberville and Farnham, until 15th November, 1912.

17565—September 24—Approving revised location Burrard Inlet Tunnel & [illegible] British Columbia.

17566—September 24—Approving location Burrard Inlet Tunnel & Bridge Co.'s railway from station 4.56.3 to station 324.32, B.C.

17567—September 25—Approving Esquimalt & Nanaimo Ry. Co., plan [illegible] Canyon, at bridge [illegible]

17568—September 23—Authorizing C.P.R. to construct spur for Elmore & Snyder, N.W. ¼ Sec. 6, Tp. 23, R. 3, W. 5 M., near Laggan, B.C.

17569—September 23—Authorizing C.P.R. to construct additional track across St. Thomas & Deschamps Sts., city of Three Rivers, Quebec.

17570—September 25—Approving C.P.R. plan showing replacement of existing trestle at bridge 37.6, Walkerton Subdivision.

17571—September 23—Authorizing C.P.R. to construct road allowance, between Secs. 35 and 36, Tp. 10, R. 32, W. P. M., Sask., across tracks of Reston to Wolseley Branch, mileage 36.01.

17572—September 24—Amending Order No. 16998, July 13th, 1912, by sub- [illegible] in fifth and twentieth lines of page two of the Order.

17573—September 23—Authorizing C.P.R. to construct spur for the J. C. Graham Co., Ltd., on Lot D.G.S. 7, outer two miles, St. John, Winnipeg, Man.

[illegible] Authorizing C.P.R. to construct spur for [illegible] Cornellier & Jolly, near Angus Station, across Subdivision Lots 138 to 147, (inc.) of Lot Cadastral No. 7, of the incorporated village of Cote de la Visitation, Co. of Hochelaga, Que.

[illegible] Authorizing C.L.O. & W. (C.P.R.) to construct across and divert road allowance between Lots 16 17, Con. 1, Tp. Hope, Co. Durham, Ont. [illegible] from Glen Tay.

17576—September 21—Authorizing C.N.R. to construct across and divert public road between Sec. 33, Tp. 30, and Sec. 3, Tp. 31, R.12, W.4.M., on its Goose Lake [illegible]

[illegible] Authorizing C.N.R. to construct across Seven (7) [illegible]

17578—September 25—Authorizing C.N.O.R. to divert St. Davide St., in [illegible] E. & N.W. sides of its right of [illegible]

[illegible] Port Arthur.

[illegible]

[illegible] York, Ont. [illegible]

[illegible] Authorizing C.N.O.R. to construct across and [illegible] Ottawa [illegible]

Volume 23. Toronto, Oct. 10, 1912

Contents of this issue on page 583

The Canadian Engineer

An Engineering Weekly

STEEL TOWERS FOR OVERHEAD TRANSMISSION LINES.

By ALFRED STILL, M.Inst.E.E., M.Am.Inst.E.E. *

It cannot be said that there is at the present time a standard type of steel structure for supporting the conductors of overhead transmission lines; neither is it likely that one particular design will ever be found suitable for all countries, climates and voltages. Any kind of supporting structure which will economically fulfil the necessary requirements will answer the purpose of the transmission line engineer, who merely requires a durable mechanical structure to carry a variable number of insulators at a height above ground, and with a spacing between them, depending upon the voltage of transmission and the length of span.

As a substitute for wood poles, steel tubes have been used, either in one piece, or built up of a number of pieces of different sizes in order to economize material and give a large diameter at the bottom where the bending moment is greatest, and a small diameter at the top where the bending moment is negligible. Steel poles of considerable height, suitable for longer spans, may be built up of three or four vertical tubes of comparatively small diameter jointed and braced together at suitable intervals to give stiffness to the structure. It is doubtful whether, in the long run, such composite tubular structures will hold their own against the latticed steel masts built up of standard sections of rolled steel, as used extensively on the continent of Europe, and, to a relatively smaller extent, in America. The term "tower" is applied mainly to the light steel structures in which the spacing between the main upright members, at ground leved, is large compared with the height of the structure; the usual proportion—which will generally be found to be the most economical in material—being 1 to 4; that is to say, if the base is square, the side of this square will be about one-quarter of the distance from the point of measurement to the top of the tower. If the towers are large, the footings are usually separate pieces which are correctly set in the ground by means of a templet, and to which the legs of the tower proper are afterwards bolted. A good example of large steel towers is to be found in the 100,000-volt transmission line of the Great Western Power Co. of California. Two three-phase circuits are carried on these towers, the vertical spacing between the cross-arms being ten feet. There are three cross-arms, each carrying two conductors—one at each end. The horizontal spacing between wires is 17 feet on the two upper cross-arms are 18 feet on the lower cross-arm, which is 51 feet above ground level. No conductor is closer than 6 ft. 5 in. to the steel structures, this being the minimum clearance in the horizontal direction. The average distance between towers is 750 feet, and they are joined at the top by a grounded guard wire 5 feet above the bottom of the highest cross-arm. The base of the tower measures 17 feet square, the parts under ground being separate pieces of steel, buried to a depth of 6 feet, to which the tower proper is bolted after being assembled and erected on site.

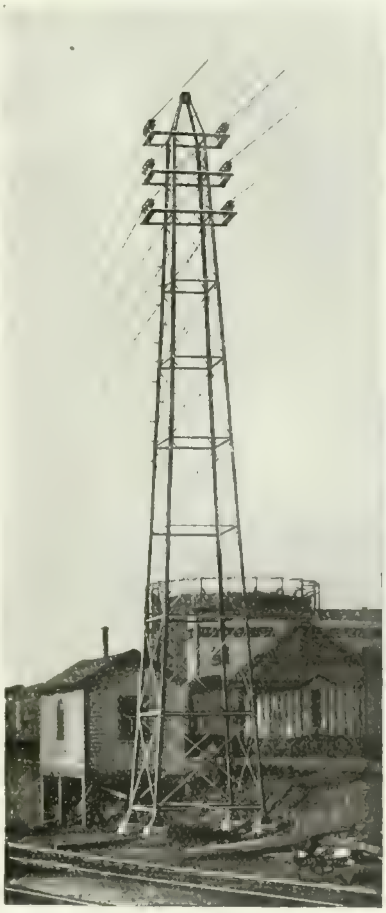


Fig. 1.

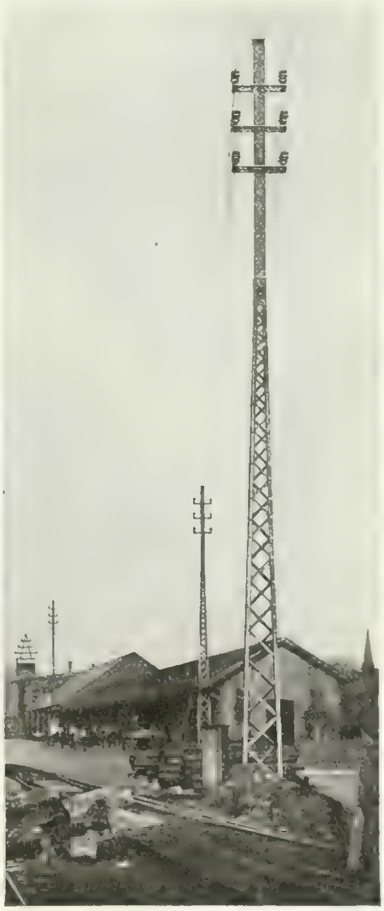


Fig. 2.

Fig. 2 shows the lighter form of latticed steel mast, while Fig. 1 is a corner tower on the same transmission

---

* Chief Electrical Engineer, mining department, Algoma Steel Corporation.

line; it is generally similar to the standard towers with wide base, as used on straight runs for moderately long spans, except for the special arrangement carrying the larger number of insulators.

The term "tower" is also frequently applied to the "flexible" type of structure which has two main vertical members only, and is specially designed to have ample strength and stiffness in a direction at right angles to the transmission line, while it is free to bend, within certain limits, in a direction parallel to the line, without being permanently deformed. Great strength and stiffness in the direction of the line is not always necessary or desirable in a transmission line support; but it is obvious that the strength and stiffness must be sufficient to withstand the forces imposed on the structure during erection, and at the time of stringing the wires. A simple braced "A" frame steel tower of the "flexible" type is illustrated in Fig. 3. This photograph shows the steel and wood pole lines running side by side between Taylors Falls and Minneapolis, Minn. These towers are 42 feet high from ground level to bottom insulator, and have a standard spacing of 440 feet.

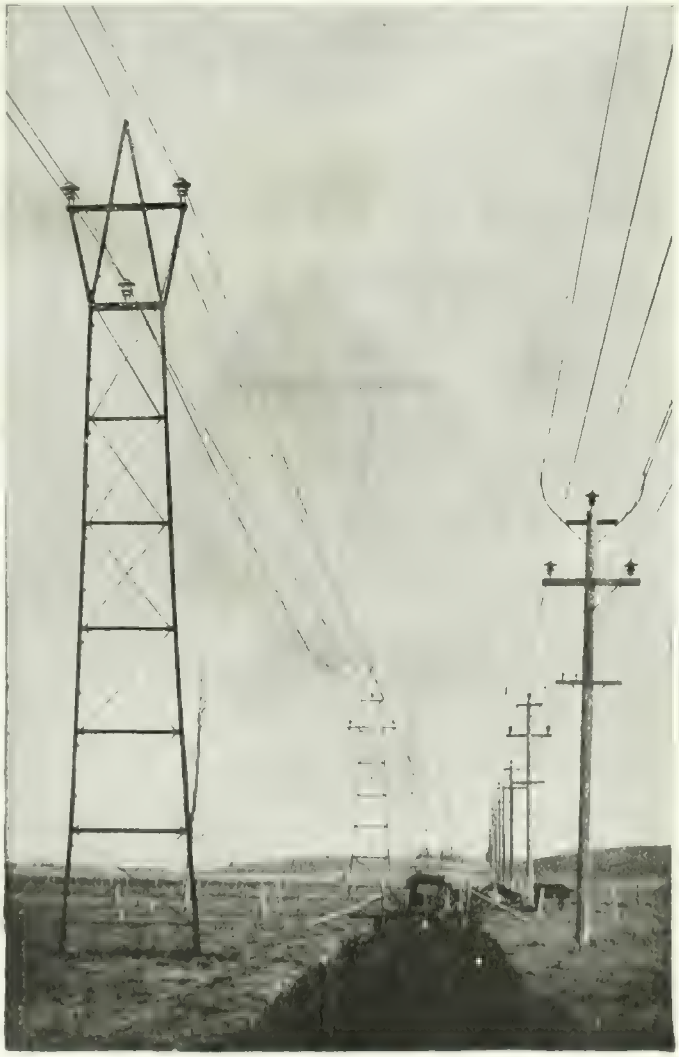


Fig. 3.—Simple Braced "A" Frame Steel Tower.

The maximum load which a tower must be designed to withstand will depend upon the number and size of wires to be carried and the estimated ice coating and wind velocity. Apart from the wind pressure on the structure itself, the loading in a direction transverse to the line will be equal to the resultant wind pressure on all the wires (which may or may not be ice coated, depending on the climate); the effective length of each wire being the distance between supports.

In the direction of the line the forces are normally very nearly balanced, but in the event of one or more wires breaking, the unbalanced load may be considerable, and it is well to design the towers, if possible, so as to withstand the stresses imposed upon them if two-thirds of all the conductors in one span are severed. On the other hand, it is not possible to tie the conductors to the insulators in such a manner that the wires will slip, or the tie break, before the conductor itself is strained beyond the elastic limit of the material (about half the breaking load). It must not be overlooked that if the wires break in one span only, the [illegible] of pin type insulators are each will be subjected to a twisting moment, and if the strain in the wires is at one end only of the cross-arm, the whole tower is subjected to tortional strain

In Vol. XXV. (January to June, 1911) of the transactions of the Canadian Society of Civil Engineers, Mr. W. G. Chase gives some interesting particulars of the steel tower line from the municipal hydro-electric works of the city of Winnipeg at Point du Bois Falls. The supporting structures are of the "flexible" type, two designs being used, one for firm soil and one for swamp construction; the height being 42 feet. Braced towers are placed at intervals of about 1,200 feet and these were tested up to 6,200 lbs. applied at one end of the cross-arm 43 feet above ground in a direction perpendicular to the line. The test pull in the direction of the line was 7,200 lbs., corresponding to 1,200 lbs. per pin. The "flexible" towers are designed to have the same strength as the braced towers to resist wind pressures across the line, but they are intended to withstand only 480 lbs. in the direction of the line. The weakest point in the line is the wrought iron insulator pin which is intentionally designed to yield before the structure is damaged; these pins withstood on test a load of 1,500 lbs just before breaking. The towers carry six aluminum wires each of 278,600 circ. mils section. These conductors are tied securely to the braced towers, but on the flexible towers, the tie is designed to break with a pull of 80 to 100 lbs.; number 14 soft aluminum wire being used for the ties. This line is 77 miles long, and it transmits power at 66,000 volts.

The normal length of span on steel tower lines usually lies between 400 and 600 feet, but very much longer spans can be used where the character of the country would render their use economical, or where rivers have to be crossed. On the transmission system supplying Dunedin City, New Zealand, with electric energy at 35,000 volts, there is a span 1,700 feet long where the line crosses the ravine near the power station. The peculiarity of this span is the great difference in level between the two supports, the upper tower, which is a special steel structure, being 650 feet above the lower tower.

The 22,000-volt transmission lines of the Canadian Niagara Power Company cross the Niagara River near Buffalo in two spans, the longest being 2,200 feet long. The minimum clearance above water level is 131 feet, necessitating very tall supporting towers. These are of steel, arranged to carry nine 500,000 c.m. aluminum cables with a 13-foot spacing. An attachment consisting of a steel cable passing over a sheave and provided with counterweight, maintains a constant tension on the conductors and takes up variations in length due to changes of temperature.

On the high tension transmission lines of the Central Colorado Power Company, there is a single span 2,500 feet long. The St. Joquin River is crossed by a 3,000-foot span. The 100,000-volt lines of the Great Falls Power Company between Rainbow Falls and Butte, cross the Missouri River in a single span 3,034 feet long.

The longest span in the world is 4,200 feet across the Coquiney Straits.

The tower illustrated in Fig. 4 is 70 feet in height; it is used for supporting one end of a span about 1,000 feet long, where the transmission line crosses a river.

Having determined the maximum load to which the towers of a transmission line are likely to be subjected, it is usual to leave the strength calculations and details of design to the manufacturer; but the calculation of the stresses in the various members of a simple steel structure such as a transmission line tower, is comparatively easy, by making use either of graphical methods **(parallelograms of forces)**, or the method of moments. A structure of this sort, when fixed to solid foundations and submitted to abnormal loads, is very liable to yield through the buckling of the members in compression, and the chief task of the designer is so to arrange and proportion the bracing and tying in of the compression members that the unbraced sections of these members shall not be unduly long.

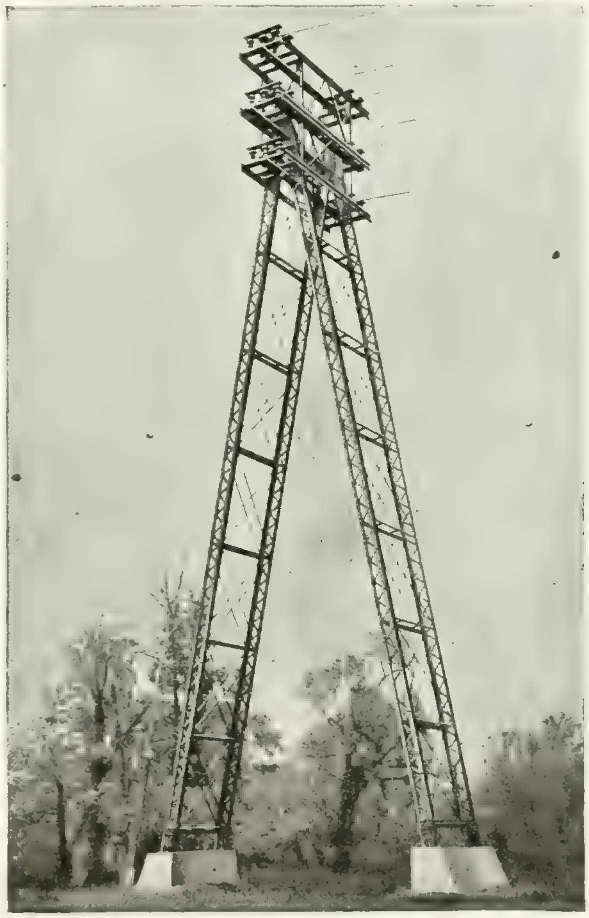


Fig. 4.—Steel Tower at River Crossing.

Rankine's formula for compression members is:

$$\frac{\text{Load :}}{\text{Area of Section}} - \text{lbs. per sq. Inch of Section} = \frac{T}{1 + C\,\frac{l^2}{R^2}}$$

Where T – maximum stress in metal in lbs. per sq. inch.

l = length of unsupported compression member.

R = least radius of gyration.

$$= \frac{\text{moment of inertia}}{\text{area of section}}.$$

expressed in the same units as l.

C = a constant, which is about 1/25,000 for mild steel struts fixed at both ends.

By using the "straight line" formula, very similar results are obtained. For wrought iron angles and tees, with ends fixed, Burr gives:

Ultimate lbs. per sq. inch of cross section = 44,000 — 140 l/R, this value being multiplied by 1.25 for mild steel. To obtain working load, divide by factor of safety.

The "straight line" formula should only be applied when ratio l/R lies between 40 and 200, which corresponds to a length of compression member not exceeding about 20 times the width of flange.

When leaving the design to manufacturers, the specification for steel towers might with advantage contain a clause to the effect that the length of the compression members shall not exceed 200 times the least radius of gyration of the section. Also in the case of painted structures, it is best to allow no metal less than ¼ in. thick. If the metal is galvanized, it may be 3/16 in. and even as thin as ⅛ in. in the case of the secondary members. It is not usual to paint galvanized iron work, partly because the extra protection hardly justifies the expense, but also because ordinary paint does not adhere properly to a galvanized surface. Special paints can be obtained, but, generally speaking, the choice lies between a galvanized structure without paint, and a non-galvanized structure which must obviously be well protected with paint. The first cost of the latter is usually lower, but the coating of paint is not so durable as the galvanizing. Sometimes the parts in the ground only are galvanized, the rest being painted.

When a tower takes a "permanent set" under excessive load, this is often due to slight yielding of the joints before any buckling of compression members takes place.

In regard to the factor of safety to be allowed in the design of steel towers, a factor of three is sometimes called for, and this is a safe figure; but it is usually sufficient to allow a factor of two under the severest expected conditions of loading; which means that, under such conditions, the structure would be stressed to the elastic limit. This factor of safety probably corresponds to a factor of about five under normal conditions of wind and ice loading; moreover, it is unnecessary to allow a very large factor of safety in such structures because abnormal stresses are nearly always moderated by the slipping of the wires in the ties, the slight yielding of the foundations or joints, or similar movements which tend to relieve such abnormal stresses as might otherwise wreck the supporting structures.

The deflection, or movement of the top of a steel tower under load is usually small, and unless the towers are specially designed of the "flexible" type, the strain is rarely sufficient to modify the tension in the wires to any appreciable extent. The design of steel tower line with the object of providing considerable elastic yielding of the supports in the direction of the line, is a special and rather difficult problem which has been dealt with by other writers, and also elsewhere by the present writer.*

The deflection of the top of a transmission tower of the ordinary light "windmill" type with wide square base, when bolted to rigid foundations and subjected to a horizontal load such as to stress the material up to nearly the elastic limit, might be from two to five inches, while the more slender latticed masts of the type shown in Fig. 1 would have a greater deflection.

The following table, which gives the deflections of built-up tubular steel poles of the type shown in Fig. 5, has been compiled from some interesting figures published in the "Standard Handbook" for electrical engineers.

---

* "Electrical World," Vol. 60, No. 2, page 97, July 13th, 1912

D_1	t_1	D_2	t_2	D_3	t_3	Weight of pole lbs.)	Maximum horizontal (load elastic limit)	Deflection (inches)
10	1/2	8 5/8	3/8	7 5/8	9/32	1342	2800	5.572
9	7/16	8	11/32	7	9/32	1099	2000	6.020
8	3/8	7	5/16	6	1/4	846	1600	7.852
7	5/16	6	1/4	5	3/16	600	900	8.217

When making comparisons between wood and steel for transmission line supports, it is not only the matter of first cost that has to be considered. Steel structures have the advantage of being invulnerable to prairie and forest fires; moreover, owing to the longer spans rendered possible by the stronger and taller supports, there is less chance of stoppages owing to broken insulators, and less leakage loss over the surface of insulators. A fact that is often overlooked is that the size of conductor limits the practical length of span; for instance, with a small conductor such as a No. 4 B. & S., it would not be wise to have spans much above 250 or 300 feet. This suggests what is frequently found to be the case, namely, that the total cost of a line may be reduced by using a conductor of rather larger section than the electrical calculations would indicate as being necessary because the stronger cable permits of a wider spacing of the supports and towers.

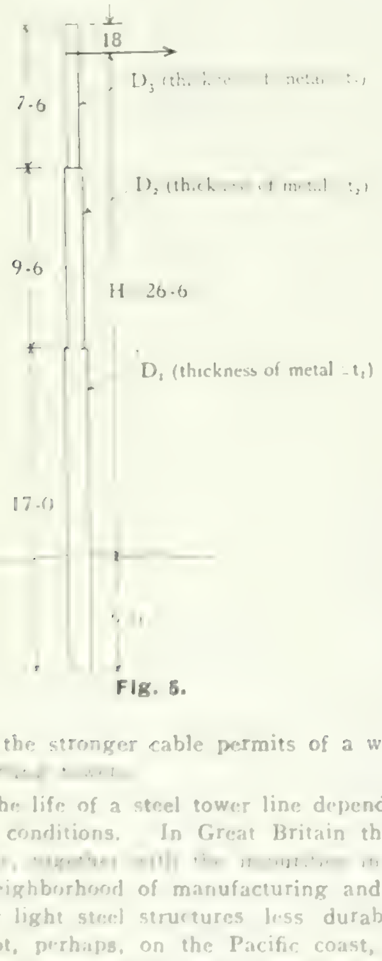

18
7-6
D_3 (thickness of metal = t_3)
D_2 (thickness of metal = t_2)
9-6
H 26-6
D_1 (thickness of metal = t_1)
17-0

Fig. 5.

The life of a steel tower line depends somewhat on climatic conditions. In Great Britain the dampness of the climate, together with the impurities in the atmosphere in the neighborhood of manufacturing and populous districts, render light steel structures less durable than in America (except, perhaps, on the Pacific coast, where special precautions are required to guard against rapid corrosion due to the prevalence of fogs and moisture). Not only has the iron work protected by paint to be repainted on the average every three years, but [illegible] as the present ownership of valuable property renders the construction of a straight transmission line with long open spans almost impossible in the United Kingdom. These conditions are all in favor of the employment of selected and well creosoted wood poles, the life of which may be 20 years or more.

It is well to test the quality of the galvanizing on steel towers before erecting. This is readily done by immersing samples in a solution of sulphate of copper (specific gravity about 1.186) maintained at a temperature of 60 to 70 degrees Fahr. After remaining in the solution one minute, the sample should be removed, thoroughly washed in water and wiped dry. This process should be repeated four times, after which there should be no red spots indicating copper deposit.

The nature of the foundations necessary for steel towers will depend on the height of the tower and the pull to be resisted. In unsuitable soil it may be necessary to use concrete blocks to which the legs of the tower can be anchored; but in solid ground the concrete can generally be dispensed with. The shape and depth of the footing under ground must be such that the weight of concrete (if any) and the weight of packed earth shall be sufficient to prevent the upward pull due to the maximum horizontal load at the top of the tower.

A factor of safety of two is usually allowed. The weight of concrete may be taken at 140 lbs. per cubic foot, and of good earth at 100 lbs., the volume of the earth to be lifted being calculated at the angle of repose, which may be about 30 or 33 degrees with the vertical, as indicated in Fig. 6. If the footing of a tower is in gravel or a mixture of sand and loam, tightly packed, there is actually a far greater resistance to the pulling up of the footings than that which is offered by the mere weight of the footings with prism of earth as calculated the usual way.

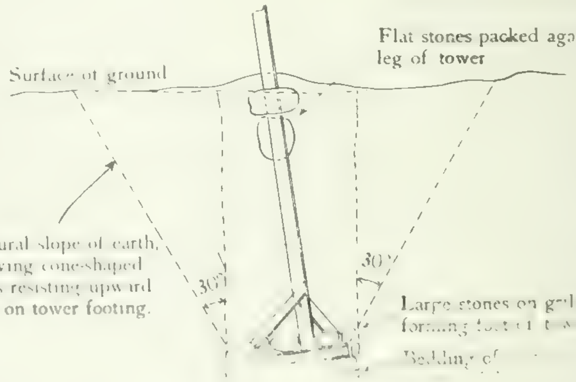

Flat stones packed against leg of tower
Surface of ground
Natural slope of earth, showing cone-shaped mass resisting upward pull on tower footing.
30°
30°
Large stones on grillage forming foot of tower
Bedding of

Fig. 6.

When concrete has to be used, it is generally cheaper to reinforce it with steel of an inverted T form, as this makes a lighter construction than a solid block of concrete, and an equally good hold is obtained owing to the increased weight of the packed earth which has to be lifted. In marshy or loose soil, or where the right-of-way is liable to be flooded, special attention must be paid to the design of durable foundations. Concrete footings with or without piles, or rock-filled cribwork may be necessary; it is a matter requiring sound judgment, and preferably previous experience on the part of the engineer in charge of construction. Crumbling hillsides are best avoided; it is extremely difficult to guard against damage by landslides or even snowslides when towers are erected on the steep slopes of hills.

The Hydro-Electric Commission of the Province of Ontario, Canada, have a total exceeding 280 miles of high tension line, supported on steel towers spaced on the average 550 feet apart. They use concrete only where necessary. The standard double circuit tower measures just over 56 feet from ground level to the top. The leg angles with steel footings are buried not less than 7 feet in good ground. In rock, a footing of concrete is usually made to level up the four feet of the tower, and holding down bolts are let into the rock to a depth of not less than 2 ft. 6 in. and grouted in. When a deep footing is necessary in poor soil, the concrete block for each leg will measure about 1 ft. 9 in. square at the top and something over 3 foot square at the bottom, with a base about six inches thick and four feet square, the total depth being approximately 7 feet, with only a small portion—usually less than a foot—appearing above ground level.

Steel towers are usually shipped in sections and assembled on the ground before erection. Sometimes they have to be erected in pieces from the ground up, but usually the structure is stiff enough and light enough to allow of the complete tower being raised from the ground by using a team of horses and the necessary poles with block and tackle.

The illustrations of steel towers and structures which accompany this article have been kindly furnished to the writer by the Archbold-Brady Company, of Syracuse, N.Y. The photographs represent the latest American practice in steel pole line construction.

◆

A STADIA IN GEORGIAN BAY, DISTRICT OF PARRY SOUND.

A stadia survey affords a quick and accurate method for the location and mapping of land. Mr. A. G. Ardagh, in a paper presented to the Association of Ontario Land Surveyors gives a description of the methods used on a stadia survey in Ontario.

Instructions for this survey were dated March 19th, 1910, and the survey was temporarily commenced a few days later. It was the intention of the Surveys Branch to have base lines for triangulation measured on the ice in preparation for the summer survey, and this could have been accomplished if the exceptionally warm weather of March in last year had not rendered the ice unsafe. I had hoped to use the ice to run a closed transverse completely around the district assigned to me, and at the same time leave bases for triangulation. An attempt to do this was made, but accomplishment was defeated by the state of the ice.

The survey was definitely commenced on April 18th. The backbone of the survey was a run of triangulation along the main open channels closing on itself, now and then, where the channels made this possible. The bases were measured with a 5-chain tape, wherever the ground was suitable. Such places were not easily to be had except at the outer reefs, and they varied from 5 chains to 20 chains in length. Starting from a measured base, the length of the next base was calculated trigonometrically, and compared with the actual measurement of the new base, which gave a check on the work in between. All angles were read singly and then doubled, as a check both upon sighting and reading, and all three angles of the triangle were read and totalled to 180 degrees. The instruments used were a D.L.S. Watt Transit, 6-in. diameter, a Bausch & Lomb 4-in. (a very fine instrument), with a Foster for spare. The instruments only read to minutes, half minutes being estimated; adjustment was frequently necessary to the angles. The bearings were checked by astronomic observation every now and then, with an error of a minute or two. For plotting, the latitudes and departures of the main courses were calculated. In two instances in cycles of triangulation of 15 miles each the error in the lats. and deps., as calculated, was over 1/10th of one per cent. Although in the arrangement of pickets, selection of angles, etc., no great precision was aimed at, but only quick, practical results, yet I do not see the necessity for an error of this amount, and believe it was not wholly due to merely cumulative error. All township posts found on the mainland were tied in by triangulation.

The man doing the triangulation had a small board on which he plotted the triangles to scale on sheets. The angles were adjusted, if necessary, and the bearings and sides calculated following round each triangle and checking back on the first side. The triangulations points were indicated by the Greek letter Δ and the turning points by the letter "T." Where more than one transit is engaged on the stadia work, each transit man should have his subscript to prevent confusion where the same numbers are used by each man, and the numbers should be marked on the pickets.

The stadia transitman takes the copy of the triangulation sheets with him that affect the part he is working in, and where passing triangulation point, sets up at it and checks and corrects his bearings thereby. I think the stadia wires are best adjusted at 10 chains, so that exactly ten links are read on the rod. There will be a slight error over and under this distance, but of no practical account in intermediate readings.

Apart from the triangulation, the work consisted of a multitude of short shots, and for this the stadia wires appeared to be most apt and quickest, although I had a micrometer with me. The shots might average 8 or 10 chains, and rarely went up to 20 chains, even on turns. The transitman reads the rod and enters the distance first, reading his vernier while the rodman moves on, and no second instrument has to be consulted.

Stadia parties consist of three—transitman, rodman and steerman—the two latter together in a canoe. At first I furnished the transitman with a skiff, but latterly found that no time was lost by having the canoe men come back for him, as they had plenty of time to do it while he checked his bearings, marked his picket, made his sketches and got ready to move.

The Watt instrument read four ways to 90 degrees and one way from zero to 360 degrees, so that readings could be taken either in quadrants or on azimuth; the latter is less productive of error, as occasionally the wrong quadrant is entered in the notes, and in any case it is one more tax on the mind. The Bausch & Lomb could only be read on azimuth, and so some of the readings had to be converted in the office to quadrant bearings. To obviate reduction as much as possible, the readings were entered both ways from north to south with this instrument. Although errors in quadrant may generally be detected in plotting, yet a little time in the field may save a lot of worry in the office, and it is important to be sure of the bearings of the traverse before you pick up your instrument. The following, I think, is a good method of ensuring accuracy: Having brought the instrument from the last turning point with vernier clamped and lower limb free, sight on the back point, seeing also that the vernier has not shifted, and after taking intermediates, set the forward point, then turn again on the back point and see that lower limb has not shifted since setting up, then set the vernier at the forward reading and note if the wire intersects the picket. It has happened that where the instrument has been carried clamped from one station to another, the bearings have checked out on closing the traverse, but owing to reading of one course having been entered wrongly, the work would not plot. We don't need to be told how to do work nearly as much as we need to have hammered into us that any neglect of system to effect a temporary saving of time will make us pay dearly in the end.

The loose-leaf system was employed and found satisfactory. Holders with strong springs and which fitted easily into the pocket were used. The field notes were drafted to scale. The scale first adopted was too small and necessitated the enlargement of portions. The northerly part of the work was drafted to a scale of 4 chains, and even this cramped the notes, as the exhibited sample will show.

Search was made for township posts along the coast. The township of Harrison was surveyed thirty years ago, the surveyor now being deceased. The country has been burnt over, or both timbered and burnt, and a great many of the posts have been destroyed. The original blazed trees were found in some instances. We made a stadia survey of the coast which, based on the triangulation, produced a good result. Following the indentations of the shore, we surveyed 95 miles of main coast line, mostly in one township. The original coast line of Harrison is more or less imaginary, no actual traverse having been made in the original survey.

The islands were marked by either substantial posts or blazed trees, and the number of the island painted on the rock in white. Roman numerals were used by instructions. This was done in advance by a party of two, who also kept a list of islands and posts, and described the unpatented islands, while the notes of the transit party following after furnished a final check and the position of the tree was tied in by distance and bearing. This was the work of a moment when the rodman was passing it. Any items overlooked in the proper order consumed a lot of time afterwards in picking them up.

◆

STEEL HIGHWAY BRIDGES.

Mr. Neal Garver, instructor in structural engineering at the University of Illinois, stated in a paper presented before the Illinois Society of Engineers and Surveyors some months ago that during several years' experience in bridge work with a large company he had observed on more than one occasion that the contractor did not attempt to slight either the fabrication or erecting work on railroad bridges, but in the case of a highway structure far less care was exercised on many occasions.

In the construction of small steel highway bridges, it is an exception to inspect the steel before it leaves the fabricating plant, which Mr. Garver regarded as a mistake. There are many details, some of considerable consequence, which can be easily remedied at the shop, but are difficult or expensive to change in the field. For example, some ¼-in. lacing bars were used on a bridge where 5/16-in. bars were required. In another case, Lomas nuts of the same size were used for 3 and 3¾-in. pins; the nuts were all standard size for the 3-in. pins, but for the 3¾-in. pins the recess in the nut was insufficient to pass over the shoulder of the pin. In still another case the specifications required all finished [illegible] to be painted with white lead and tallow before leaving the shop. This was mentioned on the shop drawings. It was further required that the masonry and shoe plates on which the expansion rollers moved should be oiled. The pins were unoiled and had become quite rusty, the rollers had been painted with a heavy black paint, and the masonry and shoe plates were unplaned. The structure was a truss span with adjustable counters in the frames. In order to give the required net section, the [illegible] should have been upset, but they were not. On a [illegible] [illegible] [illegible], upon the shop drawings called for the [illegible] and [illegible] to be riveted [illegible], and the [illegible] of the [illegible] field riveted. Instead of being riveted as required, the bridge was put out completely bolted, [illegible] two members being [illegible]. In [illegible] points on the [illegible] and [illegible] had been [illegible] by shop errors, the specifications under which the bridge was inspected required the adjustable [illegible] [illegible] to be [illegible] per cent. [illegible] that [illegible] [illegible] [illegible] directions the efficacy of the new bridge was made only 80 per cent. of what it should have been.

Mr. Garver is of the opinion that many of the weak points in small steel highway bridges, due to defects of erection, can be traced directly to the foreman. He believes that poorly driven steel rivets are to be found on practically every highway bridge job. Well-driven rivets require both care and experience, qualifications usually lacking in the foremen for such work. It is not unusual to find rivet holes filled with cement and painted over. Turned bolts furnished for highway bridge work are often machine or pressed bolts turned down about 1/16 in. smaller than the rivet hole and not to a driving fit, as required by specifications. Real turned bolts are turned out complete from the steel bar.

The packing of pins is often carelessly done, and sometimes the foreman is hardly to blame for this because no sketches are given on the drawings to indicate in what order the bars are to be placed on the pins. Without such a sketch it may happen that the bending moment on the pin will be much greater than it was calculated to receive. Constant trouble is experienced in forcing the foremen to place collars on the pins to keep the bars in their proper positions in the tension members of the bridge.

In the design of highway bridge details, a common point of weakness is the connection of the floor beams to the posts, which is lacking in rigidity. Sometimes the post is so detailed at this point as to reduce its efficiency materially in taking compressive stresses. For example, the post may be made up of two channels laced, and the floor beam suspended below the bottom chord. The channels are cut off above the bottom chord eye-bars to clear the eye-bar heads and only narrow plates are extended down to carry the floor beam. The omission of any provision to carry the outside end joists where they come close to the shoe and cannot rest on the masonry is often observed in plans.

Mr. Garver's suggestions for improving highway bridge work are as follows:

1. In states having highway commissions the highway engineer should get up standard shop drawings for all spans in common use. The drawings should be carefully checked, all poor details eliminated and all mistakes corrected.

2. All fabricated materials should be carefully inspected by an experienced man before being shipped from the fabricating plant. This will eliminate all shop errors, intentional or otherwise, and provide first-class work to go into the field.

3. The work should be carefully inspected in the field after erection and before its acceptance.

4. All companies bidding on this class of work should be given due notice of what to expect, so there can be no complaint of its enforcement.

5. Mr. Garver believes that there is only one price basis fair to both parties concerned, and that is a pound-price basis.

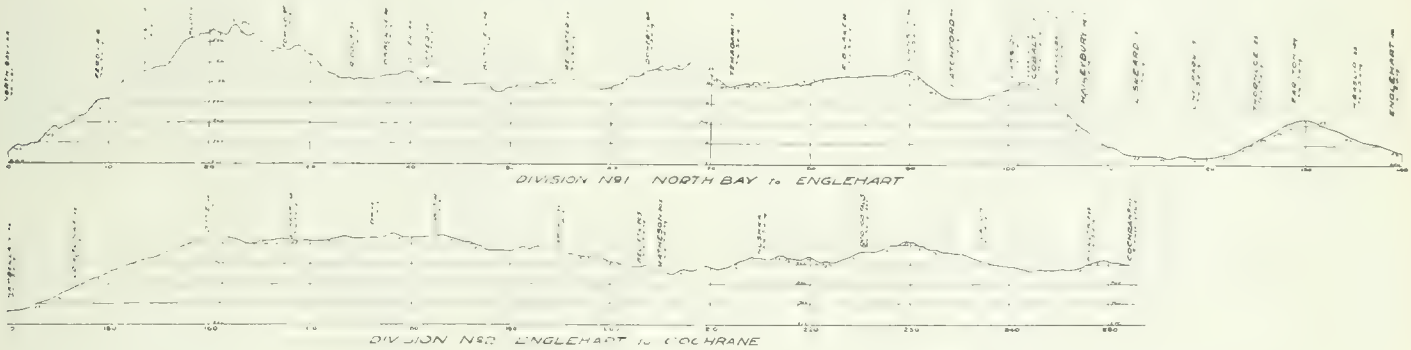
6. The bids should be called for, not for a single bridge at a time, but for the steel bridges for the entire state for a full year, on a pound-price basis, bids being called for on each class of work, with a maximum and minimum tonnage to be ordered under those bids. The objection to this system might be that it would eliminate the small bridge companies. The time has arrived, Mr. Garver considers, when economy should be practised in public as well as private affairs, and it is quite certain that private corporations would not use the methods that have been in vogue generally in the management of public business. If the small bridge companies can do as good work at the same price as the larger concern, they would not necessarily be eliminated.

GRADE REDUCTIONS ON THE T. & N. O. RLY.

The following discussion on the question of grade reduction on the T. & N. O. Railway is abstracted from a report by the chief engineer, Mr. S. B. Clement, to the T. & N. O. Railway Commission contained in the annual report of the commission:

The main line of the T. & N. O. Railway between North Bay and Cochrane is a natural connecting link, between the Grand Trunk Railway of Eastern Canada and the Grand Trunk Pacific Railway of Northern Ontario and Western Canada. That this is so, is manifested by the fact that the G.T.R. is now negotiating with the Commission for the privilege of routing its through, passenger and freight traffic to and from the G.T.P. Railway via the T. & N.O. Railway.

That section of the T. & N.O. Railway between North Bay and New Liskeard was located as a colonization railway and placed under construction before the National Transcontinental was projected. Later when N.T.C. Railway was decided upon, it became apparent that if the T. & N.O. Railway were to be extended from New Liskeard to a connection with the N.T.C. Railway it would receive from the latter a large volume of traffic in addition to what would be developed with the growth of the country, opened by the T. & N.O. Railway itself. The maximum grades on this new N.T.C. Railway were understood to be 0.4 per cent. against eastbound and 0.5 per cent. against westbound traffic, with all grades fully compensated for curvature, the sharpest curves being 4°. The same standards of grades and alignment were adopted by the Commission for the extension of the T. & N. O. Railway from New Liskeard to the Transcontinental Railway. As actually located, however, the maximum grades on the National Transcontinental Railway are 0.6 per cent. against westbound traffic, instead of 0.5 per cent. The maximum grade on the T. & N.O. Railway between New Liskeard and Cochrane is therefore slightly less than the maximum grade against westbound traffic on the National Transcontinental Railway.


DIVISION Nº1 NORTH BAY to ENGLEHART
DIVISION Nº2 ENGLEHART to COCHRANE

Profile of Main Line of T. & N. O. Railway.

Uniform and definite maximum grades do not appear to have been adopted or rigidly adhered to at the time of the location and construction of the section between North Bay and New Liskeard. In general, grades in both directions up to 1 per cent. not compensated for curvature, were freely used on all portions of this section while 1.25 per cent. grades not compensated were used in several places between North Bay and the summit in Merrick Township at M.P. No. 23. The ruling grades over the first division therefore, are equivalent to 1.2 per cent. south bound, and 1.45 per cent. north bound when compensated for curvature, curvature as sharp as 6° having been freely used on maximum grades.

The difference between the physical characteristics of the two sections of the railway is strikingly shown in the following table:

	North Bay to New Liskeard.	New Liskeard to Cochrane.
Distance	112.6 miles	140.0 miles
Ruling Gradient—North Bound	1.45 %	0.5 %
South Bound	1.2 %	0.4 %
Maximum Curvature	6°	4°
Curvature per mile	83°18′	27°56′
Tonnage Rating (10 wheel class)—		
North	560 tons	1,460 tons
South	700 "	1,710 "
Maximum Tonnage Rating (New Consolidation Class)—		
North	1,070 tons	2,700 tons
South	1,290 "	3,160 "

A very large proportion of the operating expenses necessary to handle a given traffic varies directly as the number of trains it is necessary to operate. Any increase in the trainload, whether resulting from a reduction in the ruling grade or an increase in the power of the locomotives, will reduce the train mileage, and proportionately decrease the operating expenses. In general, it has been well established that capital expenditures on grade reduction are economically justifiable and to be recommended, whenever the resulting reduction in operating expenses is greater than the interests on the capital expenditure.

During the year a series of surveys was completed that had been carried on intermittently since 1906, to determine to what extent it was practicable to reduce the excessive grades between North Bay and New Liskeard. The shorter and lighter of these grades can be reduced without changing the alignment while the longer and heavier can only be eliminated by rebuilding on a new location, in some cases at a considerable distance from present right of way. Wherever these diversions have been necessary actual locations have been made and estimates of cost prepared.

The most striking feature of the accompanying profile of the T. & N.O. Railway is what is locally known as the "Merrick Summit," just north of North Bay. The elevation of the North Bay yards at the C.P.R. Junction is 652 ft. above sea level and from Riddle north for 25 miles, the general elevation of the country is approximately 1,000 above sea level. The intervening "Merrick Summit," with an elevation of 1,300 ft. above sea level, is the most serious obstacle to be overcome. In the original location, this summit was crossed by deflecting several miles to the east from North Bay, following the rugged shores of Four Mile Creek, and the North River to the summit. After an exhausted examination of the country on both sides of the right of way, it was found that a lower grade from North Bay could be obtained by following Duchesnay Creek and the summit could be crossed at an elevation of about 1,170 ft. or about 130 ft. lower than the present summit, connecting with the present line at M.P. No. 35, just north of Riddle. If at all possible, it is desirable, that the ruling grades on the first division should not exceed those on the second division, but it is a physical impossibility to obtain an 0.5 per cent. grade north from North Bay. This diversion, North Bay to Riddle, has been located with maximum curvature of 4°, and with maximum grades of 0.8 per cent. northbound and 0.6 per cent. southbound, all compensated for curvature. The cost of construction will not be excessive. The diversion gives the lowest grade that can be obtained from North Bay without swinging the line far to the west to the Sturgeon River Valley. With this diversion as a key to the situation it will be unprofitable to attempt to lower the grades between Riddle and Liskeard below 0.8 per cent. northbound and 0.6 per cent. southbound.

Having adopted these ruling grades, every grade in excess of them, between North Bay and New Liskeard, was carefully examined. It will not be necessary to reduce a number of the shorter of these grades as they may be operated as momentum grades. The reduction of the grade between New Liskeard and Cobalt from 1 per cent. to 0.6 per cent. can only be accomplished by a diversion that would pass at a considerable distance from the present station grounds, at Haileybury and New Liskeard. For this reason, it is advisable, for the present, to overcome this grade by means of a helper engine service.

The following summary statements show the proposed method of reducing all grades between North Bay and New Liskeard to a maximum of 0.8 per cent. northbound and 0.6 per cent. southbound:—

Table Showing Reduction of Grades—North Bay to New Liskeard.

Location, mile to mile.		Method of Reducing Grade.	Estimated Cost.
2.	35	Diversion	$1,482,500
40	41.2	Train filling	50,120
47.9	48.5	"	25,610
51.7	52.5	"	11,000
[illegible]	[illegible]	"	39,100
[illegible]	[illegible]	"	33,280
[illegible]	[illegible]	"	9,200
[illegible]	[illegible]	Diversion	307,075
[illegible]	[illegible]	Train filling	16,225
90.	94.	Diversion	220,000
[illegible]	[illegible]	Train filling	8,400
[illegible]	[illegible]	Helper Engine Service	....
		Total	$2,20[illegible]

The total length of the North Bay-Riddle diversion will be thirty miles, replacing thirty-three miles of present line. The curvature on diversion averages [illegible], and on the present line [illegible] per mile.

The total rise and fall is as follows:—

	Rise.	Fall.
Present main line	[illegible]	[illegible]
Diversion	[illegible]	[illegible]

◆

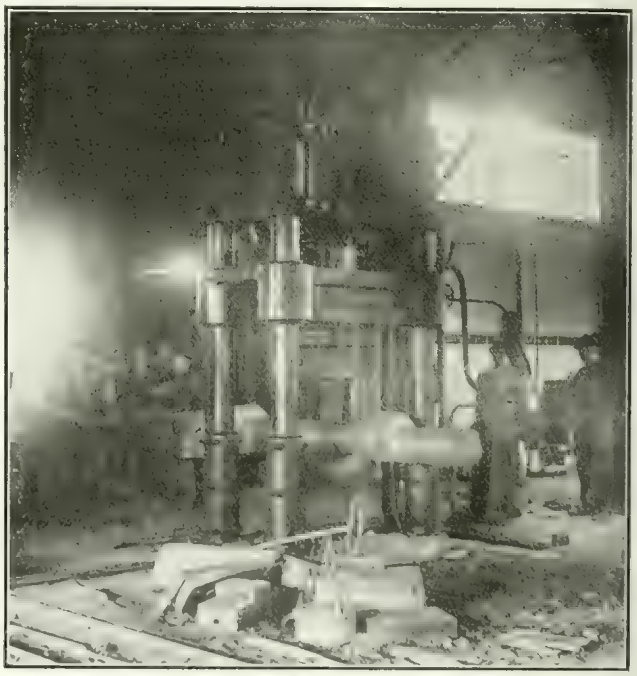
Professor W. W. Andrews of Regina, is engaged in making a study of the coal and clay deposits of the southern part of the province for the Saskatchewan government. In connection with the fuel problem the professor has succeeded in making briquettes from lignite and also from straw. In regard to the latter he claims that out of five tons of straw he can manufacture [illegible] of straw briquettes, which will be [illegible] to the best firewood.

A NEW FORGING PRESS.

There has recently been installed at Welland, Ont., by the Canada Foundries and Forgings, Limited, in the Canada Forge plant, a high-speed hydraulic forging press of German design. The press was built in the United States and is one of the first of its kind in Canada.

The problem which this new press has been designed to solve is that of forging the metal by pressure instead of by repeated hammerings. Heretofore, the process of shaping the metal to its different forms has been accomplished by hammer, in which the hammer head, urged at high velocity, beats the mass of metal into shape by a series of blows. This process naturally is accompanied by tremendous shock and vibration.

The new high-speed hydraulic forging press recently installed by the Canada Forge Company, operates at shorter range. It kneads the metal by a press head, which, after being brought into contact with the metal, is urged by tremendous force, which works the mass not only at and near the surface, but through to its centre. The new press is a 500-ton one, and, being of the hydraulic type, is more efficient than the steam press. Water pressure at 3,000 pounds per square inch is supplied by high-speed pumps driven by A.C. motors direct connected.



View of New High-Speed Hydraulic Forging Press Installed by Canada Foundries and Forgings, Limited, Welland, Ont.

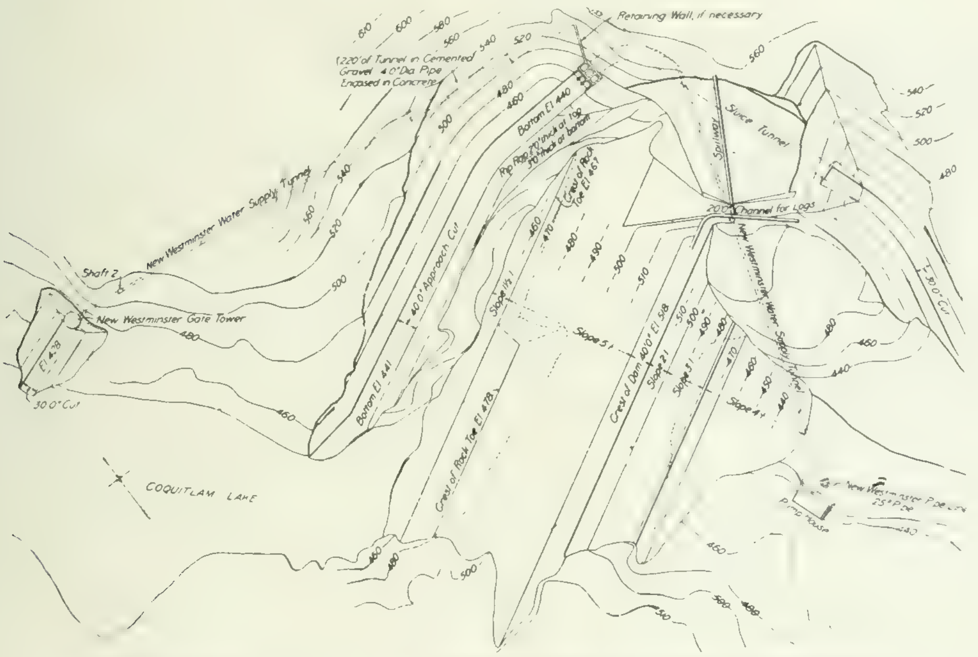
Serving the press are two electric gib cranes, one on either side, which carry the billets from the two large furnaces especially constructed for the purpose. A third large furnace is now being installed for annealing and heat-treating carbon and alloy steels.

An interesting electric, modern welding equipment has recently been installed in the Canadian Billings & Spencer plant, also at Welland, which concern is another of the subsidiary companies of the Canada Foundries and Forgings. This electric welding equipment is used constantly on automobile and carriage work, for which it is especially adapted. The company is also carrying out extensions in order to put into operation a new five thousand pound steam hammer early next year.

THE COQUITLAM-BUNTZEN HYDRO-ELECTRIC POWER DEVELOPMENT.

The Coquitlam-Buntzen Water Power System is owned and operated by the Vancouver Power Company, Limited, a subsidiary company to the British Columbia Electric Railway Company, Limited, operating in the city of Vancouver, British Columbia, and the surrounding towns and districts over an area of 1,600 square miles. Mr. Charles A. Lee, assistant engineer of the Vancouver Power Company, describes the enlargement of this development in an article published in a recent issue of the Engineering Record, from which the following details are taken. This power system was first put in operation in December, 1904, replacing a steam plant which had been used up to that time.

The Buntzen power house is at sea level on the east side of the North Arm of Burrard Inlet, about 16 miles from Vancouver. The original installation consisted of four 1,500-kw. generators driven by Pelton water wheels. Water is supplied to the wheels through steel penstocks from Lake Buntzen, the north end of which is only 1,700 ft. from the power house. This end of the lake is the outlet end, and a concrete dam, 54 ft. high, was built across the creek, raising the level of the lake to 397 ft. above sea level, thus giving a mean head of about 390 ft. at the wheels. The penstocks are connected to steel pipes built in the dam at El. 378. These pipes are 4 ft. 6 in. in diameter, and the flow of water in the penstocks is controlled by roller-bearing sluice gates over the openings on the lake face of the dam. These gates are placed behind suitable racks and are operated from the crest of the dam. Ten openings for penstock connections were built in the dam to provide for future extensions of the power house.


Retaining Wall, if necessary
1220' of Tunnel in Cemented Gravel 4 0" Dia Pipe Encased in Concrete
Spillway
Sluice Tunnel
Bottom El 440
Rip Rap 2'0" thick at top 3'0" thick at bottom
Crest of Rock Toe El 467
20'0" Channel for Logs
New Westminster Water Supply Tunnel
Shaft 2
New Westminster Gate Tower
El 438
30 0" Cut
40 0" Approach Cut
Bottom El 441
Slope 1½:1
Slope 5:1
Crest of Dam 40'0" El 518
Slope 2:1
Slope 3:1
Slope 4:1
Crest of Rock Toe El 478
New Westminster Water Supply Tunnel
30 0" Cut
COQUITLAM LAKE
New Westminster Pipe Line 25" Pipe
Pump House

Location Plan of Earth Dam and Rock Tunnels for Power Development.

Watershed.—The area of Lake Buntzen is about 500 acres, and this lake is used as a reservoir to supply water for the immediate needs at the power house. By the use of flash-boards across the spillway the lake level can be raised to El. 400, and it can be drawn down to El. 388 when it is so required, thus giving an immediate available supply of 6,000 acre ft. The Lake Buntzen watershed has an area of about 7 sq. miles, and the run-off is, therefore, light, excepting during the rainy seasons, when at times it reaches several thousand cubic feet per second. The main supply of water is drawn into Lake Buntzen from Coquitlam Lake through a tunnel connecting the two lakes.

The Coquitlam Tunnel is 12,650 ft. long, driven through the solid granite ledge separating the two lakes. It was designed for carrying 500 cu. ft. per second, but actual gaugings showed a flow of only slightly over 300 cu. ft. per second. The tunnel was unlined, and had a mean section area of 81 sq. ft.

Coquitlam Lake lies directly to the east of Lake Buntzen, and is separated from it by a ridge of mountains rising over 5,000 ft. above sea level. This lake is about 7 miles long, and has an average width of 2,500 ft., and an area of about 2,330 acres. The watershed area is 105 sq. miles. The original elevation of the lake surface was 432 ft. above sea level, but a rock-filled timber crib dam was built across the mouth of the Coquitlam River at the south end of the Lake, raising the lake surface to 443 ft. above sea level.

When the system was first put in operation in 1904, it was thought that ample provision had been made for any extension of the power house for some years to come, but the rapid development and growth of the country soon made it evident that the demand for power would, in a very few years, exceed the maximum capacity of the development.

After a careful investigation it was decided that the existing development could be enlarged to utilize almost the entire run-off of the Colquitlam watershed, at less expense, and in less time, than the development of a new water power project. It was, therefore, decided to increase the storage capacity of Coquitlam Lake by building a higher dam, enlarge the tunnel to obtain the required capacity, and install new generating units in the power house.

The precipitation over the Coquitlam watershed averages 156 in. per year. The winter snows are heavy and remain in the higher parts of the mountains until late in the summer, thus forming a splendid natural reservoir. The average run-off is very close to 1,000 cu. ft. per second, the co-efficient of run-off being between 75 and 80 per cent. There are short periods during the winter and summer months when the run-off drops considerably below the normal, but there are no extended dry periods such as is the case further inland.

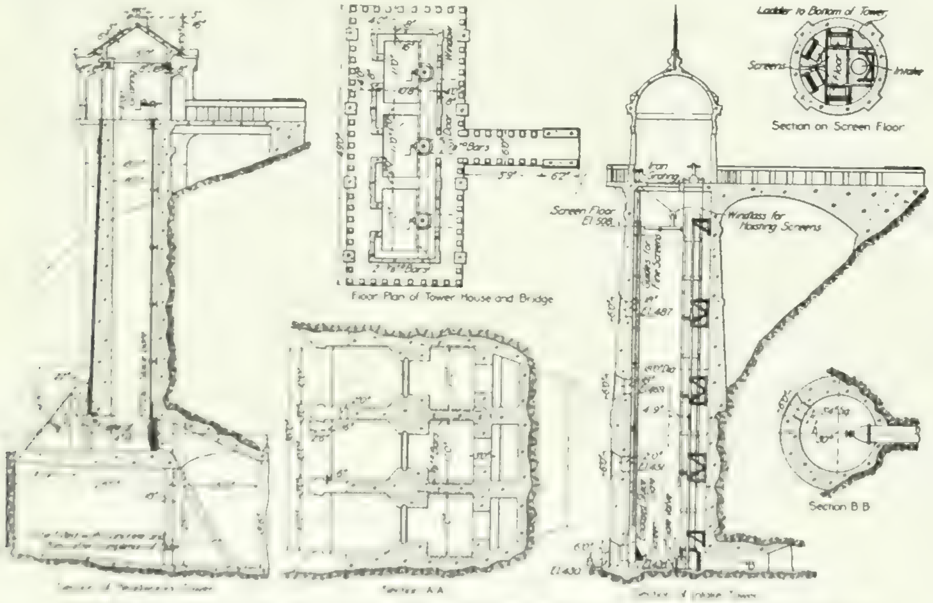
Coquitlam Dam.—In order to obtain sufficient reservoir capacity to store practically the entire Coquitlam run-off, it was decided to build a dam just below the existing timber crib dam, which would raise the lake level 60 ft. and increase the capacity of the reservoir by 162,000 acre ft. This will give a total available storage when the reservoir is full of nearly 175,600 acre ft., or 7,562,000,000 cu. ft.

The dam site is at the extreme southern end of the lake. On account of the geological formation, it was considered impracticable to build a masonry dam. Bed-rock lies so far below the surface of the valley that it would be impossible to get a rock foundation, and the hydraulic earth fill type was adopted on the recommendation of Mr. James D. Schuyler, M. Am. Soc. C.E., who acted as consulting engineer until all the original plans for the dam had been prepared.

The new dam is being built upon a great natural dam thrown across the valley at this point by the receding glacier, and is made up of fine blue glacial boulder clay, and tightly cemented gravel and boulders. Excellent construction material, in large quantities, is available and the borrow pits can be located in the most advantageous positions.

The city of New Westminster draws its water supply from Coquitlam Lake, and in order to safeguard its interests during the construction of the dam, and to approve of the final plans of the dam and the new waterworks intake, the Dominion Government appointed Mr. John R. Freeman, M. Am. Soc. C.E., to represent their interests under the agreement entered into between the Dominion Government and the Vancouver Power Company.

The completed dam will have a length on the crest of 850 ft. The crest is at El. 518, and has a width of 40 ft. The upstream slope is 5 to 1 from the crest to El. 467, and from there to the toe the slope is 1½ to 1. The downstream slope is 2 to 1 from the crest to El. 500, 3 to 1 from there to El. 475, where there is a berme 6 ft. wide, and from the berme to the toe the slope is 4 to 1. The extreme height of the crest above the lower toe is 98 ft. At both the upstream and downstream toes there are heavy rock walls, and these will confine and support the material sluiced into the dam. Both slopes are covered with riprap 3 ft. thick, the upstream riprap being laid in concrete up to above the normal water level. The total volume of the dam is 530,000 cu. yd., of which [illegible] cu. yd. are rock hauled in the toe walls and riprap and the remainder is sluiced material. There will be no core wall of any kind, and water tightness will be secured through the great thickness of puddle bound with several shallow trenches. The dam will be built almost entirely on tight blue glacial clay, which is quite impervious and forms a splendid foundation. The east end of the puddle keys into a deep trench made on the surface of the granite ledge which slopes at a steep angle towards the centre of the glacial valley.



Details of Gate Towers on the Coquitlam-Buntzen Hydro-Electric Project.

Spillway Section.—The spillway will be located at the east end of the dam, and will be cut through the spur of ledge so as to be entirely separate from the dam. The width of the cut at the entrance is [illegible] ft. and [illegible] ft. at the lower end in rock. The concrete sill of the spillway will be at El. [illegible], [illegible] ft. below the crest of the dam. A channel [illegible] ft. wide and [illegible] ft. deep will be cut along the west side of the spillway and will be used for the removal of logs and drift which may gather in the lake at the dam. This channel will be provided with a movable dam so that no water need be wasted unless required. The capacity of the spillway will be 12,000 cu. ft. per second when the water is 7 ft. deep over the sill. The spillway cut will necessitate the excavation of over 75,000 cu. yd., about 53,000 of which will be rock.

Outflow Tunnel.—During the construction of the dam the outflow from the lake will be carried around the dam site through a tunnel driven through the ledge under the spillway. This tunnel is 490 ft. in length, and has a sectional area of 400 sq. ft. The clear width is 26 ft., and the height is 18 ft. 6 in. to the centre of the roof, which is semicircular in form. The floor and sides, to a height of 12 ft., will be lined with concrete. The floor of the tunnel entrance is at El. 435, and slopes to 425 at the lower end. The tunnel was designed to carry 12,000 cu. ft. per second, when the lake surface is at El. 475, but will probably never be called on to carry much more than half of this, as the above quantity is the maximum recorded rate of run-off. After the completion of the dam, this tunnel will be used as an outlet or sluice tunnel.

The river is carried to the tunnel entrance in a channel 860 ft. long, tapping the lake at El. 443, immediately north of the old dam. This channel is 40 ft. wide at the bottom with sides sloping 1½ to 1, and calls for a total excavation of 202,000 cu. yd.

The channel at the lower end of the tunnel, carrying the river back to its old channel, is a much smaller piece of work, as the water can be depended upon to cut a channel for itself if it is properly guided and given a chance. The excavation for this channel amounts to 80,000 cu. yd.

Sluice Gates and Tower.—The gates for controlling the flow of water through the sluice tunnel will be placed in a concrete tower at the lake end of the tunnel. The floor of the tower will be at El. 455, spanning the tunnel entrance and supported on two piers placed parallel to the flow in the tunnel. Guides are provided at the upstream end of the piers for three gates, made up of 15-in. I-beams and heavy timbers, and these gates will be dropped into place when the dam is completed, thus closing the tunnel entrance. The space between the floor of the tower and the floor of the tunnel will then be filled with concrete and plums, permanently closing the upper end of the tunnel, excepting through the sluice gates. The tower is rectangular in form, built up of three separate compartments 8 by 11 ft., each one independent of the others. It is built back in the cut at the tunnel entrance, so that the back wall and side walls are against the rock for three-fourths of their height. The tower is surmounted by a concrete gate-house surrounded by a balcony at El. 513. A short concrete bridge connects the balcony with the shore of the lake. The main sluice gates are 5 ft. in diameter, and are placed in the back wall of the tower at the floor level, discharging directly into the tunnel. The openings in the front wall can be closed by auxiliary gates made up of I-beams and timber, and operated by chains from the gate house balcony. It is only intended to use these auxiliary gates for inspection of the main gates. Inclined racks are built against the front wall of the tower, protecting the gates from water-logged timber or other trash which might be drawn into the tower. Since the building of the dam and the consequent raising of the lake level rendered the New Westminster waterworks intake useless, it became necessary to construct an entirely new intake system. The new intake structure is a heavy concrete tower built on a spur of bedrock on the east side of the lake about 1,000 ft. north of the dam. The floor of the tower is at El. 428, and the floor of the concrete gate house at El. 518. The tower is circular in section, with an inside diameter of 18 ft., top and bottom. The walls are 4 ft. 6 in. thick from the bottom to El. 465, and taper to 18 in. at the top. A concrete arch bridge connects the tower with the shore. There are four 40-in. square intake openings in the tower placed at Els. 430, 451, 469 and 487, at angles of 60 deg. to each other. The openings are belled to the outside and covered with racks 6 ft. square. Gates are secured over the openings on the inside of the tower, and since these gates are subjected to back pressure only, tending to force the disc away from its seat, it was necessary to build them of special design. The cast steel gate disc slides in vertical guides, but the gate seat and the back of the gate are at a slight angle to the direction of travel. The disc is, therefore, wedged tight to the seats when in the lowest position, the guides taking the full thrust of the pressure of the water against the back of the disc. In all other positions of the disc the seats are not in contact; hook wedges are provided at the top and bottom of the gate to hold it against the seat. The seats, and all wearing surfaces, are lined with gun metal. These gates are enclosed in a sheet steel box having an opening directly in front of the gate opening over which the fine screens are placed. These screens are made up in teak wood frames and are lowered into position by means of a hand winch placed on the screen handling floor at El. 508. The screen frames slide in channel guides secured to the tower walls by brackets and anchor bolts.

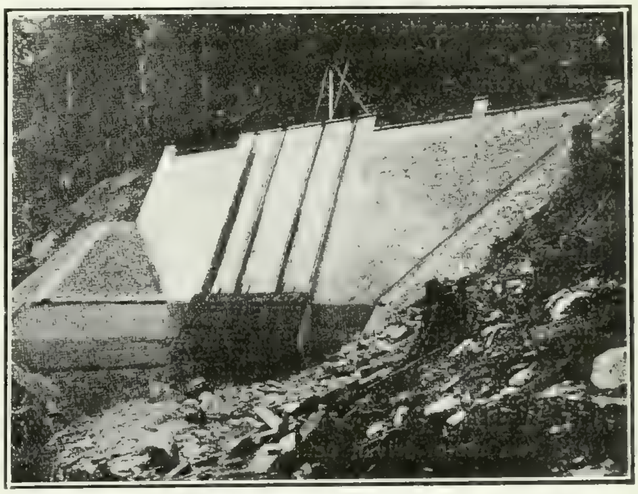
A secondary intake is placed entirely within the tower whereby the water may be drawn off at any desired level. This intake consists of a stand pipe 42 in. in diameter built up in four separate sections, each section having conical seats on the upper and lower ends, each section seating on the one next below it, and the bottom section seating on a heavy cast iron elbow set in the tower floor. The intake pipe sections are guided between two 60-lb. rails placed on opposite sides of the pipe and bracketed to the tower wall at frequent intervals. Lifting rods 1½ in. in diameter are attached diametrically opposite near the top of each pipe section. This intake is operated by hand by means of a lifting gear which may be attached to any set of lifting rods.

The openings in the intake pipe are at Els. 433, 451, 473 and 481. A channel 20 ft. wide at the bottom, with side slopes 1½ to 1, is cut from the base of the tower to deep water in the lake.

From the intake tower the water enters a tunnel 1938 ft. long around the east end of the dam, and connects to a distributing chamber near the lower toe of the dam. This chamber is supplied with a blow-off valve and pipe connections. The tunnel is all in rock excepting for a distance of 508 ft., which portion is lined with steel pipe 4 ft. in diameter encased in concrete. The tunnel in rock is 4 ft. wide by 6 ft. 6 in. high, and only the floor is lined with concrete.

Construction Methods, Excavation.—The construction of the Coquitlam dam was started in the winter of 1908. The whole of the dam site was covered with heavy virgin forest, and it was necessary to clear about 60 acres before other construction work was started. During the winter of 1909 the pumping plant was installed, and in the spring of 1910 the stripping of the dam foundations and the excavation of the diversion channel were started. All of this excavation work has been done by the hydraulic process and this method has proved very successful for the greater part. While working in the upper parts of the cut in the boulder clay banks, with a flume having a grade of over 3 per cent., as high as 11,000 cu. yd. of material were removed in one week, about 120 hours actual working time, using one jet delivering 10 cu. ft. per second at a pressure of 110 lb. per sq. in. at the nozzle. This record just cited is considerably above the average, but serves to show what can be done under proper working conditions.

In the excavation at the lower levels, a great deal of difficulty was experienced because of the very low flume grades and the heavy materials encountered. It became necessary when excavating the bottom of the diversion channel to use hydraulic gravel elevators to raise the sluiced materials from the floor of the channel to the flume level, a height of from 5 to 12 feet, depending on the distance the flume end extended into the cut. This flume was run on a grade of only 2½ per cent., and it was necessary to use great care in the grading of the sluiced materials so that they would not drag and clog the flume.



Completed Tunnel Intake, Showing Trash Rocks.

The flumes used in all of the excavation work are of rectangular section 20 in. wide. They are built of 1½-in lumber and are unlined on the sides. The bottom is lined with ¼-in. steel plates secured by countersunk screens and 2 x 4-in. strips nailed along the bottom corners. The lower end of each plate lapped over the one next below it about 3 in. This lining proved to be quite satisfactory, as the wear comes almost entirely on the bottom of the flume and the plates can easily be removed and replaced when worn out.

Practically all of the excavation was done in heavy boulder clay and in tightly cemented gravel and large boulders. The clay was easily handled, as it could be bored and shaken up with powder and then broken up and removed by the jet. The cemented gravel had to be treated quite differently, as it was almost impossible to bore and shoot it, and it would have required a very powerful steam shovel to handle it. It was found that a high pressure jet at close range made better progress than any other available method. Wherever it was possible to drill and shoot, this was done, but only shallow holes could be put down on account of the tendency of the drill to loosen the gravel and stick.

In these excavations a large quantity of boulders were uncovered which could not be run through the flumes. These were loaded into cars with a dragline bucket, with derricks or by hand, and dumped into the rock walls forming the toes of the dam.

The excavation for the New Westminster intake tower was made behind a cofferdam built out into the lake at that point. This dam consists of a timber crib filled with rocks and clay, having sheet piling driven along the face of the crib into the silt forming the lake bottom. The volume of this excavation was 10,000 cu. yd., 8,500 of which was sluiced and elevated from the pit by a hydraulic gravel elevator. The height of lift varied from 23 to 36 ft. At the greater lift, a 3½-in. stream under 125 lb. pressure was used in an elevator having a 10-in. throat. This method proved very satisfactory.

Tunnel Driving.—Both the sluice tunnel and the water supply tunnel were driven by contractors. Two shafts were sunk along the line of the water supply tunnel and it was worked from several faces. One of the shafts will be lined with concrete and used for inspecting the tunnel. The sluice tunnel was driven from the upper face and also both ways from a break-up directly over the point where it crosses over the water supply tunnel. This tunnel was driven with one heading and a bench. The heading included the whole tunnel above the springing line, 28 ft. wide on a 14-ft. radius, and the bench was 5 ft. deep. Most of the rock removed from the water supply tunnel was wasted, but all of that taken from the sluice tunnel was used in building up the toe walls of the dam.

The material overlying bedrock in the spillway cut was removed by the hydraulic process and the rock is being quarried out and placed in the dam toe walls by two cableways. The sluicing of material into the dam was started this summer. The borrow pits are placed in an advantageous position where the choice of material is large and the grades are good.

The original pumping plant supplying water for the sluicing operations consisted of two motor-driven centrifugal pumps of 4 cu. ft. per second capacity each, one of them operating against 50 lb. per square inch, and the other against 150 lb. per square inch. This plant has been increased by the addition of one motor-driven centrifugal pump delivering 4 cu. ft. per second against 150 lb. per square inch, and two motor-driven centrifugal pumps delivering 5 cu. ft. per second each against 150 lb. per square inch. The compressor plant consists of two motor-driven compressors delivering 400 cu. ft. per minute at 100 lb.

Power is obtained from the Lake Buntzen power house. The line supplying the dam taps the company's line six miles south of the dam site. The current is transmitted at 34,000 volts and transformed at the dam site to 2,200 volts, [illegible]

Enlargement of Coquitlam Tunnel.—It was absolutely [illegible] Coquitlam Tunnel open for a large part of the time in order to maintain a supply of water in Lake Buntzen, and this made the actual working time in the tunnel very uncertain and of short duration. During the summer months more than half the time was lost in this way on [illegible] from the Lake Buntzen [illegible]

The work of enlarging the tunnel was started from the [illegible]

[illegible] engineers was the "overhead" method, which consisted of [illegible] tunnel sides. These timbers were placed about 6 ft. apart, [illegible] timber floor as the floor of the heading. In this way the work could be carried on in both directions from as many "break-ups" as was practicable. The several headings were mucked into cars on the track in the tunnel below by withdrawing the floor timbers and opening up the floor directly in front of the muck pile. The timbering was kept well ahead of the faces and left standing for some distance behind them. During the first part of this work horizontal holes about 6 ft. deep were drilled into the face of the heading in the usual way, but on account of the hardness of the rock and the heavy charges of powder necessary to make a clean break it was almost impossible to make the timbering of sufficient strength to stand the blow. The method of drilling was, therefore, changed and vertical holes were drilled from the tunnel below before the timbering was put in, keeping the drilling well in advance of the face. This system of drilling and shooting proved satisfactory, as the force of the shot did not act downward on the timbers, but threw the muck back from the face.

This method of enlargement gave the tunnel a section much the same as an egg held with the point down, with an area of 176 sq. ft.

Some very fair work was done under this system after the crew was well broken in, but there was one difficulty which it seemed impossible to overcome. The timbering cut down the area of the tunnel to such an extent that its capacity was considerably decreased. This made it necessary to leave the tunnel open for a greater part of the time than would have been necessary otherwise, in order to keep the level of the water in Lake Buntzen above the lower limit, and, therefore, less time was available for work in the tunnel. The greater the number of headings worked the greater was the obstruction in the tunnel, as timbering was necessary at every heading. The demand for water was increasing daily in spite of the fact that the company had built a steam plant in the city and had relieved the Lake Buntzen power house of 4,000 kilowatts of its load.

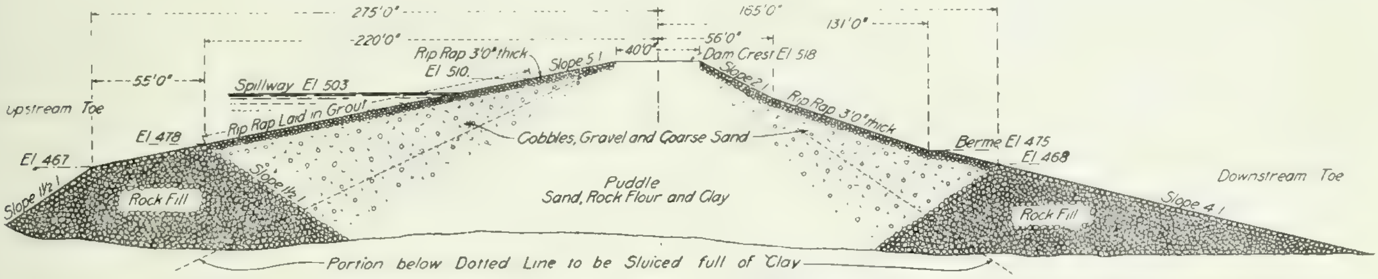
In July of 1910 the "overhead" method was abandoned in favor of one which necessitated no timbering. At this time about 1,800 ft. of enlargement had been completed and the tunnel was drilled to a point 3,000 ft. from the portal. Before changing over the drilled portion was completed by the first method.

Drilling and Mucking.—The method by which the remainder of the tunnel was enlarged consisted of removing sufficient rock from one side and the roof to increase the area from the original 81 sq. ft. to 192 sq. ft. The side headings were started at intervals of from 100 to 130 ft., and were worked in both directions. The drilling was all done from the main tunnel at right angles to the line of the tunnel. The holes were drilled 8 ft. deep, and were placed in vertical rows spaced 3 ft. apart, each row having five holes. Two rows of holes were drilled from one setting of the drill column mounting two drills on horizontal arms, one on each side of the column. The drilling was carried on independently of the shooting and mucking, and was kept well ahead of these two operations. When the "break-outs" were first started and were narrow between the faces, only one row of holes would be shot on each face, but two rows were shot on each face after the headings had widened out sufficiently to accommodate the muck pile without spilling it out over the tracks in the old tunnel. As many as 14 "break-outs" were worked at one time, giving 28 working faces. This operation removed the rock from the side of the tunnel, and the roof was trimmed up by a separate gang following the first. The heavy shots in the side of the tunnel broke out well into the middle of the roof, and it was often necessary to do very little trimming. After the side holes had been shot and mucked a small, gang followed with stoping drills and drilled the roof where it was necessary.

The work was carried on in the tunnel as long as the water in Lake Buntzen was above the minimum level. When this level was reached the tunnel was opened and allowed to remain open until the lake was filled again. Two ten-hour shifts were worked in the tunnel. All of the drilling was done on the day shift, and the shooting was done when the drilling shift went off duty.

When the night crew came on the two tunnel locomotives took the men as far as the first face, where they started to clear the track of all muck. As soon as the track was cleared the cars were spotted at each of the faces and the mucking was carried on as quickly as possible and the tunnel cleared ready for the day shift and drills.

The muck was hauled in 1⅓-cu. yd. side dump cars, which were handled in the tunnel in trains of 25 to 30 cars by electric locomotives of 40 h.p., taking current at 500 volts from a trolley wire hung from the roof of the enlarged tunnel. The trains were run on schedule time, having regular passing points. There was also a telephone in the tunnel, and any delay was reported and the passing points of the trains changed accordingly. Side tracks 500 ft. long, for the passing of trains and the storage of cars, were built in the enlarged tunnel every 1,000 to 1,200 ft. The track was laid on 36-in. gauge and constructed of 20-lb. rail. Two lighter locomotives were used for handling the cars outside of the tunnel on the dump and making up trains for the tunnel locomotives.



Cross Section of Dam, Showing Distribution of Material.

The muck was all dumped into Lake Buntzen, which is very deep at the tunnel entrance. The dumping tracks extended down the shore from the tunnel for a distance of about 1,000 ft. On account of the tendency of the dump to slide under the weight of the loaded cars, it was carried out on two levels and the tracks were kept some distance apart. By this arrangement the cars could be dumped from the upper track while repairs were being made, or the track shifted on the lower dump.

Drainage and Ventilation.—When the gates at the Coquitlam end of the tunnel were closed it was necessary to wait for some time before the tunnel was sufficiently free of water to allow the workmen to enter. In order to better this condition, an automatic shutter dam was placed in the tunnel at station 72 + 00. This dam was pivoted on its horizontal axis and closed automatically when the water was 4 ft. deep, thus storing the water to that depth behind the dam, allowing the lower end of the tunnel to clear quickly. When the gates were again opened and the water raised, the dam swung so as to be parallel to the flow of water, offering no resistance to the flow.

The original tunnel was not driven straight through on one grade, but sloped from El. 400 at the Buntzen portal to El. 410 at station 72 + 00. From there it sloped to El. 407 at station 119 + 00 and to El. 428 at the Coquitlam end at station 126 + 45. There therefore existed a sump nearly 5,000 ft. long near the Coquitlam end of the tunnel, where the maximum depth of water was about 4 ft. It was at first intended to enlarge this portion by shooting down enough rock from the roof of the tunnel to fill the sump and bring the floor to true grade, thus having a dry tunnel to work in, but this plan was rejected in favor of placing a large motor-driven centrifugal pump at the Coquitlam end of the sump and pumping the water from the sump back into Coquitlam Lake. The pump was set up in a water-tight compartment blasted out of the side of the tunnel. The pump motor was started from above shortly after the gates were closed and the sump pumped dry in a very short time. The method of enlarging the tunnel from the summit, through the sump, and to the gates at the Coquitlam end, was the same as that used up to the summit.

The tunnel being open at both ends, it was a comparatively easy matter to ventilate and clear out the powder gases. A large motor-driven blower of 56,000 cu. ft. per minute capacity was placed at the Buntzen portal. After the shooting was done the portal was closed and the blower started, and all gases were cleared out within 30 minutes.

Drills and Drilling Gangs.—No. 7 Water Leyner drills were used almost exclusively in the work of enlargement, and the work done by these machines is exceedingly creditable. They averaged something over 40 ft. of hole per machine per day of less than 9 hours actual drilling time. most of the machine men were not experienced Leyner men, and they were often prejudiced against that drill, but they learned rapidly and soon came to like the machines. The greatest number of drills in use in the tunnel at one time was 54, not counting the stopers, which numbered from 3 to 7.

Each drilling foreman had charge of four machine crews. Upon going off shift, the drill foreman loaded all of his machines and steel on the train and took it to the repair shop, where the machines were gone over by the repair crew during the night, and any necessary adjustments were made. In this way the machines were always kept in first-class order. On going into the tunnel each morning each drill crew attended to the loading of their machines and sharp steel. One repair man was kept in the tunnel on the drilling shift and any slight repair or adjustment could be made at once. The steel sharpening was done by three Leyner sharpeners working two shifts of ten hours. One temperer on each shift tempered all the steel.

Air was furnished to the drills by two compressor plants, one at each end of the tunnel. The Buntzen plant consisted of one Ingersoll-Rand and four Leyner motor-driven compressors having a total capacity of 2,250 cu. ft. of free air per minute. The Coquitlam plant consisted of two Ingersoll-Rand motor-driven compressors having a capacity of 500 cu. ft. of free air per minute. Both of these plants fed into a 5-in. diameter air main running the whole length of the tunnel. Water under pressure was furnished to the drills through a water main laid parallel to the air main.

The tunnel enlargement was completed in March, 1911, in less than 100 working days after the side method of enlargement was started. The average advance per day of two shifts during this time was very close to 100 ft. of enlargement. The maximum advance for one day was 175 ft., when 730 cars of muck were hauled out of the tunnel. The maximum number of men at work at one time was 450. Serious accidents to the workmen were very rare occurrences. On most work of this character accidents are almost the rule, but on this work only one man was killed by rock falling from the tunnel roof, and two were injured by a "missed hole."

Tunnel Intake.—When the tunnel enlargement was started a 9-ft. diameter Coffin sluice valve was put in the tunnel a short distance downstream from the old gates. This valve was placed in the tunnel at the bottom of a shaft sunk from a tunnel which was driven above the proposed high-water level of Coquitlam Lake and was designed to operate under 85 ft. of head.

When the tunnel enlargement was completed the Coffin gate was taken out and re-set about 40 ft. upstream in place of one of the original sets of gates, and the old gates were removed entirely. In the place of the Coffin gate two Stoney roller bearing sluice gates were installed. These gates are each 4 ft. 6 in. wide and 10 ft. high. The Coffin gate is set in a Venturi throat and the tunnel is concrete lined between the Coffin and the Stoney gates. The Stoney gates will be used as the usual operating gates, and the Coffin gate as an emergency gate or whenever perfect watertightness is required.

The original intake consisted of a rock-filled timber crib built out into the lake and enclosing three intake tunnels 7 ft. square, made up of 12 x 12-in. timbers set close. These short intake tunnels were joined together into one tunnel back in the rock in front of the gates. The capacity of this intake was not sufficient for the enlarged tunnel and it was therefore torn out and a new one constructed.

The new intake consists of a heavy masonry retaining wall inclined back against the steep hill above the tunnel entrance, the elevation of the top of the wall being above the proposed high water level. The bottom of the wall is on bed rock and it is 50 ft. wide at the tunnel entrance. The main wall is flanked by two inclined wing walls extending diagonally out into the lake from the back wall. Four rails are laid vertically up the face of the back wall from below the tunnel entrance to the top of the wall, and these rails form the track to the racks. The racks are mounted on eight wheels and are made up of a heavy framework of I-beams supporting a "gridiron" of 40-lb. rails laid vertically a few inches apart. The gate operating gear is placed in the upper tunnel and the gates are geared to be operated by either electric motor or gasoline engine, or they can be operated by hand.

The rack is 41 ft. wide and 35 ft. high, and is supported by heavy cables, counterbalanced that it can be raised and and cleaned at any time, and operated by a power winch. In case any very heavy drift gathers in the forebay it can be removed by a heavy [illegible] [illegible] which is placed on the top of the retaining wall.

Power House.—Since the original installation of four [illegible]-kw. generators in the Lake Buntzen power house the capacity of this plant has been increased three times, each time by the addition of one [illegible]-kw. generator driven by [illegible]-h.p. impulse waterwheel. The present capacity of the plant is [illegible] kw. in [illegible] generators driven by waterwheels totaling [illegible] h.p. Three-phase, [illegible] current is generated at [illegible] volts. Two [illegible] waterwheel and motor-driven exciters supply the excitation current for the main generators. The equipment is complete with all switchboard instruments, etc., but the transformers and high tension apparatus are placed in a separate building. The power house is a native granite building and the transformer house is constructed of reinforced concrete. The current is stepped up in the main transformers to 34,000 volts, at which voltage it is transmitted to the various sub-stations around Vancouver.

No further extension can be made to this plant without going to great expense, and the company now has under construction a separate power house at a point about 1,800 ft. south of No. 1 plant.

This new power house, known as "Lake Buntzen Power House No. 2," will draw water from Lake Buntzen through a concrete-lined tunnel 14 ft. 8 in. in diameter and 1,750 ft. long. A concrete surge tank is built at the lower end of the tunnel, and the water is conveyed from the tank to the power house, a distance of 600 ft. down the hill, through three heavy steel penstocks 8 ft. 6 in. in diameter.

Power House No. 2 will be equipped with three generators of 8,900 kw. capacity driven by 13,500-h.p. Doble impulse wheels. Each generating unit is complete with a 300-kw. waterwheel and motor-driven exciter. Three-phase, 60-cycle current is generated at 2,200 volts and stepped up to 60,000 volts in the main transformers, at which voltage it is transmitted to Vancouver. The equipment of this power house will be complete in every way and of the most modern and approved design, and will include 36,000 kw. in transformers, together with all high tension switching apparatus. The power house building is of reinforced concrete and of handsome design. Two of the three units will be installed and put in operation during the winter of 1912-13.

The works at present in progress are being carried out under the direction of Mr. R. H. Sperling, general manager, and Mr. G. R. G. Conway, chief engineer of the company, assisted by Mr. W. V. Hunt, hydro-electric engineer; Mr. Fleming Ramsaur, resident engineer at Coquitlam Dam, and the writer as assistant engineer. Mr. J. R. Freeman, M. Am. Soc. C.E., is advising engineer for the Dominion Government, and Mr. R. S. Stronach is inspecting engineer, acting under instructions from the Water Powers Branch of the Department of the Interior.

◆

A NEW BRITISH FACTORY FOR DIESEL ENGINES.

In spite of the progress which has been made by Continental engineers in the construction of Diesel engines it is of considerable interest to note that extensive Diesel engine works are being built as Ipswich by the Consolidated Diesel Engine Manufacturers, Limited, London. This will be the first large factory in Great Britain devoted exclusively to the manufacture of Diesel engines for ship propulsion as well as for stationary purposes.

Situated in a most convenient and accessible quarter of the town, with lines from the Great Eastern Railway running direct into the buildings, the new works will be equipped completely with the latest types of machinery and plant for first-rate workmanship. From the inauguration employment will be given to several hundred workmen, and provision has also been made to secure additional land in order to cope with the increasing demand for Diesel engines. All preparations are well in hand, and it is anticipated that the works will be in full swing in the early part of the coming year.

Mr. W. J. [illegible], managing director of the Consolidated Diesel Engine Manufacturers, Limited, is in Toronto this week and expects to go on the Coast before returning to England.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, OCTOBER 10, 1912. No. 15.

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
City Government by Commission 583
Sewage Disposal and the Great Lakes 584

Leading Articles:

Steel Towers for Overhead Transmission Lines.... 569
A Stadia in Georgian Bay, District of Parry Sound 573
Steel Highway Bridges 574
Grade Reductions on the T. & N. O. Railway...... 575
A New Forging Press 576
The Coquitlam-Buntzen Hydro-Electric Power Development 577
Canadian Ports of the Pacific 585
A New Type of Sewer Pipe.................... 591
A New System of Illumination to Avoid Glare by Diffusion 593
American Road Congress 595

Coast to Coast 598
Personals 599
Coming Meetings 600
Engineering Societies 600
Market Conditions 24–26
Construction News 67
Railway Orders 72

CITY GOVERNMENT BY COMMISSION.

The justification for government by city council will fast disappear if many men of the type indicated by the following statement are elected municipal office. An alderman in one of our larger cities the other day made the statement that the day should never come again when the judgment of experts should be considered infallible, especially when the expenditure of immense amounts of money is involved. To secure economy in carrying on the industrial affairs of a city the work necessarily must be in the hands of experts. Until this fact is thoroughly understood by the public, inefficiency and waste must follow the present system. Prof. Slichter, of the University of Wisconsin, in a recent address on the present tendencies of this age, states that perhaps the greatest mission of science and industrialism to our era is the removal of controversy from human progress. This is, indeed, a great service to mankind—to narrow the field of strife, to remove obstacles, to settle great public matters by bringing to bear accurate data, adequate analysis of cause and effect, and expert judgment—so that contention, or partisanship, or politics, is eliminated, and things are settled on their merits. This phase of the industrial age is fast developing. The numerous expert commissions appointed by the States and Government to investigate and determine important questions upon the basis of exact knowledge is a pertinent illustration. The Wisconsin Commission is settling all matters concerning the public utilities solely after adequate investigation and skilled tests. These same matters can never again become the football of partisanship or political manipulation. Likewise, the commission form of municipal government is removing from the field of politics, and local contention, questions which are really largely matters of skill and exact science. The best kind of water supply, the proper sort of sewage disposal, the best way to handle streets, street railways, public parks, schools, playgrounds, public health, the housing problem, etc., are no longer matters of fight or ballot in well-ordered communities. There exists always a best way, and experts are selected to find and direct it. The modern civilized community is no longer a state, but a school. The body politic has become one vast, complexly organized, research institution. Governments are, in this age of industrialism, instruments for replacing darkness with light, for substituting for the indefinite and approximate, the definite and accurate. This is about all there is to the best public service. The State has become a great thinking, investigating organization, or laboratory, or research institution. There is this distinction between the school and the State: the school researches only, the State researches and acts. The illumination of great public matters by modern scholarship is best illustrated by what is constantly occurring in the countries of western Europe. There, as every one knows, municipalities are in the hands of experts whose life work is a study, as in a laboratory, of the needs of the community and its individuals. Nothing is left to chance, and little to choice, except when the people can be trusted to choose wisely. The city and State with its utilities, sanitary inspection, land purchase, construction and sale of homes for working men, control of food, care of children, supply of milk, expert advice to mothers, the promotion of all sorts of special schools, museums, galleries, theatres, concert halls, municipal banks, pawnshops, employment bureaus, industrial insurance, old-age pensions, etc., etc., is conducting a laboratory for racial and civic betterment, and is carrying upon the broad shoulders of the State the burden that a democracy would shift to the people themselves. All new or difficult questions receive special study, and an honest attempt is made to settle them in the best manner.

◆

SEWAGE DISPOSAL AND THE GREAT LAKES.

The International Joint Commission on Waterways is now in session at Ottawa, and is taking evidence preparatory to reporting on the question of the pollution of boundary waters. It will be remembered that a short time ago this Commission was instructed by the governments of Canada and the United States to investigate and report on this question.

Dr. McLaughlin, of the Surgeon-General's Office at Washington, D.C., in his evidence before the Commission last week, stated that to compel cities along the Great Lakes to so treat their sewage that it would not contaminate the lakes into which it is dumped would place upon these cities an unnecessary and unjustifiable expense which would bankrupt the cities in most cases. He adds that it is largely a matter of sentiment which would prohibit dumping raw sewage into rivers and lakes. He considered it impossible that contamination from Canadian cities was ever washed across the lakes to make impure the water of an American city, or vice versa.

Dr. Hastings, Medical Health Officer of Toronto, takes issue very strongly with Dr. McLaughlin, and his objections are well taken. Dr. Hastings, however, labors under a misapprehension when he states that Dr. McLaughlin's viewpoint, as expressed in his evidence, is that of the engineer rather than the health officer. It is true that the engineer is controlled to some extent from the standpoint of economy, and is not governed by the desire for complete bacterial purification. Dr. McLaughlin cannot be considered in any sense an engineer, and we are quite satisfied that if engineering experts had been consulted their evidence would have been very different from his.

If Dr. McLaughlin has been correctly quoted, his evidence is certainly not borne out by the facts. It is well known that Niagara Falls, for many years, has had the highest death rate due to typhoid of any city or town in America, and this has been directly due to Buffalo dumping its untreated sewage into the Niagara River above Niagara Falls. The provincial bacteriologist for Ontario in his report for last year states that a study of Lake Ontario water would lead one to suspect that this lake is becoming more and more infected. The samples collected some years ago would have led one to hope that it was possible to go out into the lake far enough to escape the infection, but this year he has found infected samples and those containing high bacterial counts fifteen miles out into the lake. The chemical samples collected at the same time bore out these findings. He states that though infection is less frequent far out, still it exists, and comparatively frequently.

It is understood that the provincial health authorities of Ontario will be represented before the International Joint Commission before the investigation is completed, and it is altogether probable that their evidence will be decidedly against that offered by Dr. McLaughlin.

EDITORIAL COMMENT.

It is nearly time the city of Toronto took action on the question of a City Architect. We are tempted to believe that another of the Council desires a permanent civic position.

* * * *

The council of the city of Winnipeg, as is usual with such bodies, before acting on the report on a new water supply, is first wasting valuable time in criticism of the expert who made the report. What should be done at the earliest possible moment is to secure an accurate estimate of the cost of obtaining water from Shoal Lake.

* * * *

The raising of the standard of entrance to the University of Toronto this session has had its effect on attendance. Last year's registration in the first year of the Faculty of Applied Science and Engineering was about two hundred and eighty. This year's registration is, to date, one hundred and eighteen.

* * * *

Hon. Frank Cochrane, Minister of Railways, at a railway route map hearing, held in Ottawa recently, withheld his approval of the route of the Alberta, Peace River and Eastern Railway until October 15th, in order to give the promoters an opportunity to prepare a map of the Calgary-Edmonton section, giving more details and indicating more clearly the location of the other railway lines. Incidentally, he stated that in future he does not propose to approve railway lines until good surveys have been made. We are glad to note this move of the Minister. Far too many projected railroads have received their charters without sufficient preliminary surveys being made to show the practicability of the individual schemes.

* * * *

Last week we emphasized the remarks of Sir William Willcocks before the Western Canada Irrigation Association, concerning the tendency towards light design in the irrigation works of Western Canada. In the daily press this week we note that the intake belonging to one of the irrigation companies has failed. The structure is almost completely destroyed, and it is understood that there was the loss of one life. There is little question that in many instances economy of design rules to the exclusion of a proper factor of safety. The regulating works on the rivers in the East are most conservatively designed and built; in fact, to the minds of those in the West, accustomed to making a dollar go as far as it will, these works appear stronger than there is any necessity for. At the same time, practically no failures occur there. As population increases in Western Canada, the necessity for more permanent works will become apparent.

◆

DEATHS IN FACTORIES.

According to the report of the chief inspector of factories of Ontario for the year ending December 31, 1911, there were [illegible] accidents reported during the year, which is an increase over the previous year. One reason for the increase is that minor accidents are now reported and another is that the law regarding the reporting of accidents is better observed than formerly. The chief inspector states that a large percentage of the accidents were due to causes that could not reasonably be removed and could only be avoided by the exercise of care on the part of the employees themselves. The fatal accidents totalled 44, which was proportionately the same number as in 1910.

CANADIAN PORTS OF THE PACIFIC.

The Panama Canal is now so nearly an accomplished fact that the importance of the Canadian ports on the Pacific is becoming greater than ever. In a paper prepared for presentation to the annual convention of the American Society of Civil Engineers to be held at Seattle, Wash., on November 20th, 1912, Mr. H. M. Chittenden has discussed the larger ports of the Pacific Coast under the headings of Strategic Relations of Coast Ports, Descriptive Data, Engineering Problems, Administrative Systems, Plans for the Future, Influence of the Panama Canal. As the paper is a very comprehensive one and rather long, we present a very brief abstract of that portion which deals with the Canadian ports.

Commerce of the Pacific.—Since the days of Magellan, imaginative minds have pictured the Pacific Ocean as the future home of the world's commerce. There is something in the immensity of that ocean, in the present vastness of the population on one shore and the future vastness of that on the other, which conjures up visions of argosies such as the Mediterranean or the Atlantic has never known. The situation as it actually exists, however, makes this picture somewhat of an illusion. The very wideness of the intervening sea is a mighty barrier to economic intercourse across it. The breadth of the Pacific as compared with that of the Atlantic, depending on the latitude, is as two or three to one; and, while the cost of transit and loss of time may not be in the same proportion, there is still a wide disparity against the larger ocean. There are also the almost insuperable barriers of race and economic conditions on the Asiatic Coast. We do not admit the Oriental to our shores as we do the European. That immense source of traffic which has sustained its thousands of ships on the Atlantic is cut off on the Pacific. Likewise those Oriental countries have little to offer the traveller, which can compare with the lure of European civilization, ancient and modern. Tourist traffic across the Pacific is a bagatelle compared to that over the Atlantic. Finally, the deep poverty of the hordes who swarm the Asiatic shores, and the backward condition of industry there, are not promotive of vigorous commercial intercourse, for they offer relatively little to sell and less with which to buy.

Thus it results that the commerce of this ocean, great though it be, is small compared with that of the Atlantic, and small to what might be expected from the millions of inhabitants affected by it. Its growth in the near future, strange as it may appear, is more dependent on the countries which border the Atlantic than on those washed by its own waters. As far as the Pacific Coast is concerned, the eyes of its people are turned east rather than west. It is there that their kindred dwell; it is there that the capital exists which shall develop their boundless resources; it is thence that must come those who shall help to populate their shores. It is this fact—that their future is on the Atlantic rather than on the Pacific—which makes the opening of the Panama Canal an event of such tremendous import to them. It is bringing them to their own. It fronts them toward Europe. It opens to them the treasures of the Occident—far more potent, if less romantic, than those of the Orient. It gives them something of the advantage which the eastern shore of the Continent enjoys by reason of its closer relation to the fundamental sources of our civilization.

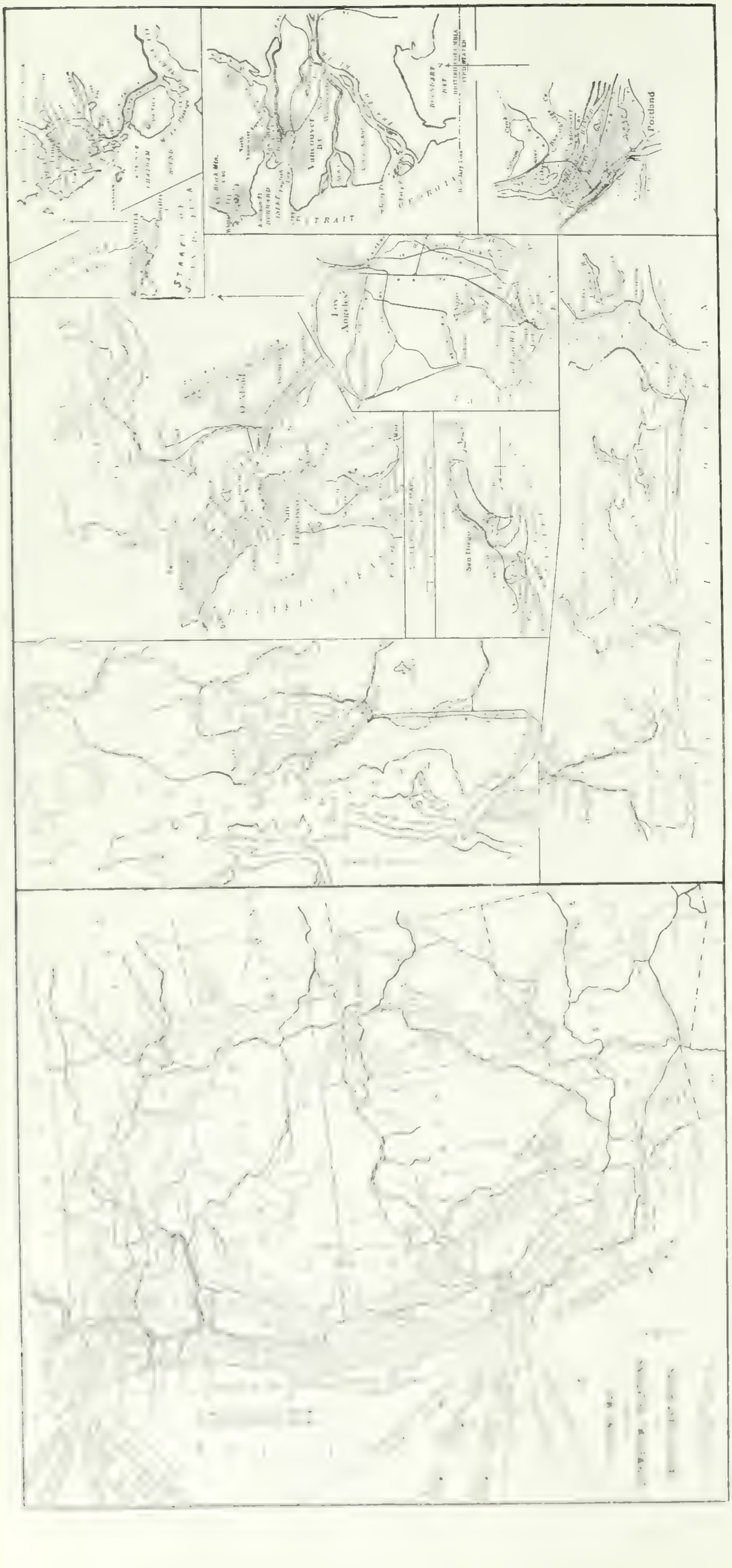
If this condition is true of the present, and will remain so, to a degree, for the indefinite future, let it not blind us to the profound changes which are taking place in those ancient, and, but yesterday, non-progressive, countries which lie on the other side of the Pacific. When we consider what a volume of commerce the accidents of political fortune have turned in this direction from the [illegible] Philippines, when we reflect on the marvellous progress of modern Japan; and when we note the amazing changes now going on in that venerable nation which has slumbered indifferent to the rest of the world for thirty centuries or more, we cannot afford to take a pessimistic view of our future relations with that side of the globe. If ever these people accomplish what is within their practical reach; if ever they turn to account, as is done in Europe and America, their wealth of natural resources and their own capacity for industrial development, surely there will result a mighty increase in trade between them and the rest of the world, and of this the American Continent will enjoy the greater share.

Thus, while the Atlantic holds out to us the brighter present prospect, there is brilliant promise in the Pacific, and in every direction the future is big with hope. Visions of the coming day are profoundly stirring the minds of men. Expansion is in the air. The measureless force of unseen psychological influences rushes the world along whether it will or no. Doubtless, it builds exaggerated hopes and paves the way to much disappointment, but its very exuberance of faith is an earnest of vast accomplishment.

This far-reaching movement, which has been crystallized into definite form by the approaching consummation of the greatest engineering work of ages, finds its intensest expression along the Pacific Coast of North America. To other parts of the world, the Panama Canal means simply increased opportunities for trade; to the Pacific Coast it means a new lease of life through the elimination of those barriers which separate it from its true source of sustenance and growth. Everywhere along the Coast, faith in the beneficial results of this great work is unbounded. It is a faith, moreover, which expresses itself in works. From Alaska to Lower California, the Coast is getting ready for the Canal. It is putting its house in order. It is spending in this work prodigious sums of money. The present decade will witness an expenditure in port development of probably $50,000,000. The slogan which has won this vast sum from the pockets of the taxpayers is: "Get ready for the opening of the Panama Canal," and the formal celebration of that event will find the work well toward completion.

It would be idle to pretend that this prodigious effort springs solely from an actual necessity of providing for the increase of traffic that will result from the opening of the Canal. The popular belief is, of course, that this is the case; but those who have studied the situation closely know better. They realize that the movement is being overdone, but they recognize that it is bound to keep on through the fear which each port entertains of what its sister ports may do. The stigma of possible failure in the race and fear of loss of prestige are the potent forces which are back of these extraordinary efforts. Los Angeles or Seattle would find it difficult on the cold basis of rational business foresight to justify their enormous prospective outlays; but they find ample justification in the necessity of keeping up with a procession which now stalks with tremendous strides from one end of the Coast to the other.

Vancouver, B.C.—Seattle's greatest rival for commercial supremacy north of Portland and Tacoma is Vancouver, B.C., a rival whose strength lies not so much in its natural advantages as in the artificial conditions arising from its being in a different national jurisdiction. It has a good strategic location, it is true, being at the outlet of the second greatest river of the Pacific Coast; but its harbor is inferior to those farther south, and its rail connections east, even to Central Canada, are inferior. Its early growth was due primarily to the fact that it was a Canadian port. That the port would have developed where, or as rapidly as, it has, if there had been no international boundary near by may well be doubted. As conditions actually exist, however, taken with the present status of American navigation laws by which



cheaper foreign shipping is excluded from our coastwise trade, Vancouver is a formidable competitor with ports farther south. In the fish and lumber export trade, particularly, conditions tell heavily in her favor.

Prince Rupert.—Prince Rupert is the northernmost Pacific terminus of the transcontinental lines and will remain so until some line shall cross into the valley of the Yukon and descend that mighty river on its way to the westernmost apex of the Continent. It is 40 miles south of the international boundary of Alaska (54° 40′) and about 700 miles along the coast from Seattle and that much nearer Alaska. It is the westernmost, as well as the northernmost, transcontinental terminus, and is 500 miles (according to the statement of the Grand Trunk Pacific officials) nearer Asia than any other terminus on the Pacific. It is said that a traveller from China would be able to reach Winnipeg, via Prince Rupert, before he could reach Vancouver, if he were to go by that port. Add to this the fact that the gradient over the mountains, with the exception of about 20 miles of 1% on the west slope, is everywhere under five-tenths, and most of the way much less than this, and some of the physical advantages of the route are apparent. Add again the proximity of Prince Rupert to the limitless wheat fields of Canada, the fact that it is in the very centre of the salmon and whale industry, among inestimable quantities of virgin timber, and its great future seems doubly assured.

Its advantages are offset to some extent by the severity of northern winters, but chiefly by the different nationality of the territory (Alaska) which it is best fitted to serve.

Secondary Ports.—Somewhat outside the rivalries of the great ports along the Coast, and flourishing on advantages which are peculiar to themselves, are several smaller ports. Among them, and the more prominent, are San Luis Obispo, about half way between San Francisco and Los Angeles; Humboldt Bay, on the North California Coast; Coos Bay, [illegible] miles south of the Columbia, and serving an important section of Western Oregon; Astoria, just inside the Columbia Bar and the first port to be established on the North Pacific Coast; Grays Harbor, a great lumber port on the west coast of Washington, [illegible] miles north of the Columbia; and Victoria, an important harbor and naval base on Vancouver Island. There are numerous harbors on the Alaskan coast, but they are still in a state of Nature. [illegible] yet has been done toward converting them into up-to-date ports. The prospective opening of the coal fields of Alaska, and a more definite Alaskan policy on the part of the Government, will undoubtedly lead to the establishment of permanent facilities at some of these points in the near future.

In its physical characteristics the Pacific Coast line of North America increases in severity from south to north, but there is less diversity in climatic conditions than one might expect for such great differences in latitude, owing to the moderating effect of the ocean currents. It is not until well up on the Alaskan Coast than one finds the harbors regularly sealed by ice in the winter season. Storms are more severe in the northern latitudes, but this is more than offset, as far as coastwise trade is concerned, by the sheltered inland passages which extend for at least 1,000 miles from Southern Puget Sound north. The tidal fluctuation increases from south to north from a mean of about 4 ft. at San Diego to 14 ft. at Prince Rupert. The teredo is very destructive in all the waters of the Coast, but the limnoria is active only in Californian waters. Nearly all the tributary streams are heavy silt carriers, and the primeval bays and inlets are partly or wholly filled up, making dredging a necessary adjunct of harbor development all along the Coast, and necessitating costly training dikes to scour channels across bars or shoals. In Southern California, the immediate shores were originally lightly timbered; but from Northern California north they were covered with magnificent forests. The coast line is remarkably uniform and unbroken by indentations as far as the Strait of Juan de Fuca, but from there north the exact opposite is the case.

Vancouver, B.C.—The chief Canadian port, Vancouver, B.C., is in the vicinity of the mouth of the Great Fraser River, though actually not in the valley of that stream. More fortunate than Portland, Vancouver has been able to flank a troublesome river with its floods and shoals while still taking advantage of its valley on its rail route through the mountains. The port has been built in a land-locked bay called Burrard Inlet, surrounded on nearly all sides by towering hills which give the location a most beautiful setting. The area of the entire inlet inside the entrance is 23.6 miles, with a shore line of upward of 50 miles; but the port proper, as at present developed, utilizes only a small fraction of this. The shores are mainly of rock formation; the tidal range is 11 ft. mean and 16.4 ft. extreme. There is no ice and the harbor is perfectly sheltered and has good anchorage.

The port facilities, as developed so far, are mainly on the south side of the east 5.5 miles of the Inlet. The portion of the Inlet comprising the harbor is about 1⅓ miles in width, connecting with the Gulf of Georgia on the west and the remainder of the Inlet on the east by two narrow channels designated First and Second Narrows, respectively. These Narrows were formed by the deposit of gravel, sand, and small boulders brought down by mountain streams on the north side of the Inlet and deposited in the shape of extensive bars. The narrows are deep, but only about 500 ft. in width. Navigation through them is seriously handicapped by strong tidal currents, which, at the First Narrows, reach as high as 8 knots per hour at spring tide, and are such a menace to navigation that the Dominion Government has undertaken to widen the entrance by dredging to 1,200 ft. The improvement will not affect the current perceptibly, but will give more leeway for the navigation of ships. In most portions of the harbor the tidal currents interfere seriously with the berthing of ships.

New Westminster.—Ten miles south of Vancouver on the Fraser River, and 16 miles above its mouth, is the town of New Westminster, which is taking active steps to develop port facilities for deep-sea shipping. The Fraser is a large river, not unlike the Columbia, but with a channel less difficult to improve and maintain. The ordinary tidal range at the port is only 5 ft., but the range between high and low water in the river is 14 ft. Reference will be made in another place to the steps being taken to develop this port.

Victoria.—This has been an important port in the past, and is so still, though its commercial business is not large. It is the chief port of Vancouver Island and on it is located the capital of British Columbia. The commercial port is on a small land-locked inlet with bald rocky shores. A few miles to the west is the celebrated Esquimault, an excellent port, strongly defended, and, prior to 1905, the headquarters of the British North Pacific Naval Squadron.

Prince Rupert.—This harbor is on an island within a well-sheltered inlet on the "inside passage" to Alaska, a little north of the mouth of Skeena River, the valley of which stream is the route of the western division of the railroad. The area of the entire inlet in front of and back of the island is about 27 sq. miles, and that of the shore line is about 80 miles. The tidal range is large, the maximum being 27 ft. and the mean about 14. The harbor is perfectly sheltered and is free from ice.

The port is very new, and its development has only begun. It now has about 2,700 ft. of berthing space, of which 600 ft. belongs to the Provincial Government and the rest to the Grand Trunk Pacific. It has a sectional dry dock 600 ft. long. The newness of the port and the fact that rail connection east is not yet opened, give little as yet for comparison with other ports. Its record lies all in the future.

The promoters of this important terminal enterprise adopted the almost unique course in civic growth of laying out their city before its occupancy by settlers began. It has been scientifically planned by artists of national reputation, and, if the plans are followed, it will be spared the disfiguration characteristic of most American cities.

The development of the ports of the Pacific has evolved a great range of engineering problems, some of which are of unusual magnitude, difficulty, and cost.

The subaqueous basaltic rock excavation at the eastern end of Victoria Harbor was performed by the drilling method. The single drill was mounted on a platform float that could be raised clear of high tide by steam power spuds. Steam was furnished from boilers on a barge. Thirty-two holes were drilled at one setting of the raised platform. The holes were 2.5 in. in diameter, drilled to a depth of 2.5 ft. below grade (20 ft. at low water), and spaced 3 by 3 ft. The actual cost for drilling and blasting only was $6.17 per cu. yd., without interest, depreciation, or plant renewal.

The blasting in Vancouver Harbor will be a more delicate operation, as it will be carried on in close proximity to constructed piers. Holes 3 in. in diameter, spaced 5 by 5½ ft. centres, will be drilled to a depth of 3 ft. below the required grade line (36 ft. at low tide), and shot off in series. It is expected that 1½ lb. of dynamite per foot or more will be used. The estimated cost for drilling and blasting is $5.60 per cu. yd. Dredging of the broken rock will approximate an additional $1 per cu. yd. The Vancouver rock is a sloping sandstone ledge overlaid with from 3 to 7 ft. of gravel, hardpan, and disintegrated sand rock.

Probably the most effective dredging plant for all purposes on the Pacific Coast is the Frühling, built in Germany in 1906 at a cost of $275,000 exclusive of duty and cost of steaming to British Columbia. It is the property of the Department of Public Works of Canada, and operates on the Fraser River. It is of the "Frühling" scraper suction type, elevating material by a pair of 16-in. centrifugal pumps through pipes and delivering to hoppers inside the hull. It is a sea-going dredge, of steel construction throughout, and is self-propelled by twin screws. Its length between perpendiculars is 187 ft.; the extreme beam is 34.5 ft., the draft, loaded, about 14 ft., and the hopper capacity at this draft

800 cu. yd. Its performance from April 1st, 1910, to March 31st, 1911, was as follows:

Hours worked	862.5
Cubic yards excavated	924,800
Average cubic yards per hour	1,072
Average cubic yards per day of 9 hours, including all delays	3,000
Maintenance cost	$37,948.10
Repairs cost	8,835.58
Total cost	46,783.68
Cost per cubic yard	$0.0505

The Grand Trunk Pacific dock at the foot of Madison Street, Seattle, is a recent structure. It is 625 ft. long, 128 ft. wide, and is supported entirely on creosoted piles, the length of the bearing piles varying from 55 to 90 ft., with bracing piles as long as 110 ft. The bents are 10 ft. apart, and the piles in the bents are spaced from 6 ft. centres at the inner end to 3 ft. at the centre. The capping and floor systems are of very thorough construction, and the dock appears to have thorough stability, notwithstanding the great depth of water in which it stands.

The main shed is 90 ft. wide, with a platform 8 ft. wide on the south side and 16 ft. on the north, the latter carrying a railroad track. There are five adjustable slips on each side and one at the outer end worked by worm gear. The fender piles are of tight-bark fir and are driven two at every bent and fastened to 12 by 12-in. stringers with ¾-in. straps. At the outer end they are spaced 3 ft. apart, and clusters of seven piles are driven at the outer corners. The timber used in construction was 241,775 lin. ft. of creosoted piling, 71,000 ft. B.M. of creosoted bracing, and 1,113,000 ft. B.M. of other lumber. In its finish, offices, equipment, and general lay-out, it is the best example of dock construction on Puget Sound.

The second of the docks selected for a brief description here is the Great Northern dock at Vancouver, B.C. It was designed by A. W. Münster, M. Am. Soc. C.E. The pier is 450 ft. long by 293 ft. wide, with a berthing space of 30-ft. depth at low water on each side, and with two sheds, 403 by 102 ft. Between the buildings is a space 41 ft. wide. The distinctive feature of the structure is a cantilever platform supported on cylindrical concrete piers, which themselves rest on a sandstone ledge. These piers are 4.5 ft. in diameter, with a base enlarged to 10 ft. The foundation is carried down into the hardpan or sandstone ledge to a minimum depth of 3 ft. below the bottom of the slip. The piers will have an average height of 52 ft. On top of them will be placed a longitudinal concrete girder, 3 ft. wide and about 7 ft. in depth, which will carry the transverse girders forming the immediate support of the floor slab, which are placed 12.5 ft. centre to centre. The transverse girders are from 2 to 3 ft. wide, 6 ft. deep, and 51 ft. long. They will project 16.5 ft. beyond the line of the piers and, acting as a cantilever, will carry corresponding parts of the front platform. The inner end of these girders will rest on a line of 16-in. concrete piles driven to refusal and stayed in position before the rock embankment is placed. The floor slab is to be 7 in. thick. The concrete platform and beams have been designed for a distributed load of 500 lb. per sq. ft. The railroad track running the length of the platform is placed centrally over the longitudinal girders. The reinforced concrete construction supporting the track is proportioned to carry a 100-ton switch engine. Tie-rods encased in concrete will anchor the concrete platform firmly to the embankment.

The warehouse buildings are of wooden construction covered with galvanized iron. The roof is to be carried on

Comparative Costs to Ship and Cargo in Pacific Coast Ports.

	SAN DIEGO.		LOS ANGELES.		SAN FRANCISCO.		PORTLAND.		PUGET SOUND.		VANCOUVER, B. C.	
	Rate	Amt.	Rate	Amt.	Rate.	Amt.	Rate.	Amt	Rate	Amt.	Rate.	Amt.
Pilotage (in) ..	$3 per ft. draft 3 cents per ton	$2[illegible]	$1 per ft. draft 1 cent per ton	$90	$[illegible] per ft. draft . [illegible] cents per ton	$270 00	$1.50 per ft. draft .... 3 cents per ton	$315	$125 to $175	$150	$1 per ft. draft ...... 1 cent per ton	$90
[illegible]		50		50		50.00		5[illegible]	.	50	.. . .	50
[illegible]	$[illegible] [illegible] each ton [illegible]	[illegible]	For ship over [illegible] | $117	177	Discharging: $4 plus ½c for each ton over 250. Loading: ½ of above	127 50	None	0	None	0	None	0
[illegible] per ton	[illegible] cents	9 [illegible]	[illegible]	9 600	10 cents .	9 600 00	10 cents .	9 600	10 cents	9 600	10 cents.........	9 600
[illegible]	Included in wharfage		[illegible]	10 032	5 cents	6 000 00	Included in "wharfage."		Included in "wharfage".		Included in "wharfage."	.....
[illegible] per month	[illegible]		[illegible]		15 cents	225 00	——		0		0	... ...
[illegible]	[illegible]		[illegible]	1 [illegible]	[illegible] (72 hrs.)	1 [illegible]	[illegible] cents	12 000	50 cents (120 hrs.	12 000	50 cents . ..	12 000
[illegible] per month					[illegible] (18 hrs.				25 cents per ton per mo. or frac. mo.	0	.. . .	... .
[illegible]	Same as "in"	270	Same as "in"...	[illegible]	Same as "in"....	270 00	Same as "in".	315	Included in charge for "in" pilotage	0	Same as "in"	90
		$22 475		$2[illegible]		$18 [illegible]		$22 280		$21 800		$21 890
Cost paid by ship		[illegible]		$4[illegible]		$1 212 00		$ [illegible]		$250		$280
Cost paid by cargo		[illegible]		21 1[illegible]	....	16 8[illegible] 50		21 6[illegible]		21 600		21 600

[illegible] a comparative study of the rates in the different ports with a view of determining the relative tax on commerce in each. In order [illegible] of terminal charges and a comparison of the principal Pacific Coast ports a purely hypothetic case has been [illegible] draft, discharging and loading cargoes of 12 000 tons of miscellaneous freight, the ship remaining in port 12 [illegible] but it is apparent that, because of the complex and diversified tariffs, as well as [illegible] averages except through an assumption that is somewhat strained. The cost of [illegible] 40 cents per short ton at all the ports. This is not strictly true, but the labor unions may be relied on to [illegible] the length of a day's work. Small miscellaneous items like water, etc., are insignificant, and have been [illegible] a variable sum. The attempt has been made to arrive at an equitable average for each port [illegible] 15 cents per month per lineal foot of dock rental. A 500 ft. space will amount to $225 [illegible] make the rental $225 per voyage.

trusses spanning the whole width of the building, leaving an unobstructed floor space. The floor inside of the building will be paved with creosoted blocks on a concrete base. The concrete slabs on the outside platform are to be covered with an asphalt wearing surface. The cost of the completed dock and buildings will be approximately $1.50 per sq. ft.

British Columbian Ports.—The British Columbian ports, particularly Vancouver, are wholly private-ownership ports, and the water-front development is almost exclusively in the hands of the railroads. It is a striking contrast to the great Canadian port of Montreal, which is one of the most progressive public-ownership ports in the world. Vancouver is passing through the boom experience of most new localities in the West, and is willing to make almost any concession to private interests for what promises most for the immediate present. Not until after the present period of expansion has passed, and public thought, now absorbed in speculation activities, has time to take stock of the situation, is it likely that the problems of port control will be given very serious consideration.

The British Columbian ports being still almost exclusively under railroad control and ownership, as far as port facilities are concerned, the rates are privately controlled, and the charges are absorbed largely by the railroads.

Vancouver, B.C.—As already stated, no comprehensive scheme of development of this port has been adopted. Special studies have been and are being made of different parts of the harbor, and there are rumors of gigantic development plans by private interests. The Great Northern Railway has a fine new pier under construction and other private improvements are in progress; but there is as yet no general plan, no distinctive scheme of port administration, and no provision of public funds.

The conformation of the harbor and the handicap of tidal fluctuation and currents have suggested an improvement which, though costly, would seem to possess great merit. That is to place a lock and dam across the throat of the harbor at the second Narrows, thus holding the upper part of the Inlet at high tide and making it a fixed-level fresh-water harbor. This would restrict the tidal area to one-third its present extent and would reduce tidal currents in the lower harbor so much as greatly to improve conditions there. It would seem on the face of it that this would be an improvement of great importance to the future of the port.

New Westminster.—The fresh-water port of New Westminster is taking active steps in harbor development. It has recently expended $15,000 on the study of a plan and its presentation and is about to put into effect the one prepared for it by A. O. Powell, M. Am. Soc. C.E. It comprises wide, marginal streets, routes for railways, the extension of the city quay, and a long waterway in a slough parallel to the river, from which the river is to be excluded at the upper end. A succession of parallel slips, oblique to the axis of the waterway, will develop a berthing space of 7½ miles.

Victoria.—Even that sometime staid and delightful provincial town of Victoria, more distinctly British than any other port of the Pacific, has become infected with the Panama bacillus and is cogitating what it may do to be prepared for the changes which it has been told are about to ensue. No definite plans have as yet been evolved, but among the tentative suggestions are an outer harbor to be protected by a breakwater in front of the present entrance to the inner harbor; and also a development in Oak Bay on the opposite side of town fronting to the eastward

Prince Rupert.—Studies for the port of Prince Rupert are now in progress under the direction of Mr. Bogue, but are not yet far enough along for incorporation in this paper. A suggestion that has been made of possible future development in this port, however, may be properly mentioned

Prince Rupert City is on an elliptically shaped island about 6 miles long north to south by 4 miles east and west. The "lakes" which separate the island from the mainland in the rear have an area north of the railroad crossing of about 40 sq. miles. It is not unlikely that the north and south passages will be dammed off and provided with locks, thus converting the lakes into a tideless, fresh-water harbor just at the level of high-tide. While this development is still some distance off, it has such great advantages, in view of the extreme tidal fluctuation in Prince Rupert harbor, that it will probably be realized eventually.

◆

BRIQUETTING BITUMINOUS COAL

In the modern methods of mining bituminous coal large quantities of slack are produced; and while in some sections of the country there is a market for the slack, for use in industrial plants provided with mechanical stokers, in other sections there is little or no market for it, states "Conservation." For this reason a number of the operators in Nova Scotia are considering the installation of briquetting plants for the purpose of converting this slack into a higher grade and more suitable fuel.

On account of the friable nature of the coal mined at the MacKay Mine much slack is made during mining operations. As there is little or no market for this slack coal the management installed a briquetting plant with a capacity of 10 tons of briquettes per hour.

This is the first plant to be installed in Canada for the purpose of briquetting bituminous coal. Unfortunately, it was damaged by fire during the month of July.

The same company are also installing two similar units at the Colonial Mine, which are expected to be in operation this year.

The briquetting plants are of Belgian manufacture and are of the roll press type.

The following is a short description of the MacKay briquetting plant:

The coal from the mine is screened over a ¾ inch screen; the lump coal (over ¾ inches) is sent to the market, and the fine coal is carried by a disc elevator to a 75 ton bin. The coal is discharged from the bin by chute into a 10 ton concrete pocket situated at the briquetting plant. The coal is then elevated by a bucket elevator to a 3 ton cone hopper. The coal is fed from the hopper to the disintegrator at any desired rate of speed by means of a revolving table and plough-shaped cutter situated at the bottom of the hopper.

The pitch after being crushed is fed into the disintegrator by means of a similar adjustable feed. From the disintegrator the coal and pitch is elevated to the mixer where superheated steam is added. The heated coal is then conveyed to the roll press by means of a spiral conveyer. The briquettes are usually soft as they come from the rolls but upon becoming slightly cool they become hard and withstand handling very well.

The pitch used as a binder for the briquettes varies from 6 to 8 per cent. of the weight of the coal. This pitch is one of the by-products obtained from the tar recovered at the Dominion Iron and Steel Company's oven plants.

The briquettes are ovoid in shape and have been used with considerable success upon the Intercolonial Railway and for domestic purposes.

The Inverness Railway and Coal Company are also installing a briquetting plant at Inverness, C.B., for the purpose of briquetting the slack made during mining operations.

Briquettes when properly made with a suitable binder possess the several advantages over raw fuel.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended September 14th:—

	1911.	1912.	Increase or decrease.
C.P.R.	$2,325,000	$2,667,000	+ $342,000
G.T.R.	1,026,449	1,110,000	+ 84,065
C.N.R.	378,300	[illegible]	− 18,000
T. & N.O.R.	39,366	28,573	− 10,793

New records in both gross and net earnings are shown in the C.P.R. statement for the month of August, issued on Saturday. Gross exceeded by about $200,000 the gross in July, when earnings for the first time passed the $12,000,000-mark. Net profits were $36,800 ahead of net in October of last year, the previous record month for the company in this respect. The gain in net in August as compared with the same month last year was $642,354, or nearly 16 per cent. The statement for the month follows:—

	August, 1912.	July 1 to August 31, 1912.
Gross earnings	$12,251,715.87	$24,304,114.45
Working expenses	7,553,790.21	15,138,011.89
Net profits	$4,717,925.66	$9,166,102.56

In August, 1911, the net profits were $4,075,571.01, and from July 1st to August 31st, 1911, there was a net profit of $7,773,599.34. The gain in net profits for the same period last year is, therefore, for August, $642,354.65; and from July 1st to August 31st, $1,387,503.22.

A cable to The Montreal Star says:—"The Grand Trunk August statement shows that the net profits for the Grand Trunk increased £35,200 sterling. Canada Atlantic showed a net decrease of £2,550. Grand Trunk Western, net increase of £6,850. Grand Haven, net decrease of £1,950.

The total profit for the whole system increased £37,550, which is regarded by the market as a fine showing.

◆

PANAMA CONSTRUCTION ESTIMATES

In thirteen months a vessel will go from the Atlantic to the Pacific Ocean through the Panama Canal, according to [illegible] Canal Commission. October 15th, 1913, is the tentative date set for the passage of the first boat through the canal. The "christening" will be done by a naval vessel. President Taft [illegible] in charge of canal construction work. The President's approval of the new canal opening programme is awaited. [illegible]

[illegible]

[illegible]

The big dam, locks and spillways projects show stages [illegible] that the Gatun locks will require about 2,000,000 cubic yards of concrete work. To September 15th well over 19,000,000 cubic yards has been put into place. The concrete work of the Pedro Miguel locks is nearly 95 per cent. completed, and that of the Miraflores locks over 92 per cent. The Gatun spillway will probably be completed within another month. Other engineering features show an equally advanced stage toward completion.

The canal will have a summit elevation of 85 feet above sea level, to be reached by a flight of three locks located at Gatun, on the Atlantic side, and one lock at Pedro Miguel and a flight of two at Mira Flores, on the Pacific side. Each lock will have a usable length of 1,000 feet, and a width of 110 feet, which will be the minimum width of the canal.

The canal is to be about 50 miles long from deep water in the Caribbean Sea to deep water in the Pacific Ocean. The channel will vary in width from 1,000 at a point just south of the Gatun locks, to 30 feet at a point near the Pedro Miguel lock. There will be a number of places where several boats can pass abreast of each other and the minimum depth will be 41 feet.

◆

LARGE TURBINES FOR RIO DE JANEIRO.

After having supplied, in 1908 and 1909, six units, each of 9,000 horsepower, for the Rio de Janeiro Tramway, Light and Power Company and their power station at Pirahy, Messrs. Escher Wyss and Co., of Zürich, are installing two more turbines, each of 20,000 horsepower, so that the works will altogether have available nearly 100,000 horsepower. The firm has supplied the turbines (Pelton wheels) as well as the pipe system. The turbines are provided with vertical shafts, which are suspended, the wheels being at the lower ends. The nozzles, of which there are four to each wheel, are controlled quite independently of one another by levers from a servo-motor. Two discharge-ports are provided in the wheel-casings in case of accident. A sluice-valve is also arranged on the supply main; this valve and the outlets are operated by the pressure regulator. These measures are very necessary, since the turbines work under a head of 286 m. (940 ft. nearly), and, running at 300 revolutions per minute, consume about 6.2 cu. m. (219 cu. ft.) of water per second. Each turbine is combined with a set of two three-cylinder high-pressure pumps for the oil feed, which supply 360 litres (80 gallons) of oil per minute. These are also constructed by Messrs. Escher Wyss and Co., and are driven by small Pelton wheels. There is a pressure-bearing between the turbine and generator, in addition to the foot-step, which has to support a load of 76 tons—the weight of the revolving parts. The new hydraulic mains leading to the power station have a length of 700 m. (0.44 mile), and a diameter of 1,300 mm. or 1,400 mm. (51 in. or 55 in.), like the old mains, but they are secured by stand-pipes, 150 metres in length. The mains alone weigh 5,000 tons.

◆

The government has let the contract for the last section of the Hudson Bay Railway which it is hoped to complete by [illegible]. The last section extending from Split Lake to the bay, [illegible] to Port Nelson and [illegible] miles long to Fort Churchill. This last link is to be built by Mr. J. D. [illegible]. It is said to be the intention of the Hon. Frank [illegible], as the result of his visit to Hudson's Bay, to run a railroad to the bay by electricity. A plant may be built at [illegible] on the Nelson River. The Nelson River, he reports, has wonderful power possibilities, and could supply [illegible] of the West. The total available power is estimated at [illegible] horsepower.

A NEW TYPE OF SEWER PIPE.

Until the present time engineers in England and the United States have recognized the fact that some form of vitrified clay segment blocks for large sewers would be a most desirable material with which to construct large sewers and as a result of this fact many styles of segment sewer blocks have been invented. None have been successful for the reason that those which could be made economically of clay did not have any provision for end joints.

Those inventions which did provide for satisfactory form of end joints were of such a shape that they could not be made economically of clay. Therefore with the solution of the only objection that has arisen by providing a ship-lap joint for the ends of the blocks, which will hold a sufficient quantity of mortar so that a tight joint can be made and retained, the American Sewer Pipe Company of Akron, Ohio, have solved the problem and are presenting a successful vitrified salt glazed segment sewer block.

These blocks are made in one and two foot lengths, also in three different types, for construction of sewers ranging from 30 inches to 108 inches in diameter; detailed description of each being shown in the enclosed table.

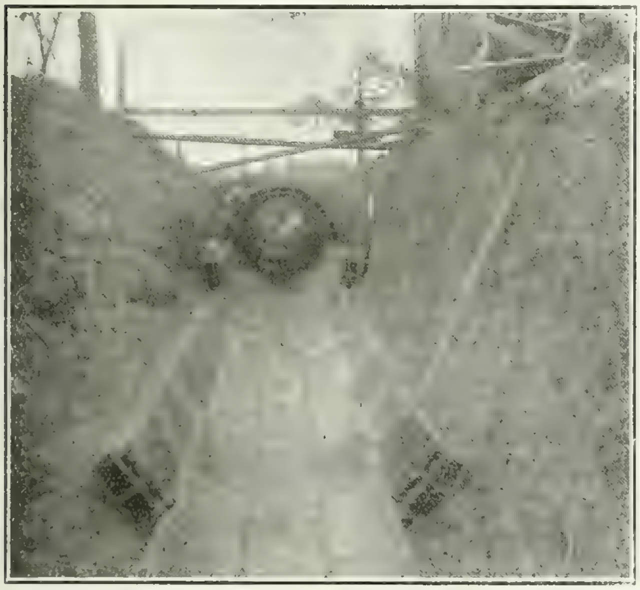


Fig. 1.

The material from which these blocks are manufactured are the celebrated Akron shale and Ohio River clays, which are acknowledged to be among the best adapted to the requirements of sewer construction, and when made in relatively thin sections, attain a perfect vitrification. In these blocks all the walls are of a thickness to which these clays best lend themselves for a perfect vitrification.

The outside surface of the blocks, being the part with which the sewage comes in contact, is the part requiring the highest glaze and it is possible to secure almost absolutely perfect glaze.

A test of Type A Block showed a crushing strength of 3,040 pounds per square inch, pressure being applied at weakest point, viz., between webs.

The end joint is made in the style of the ship-lap joint and is made possible by a web or system of webs, which provides backing for the mortar and an annular space is secured which, when filled with mortar, produces a tight sanitary joint.

The mortar joints on the dove-tailed sides are scratched to assist in retaining the mortar. The blocks are made as large as can be conveniently handled and have an inside area of approximately 270 square inches each, thus eliminating, in a large measure, the objectionable feature of numerous joints.

The outer openings in the hollow block system of sewer construction are well adapted to carrying surface water and are also of special value to the contractor, when constructing a sewer in a wet trench, as, after the invert is laid a drain is effected which carries a large amount of water and leaves a perfectly dry sewer for construction of the arch. This obviates the necessity of laying under drains.

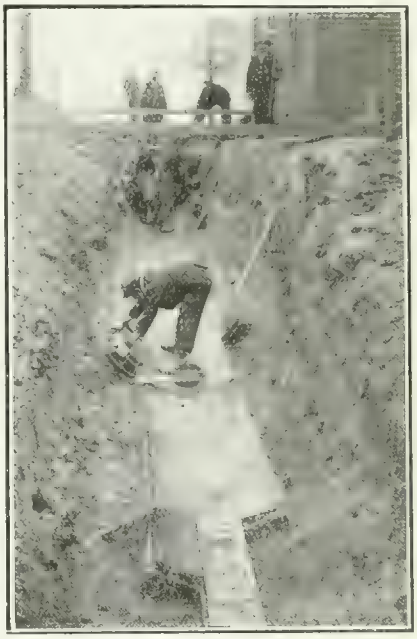


Fig. 2.

In soil where it is possible the trench is excavated as near the shape of the outer shell of sewer as possible, and the bottom of invert block laid ahead for drainage purposes and to proper line of grade. The successive tiers are thoroughly tamped at the back. A template is used as high as the spring line, after which a form for the arch is required and for which a collapsible form has been designed which greatly facilitates the work. The male and female dove-tailed joints are so constructed that only the key block requires slipping in endwise. All other blocks drop into place on the side. After forms have

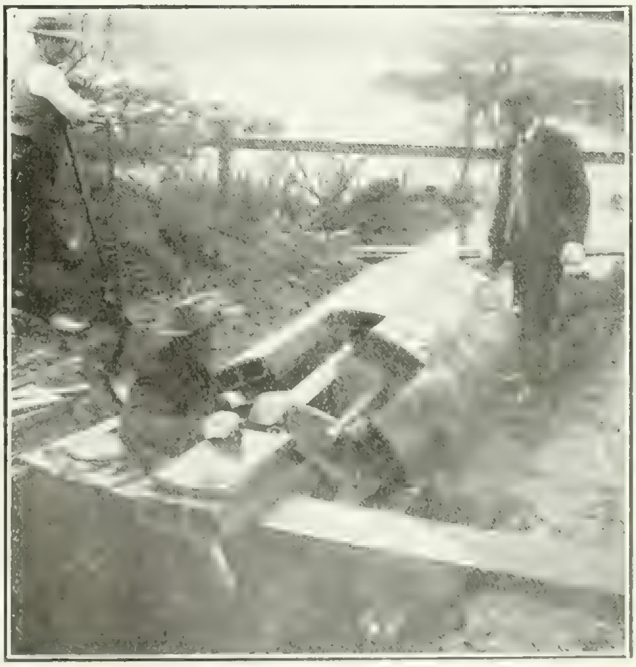


Fig. 3.

been removed all joints are pointed and all spilled mortar removed from the inner surface of the sewer. The backfilling commences immediately upon collapse of form or as soon after as feasible. The earth is thoroughly tamped to fill voids from pulling sheeting.

At the discharge or spill end of sewer a concrete apron is usually installed to insure against washing away of tamping or foundation.

The city of Flint, Mich., recently completed a 42 and 48-in. outfall sewer built of salt glazed vitrified clay segment blocks. A construction view of this sewer is shown in Fig. 1.

Sewers built of these blocks in the manner described are said to be watertight. They also are as durable and impervious as vitrified pipe. The frictional resistance to the flow of water in these sectional block sewers is claimed to be considerably less than any other type of construction adapted to the same class of work. At the same time tests have shown that the load carrying capacity is large. The type of block construction here described is manufactured by the American Sewer Pipe Co., of Akron, Ohio.

◆

KEEPING RECORDS OF MUNICIPAL IMPROVEMENTS AT FARGO, N.D.*

The city engineer's department has felt the need of complete and accurate maps of the city for all purposes, and I believe, and in some instances know, that serious errors have been made by relying on maps that were unreliable.

Two sizes of maps have been adopted for our use. A large map on a scale of 200 ft. to the inch shows all sections, quarter-sections, additions, streets, avenues, alleys, and blocks and lots. On these maps will be plotted all municipal improvements, such as sewers, water mains, sidewalks, paving, and such general information as can be of use. This size is for wall purposes.

A second size is made up on a scale of 100 ft. to the inch and each sheet contains one quarter-section, making the size of the sheet 26 x 26 in. On this map, in addition to data on the larger maps, are sewer wyes, sewer connections, water-main connections, valves, shut-off boxes, hydrants, paving, openings in paving and date made, cost of special improvements against each lot, sidewalks, new buildings, the lighting system and a great deal of minor data connected with the above. At present none of these data is collected in a compact form that can be used to any advantage and [illegible] the needs of the city. In no other way can such information be kept available for instant use than by progress maps. This work has taken a great deal of labor and painstaking [illegible]

There are no more valuable records in any engineer's office than progress records and maps, and this applies with [illegible]

[illegible]

for information, that we should be able to give and that it is the function of the city to provide to its citizens, that cannot be given because of lack of records. It is the aim to eliminate this state of affairs as rapidly as is possible. The data must be picked up in all manners of ways and time is the greatest factor in its completion.

The lack of records in the office is an unfortunate condition that has hampered our work greatly during the past two years. Efforts to remedy this defect have in some cases proved effectual, but in other cases there is no remedy whatever. As such may be mentioned lack of actual cost of contract work, time when certain contracts were begun, progress of same and time of completion; surveys made, results and conclusions; location of monuments, opening in streets, street lines, grades for sidewalks and streets and data upon which made; data upon which sewer and water mains have been designed, and cost of office work.

A complete office system has been started in order to eliminate these defects in the records. The loose-leaf system is used throughout. The lack of notes on surveys, time the men were employed on any piece of work and sidewalk records, was most noticeable and this has been remedied. The loose-leaf system of field notes was adopted, and a filing system is used which I have every reason to believe is original. The field-note sheets are 4¾ x 7¼ in. These sheets are pasted on 5 x 8-in. division index cards which have the usual 5-cut tab. On this tab the character of the work is printed and the indexing completed. The time of men employed and any class of work is kept in a similar manner.

For the purposes of engineering the records of costs have been divided into heads as follows: Board of Health; Bridges; Dam; Maps; Monument Lines; Office Supplies; Park Commission; Paving; Pay Roll; Requisitions; Sewers; Street Grades; Street Lines; Waterworks; Water Mains and Sidewalks. Each of these is subdivided into two heads: (1) Construction, and (2) Maintenance. Each of these subheads is subdivided again into Labor, Material; Engineering and Estimates.

◆

TRANSPORTATION QUESTION IN CALGARY.

The proposed piping of natural gas to Winnipeg from the Bow Valley by Calgary capitalists, with four or five pumping stations, commencing somewhere about Swift Current, which would force the gas to Winnipeg, is meeting with various objections. Mayor Spencer, of Medicine Hat, objects to a charter being granted the new company, and the Calgary Herald demands either Provincial or Dominion prohibitive legislation.

The Interurban Railway Company is acquiring 13 acres of the industrial tracts owned by the city, for use as the site of a repair shop.

A mile of street railway track is to be built by the South East Calgary Corporation, from Ogden station to the city limits. This will be handed over to the city of Calgary in return for a service operated by the municipal system over the tracks of the South East Corporation.

Plans of the Western Dominion Railway Company, considered by the board of trade this week, have the name of J. E. Askwith as president. This did not, however, convey enough information to the committee, and they decided to recommend approval of the map filed provided the promoters could assure them of immediate construction. The line is variously ascribed to the Canadian Pacific Railway, Canadian Northern Railway and Great Northern interests. It will [illegible] between the international boundary and the Peace district (passing through Calgary), which contains a vast [illegible] of clays, shales, coal, natural gas, tar, sands, and possibly oil.

A NEW SYSTEM OF ILLUMINATION TO AVOID GLARE BY DIFFUSION.*

By Hans K. Ritter, E.E., Assoc. Mem. A.I.E.E.

There are three distinct devices which are utilized to make up a modern illuminant: First, the source of light or lamp; second, the reflector or redistributor of light; third, the diffuser or softener of light.

It is the combination of these three devices into an efficient unit, its framing into a supporting structure or fixture, and the final application to our many varied needs, that are the problems of the illuminating engineer of the present day.

The tungsten lamp, mercury arc, etc., have all distinct distribution characteristics of light flux emitted by them, inherent to them; that is, they are dependent on the mechanical arrangement of the light-emitting surfaces. These characteristics cannot in general be adjusted so that a fully satisfactory light-distribution for all the necessary applications of the lights is found. To accomplish the latter, the first accessory mentioned, the reflector, is now universally used.

Most modern illuminants have such a high intrinsic brilliancy that a correction is necessary to make them agreeable to our eyesight. To accomplish this, diffusing envelopes, such as globes, spheres, etc., are widely used.

At the present time, it is common practice to combine lamp and reflector, or lamp and diffusing globe. To combine lamp, reflector, and diffuser efficiently, many difficulties arise, as all know who have seriously attempted to make this combination. The failure to create such a unit accounts for the deficiency of many lighting installations.

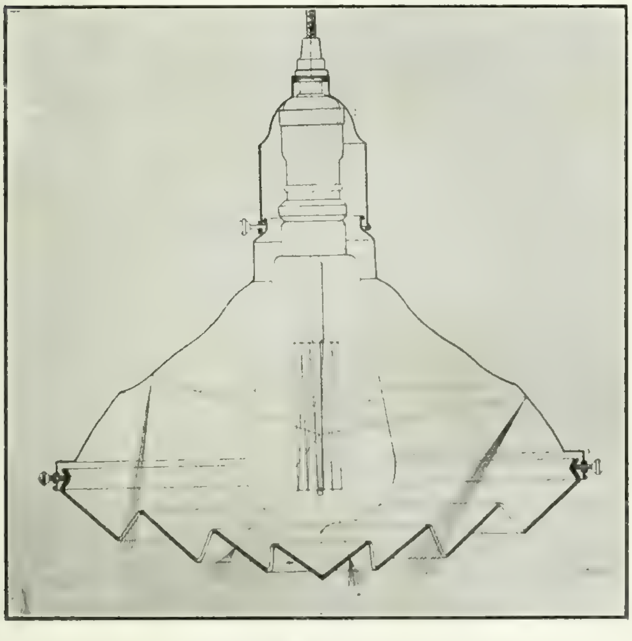


Fig. 1.

My experience shows me that it is a comparatively easy matter to make a reflector for a certain redistribution of light, but a much harder task is set if the reflector is to act as diffuser and efficiently shield the glaring source of light.

Most of the diffusing globes diffuse the light, but have no action in redistributing it efficiently.

However, to make certain a fully satisfactory arrangement, we are bound to combine lamp, reflector, and diffuser into one unit, and only so are able to produce an illuminant which is hygienic and fully satisfies our demands for ease and comfort.

Many attempts have already been made to successfully solve this problem. The most common of them is the frosting of the electric lamp bulbs; but this remedy cannot be said to fully cover this problem, as the frosting leaves the reflector surface unscreened within the field of vision, and even then the lamp's intrinsic brilliancy is high. Incidentally, sand blasting the bulb tends to diminish the effective life of the lamp, reducing it to some degree and, according to several authorities, to a large extent. It is therefore better to use clear glass bulbs, screened by a diffusing envelope large enough to keep the intrinsic brilliancy down. Another method employed to screen the source of light is by means of indirect illumination. An investigation of this method shows that it cannot be generally adopted, as its applicability and efficiency, in most cases, are dependent on the preparation of ceilings and walls.

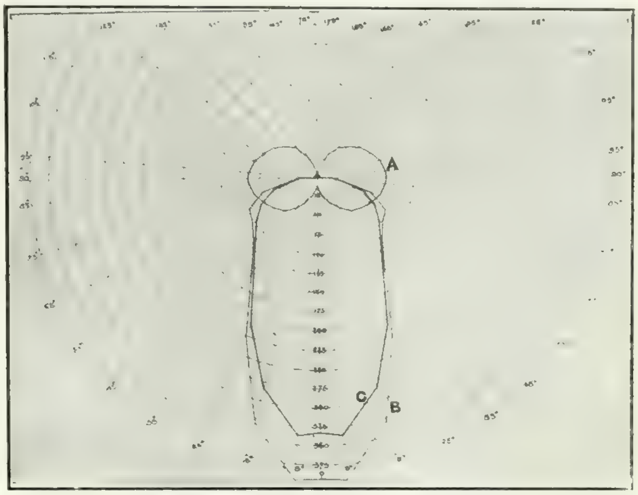


Fig. 2.

It was about the time when the Nernst lamp was at its height, and especially used for better lighting, that in the firm of Messrs. Ritter and Uhlmann, in Basel, fixture manufacturers of note in Switzerland, research tests were conducted under the direction of Mr. J. J. Ritter to find an arrangement which would embody in an efficient and proper manner the three fundamental components, namely, lamp, reflector, and diffuser in one unit, combined.

Especially the relation of many problems which arose in the practical and artistic application of fixtures to illumination and which had to be solved, was responsible for the creation of many new shades and types, and our efforts resulted finally in the invention of the combination that I am describing, patented in this country as well as abroad.

In principle, this combination comprises an upper reflector and a lower glass distributor or diffusing envelope. These totally enclose the light source in such a manner that no direct rays from the filament leave the fixture without coming from one or the other of the supplementary diffusing surfaces, the attached translucent glass, or the matt reflector within.

The lower disc, as you will see in the cut, Fig. 1, is made up of concentric, truncated cone surfaces, alternately erect and inverted. This embodies the fundamental principle of this invention. The inwardly sloping surfaces of the inverted cones are matted. The outwardly sloping surfaces of the erect cones are of clear glass.

---

*Paper read at the Annual Convention of the Illuminating Engineering Society, Niagara Falls, Ontario.

Direct rays of the filament pass through the inwardly sloping cone surfaces of the diffuser, which are matted so as to completely hide the source of light. While this translucent surface hides the image of the filament, it is not dense enough to affect the efficiency greatly.

Rays which do not go directly from the filament to the diffuser, strike the reflector surface. From this they are reflected back downward and pass out through the outwardly sloping cone surfaces of the glass, which are clear. Again, those rays which are reflected from the matted surface of the diffuser, strike the reflector, and from there pass out through the clear glass of the diffuser. I am inclined to think that this class of rays deserves more attention than is usually given to it, and that it adds materially to the efficiency of the combination. A maximum outlet for the whole spherical flux is thus provided through the lower surface, most of the light undergoing only a single diffusion. This, in addition to the correct matting of the translucent surfaces, contributes to the unusual high efficiency of this combination.

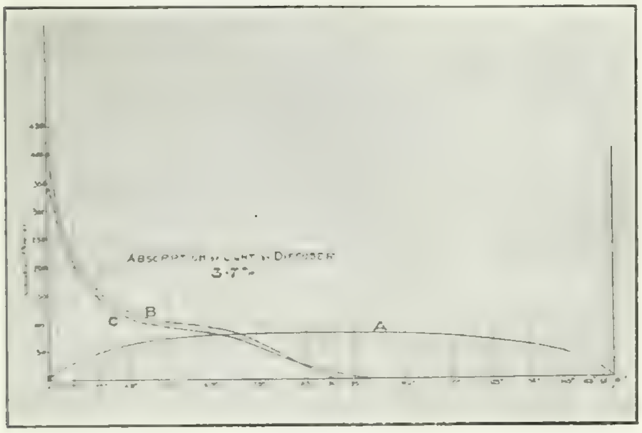


Fig. 3.

In Fig. 2, the polar diagram, curve A, shows the shape of the distribution curve for a 100-watt lamp without accessories; curve B, when a matted aluminum reflector is employed, and curve C shows the effect of the diffuser added.

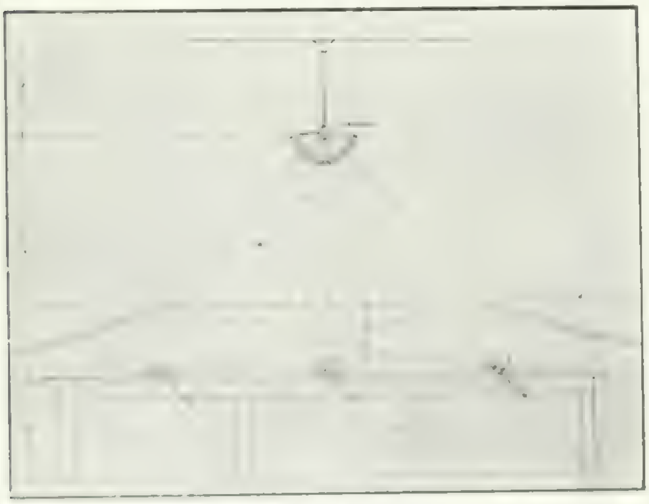


Fig. 4.

[illegible]

From the Reousseau curve (Fig. 3), you may note that the absorption of the diffuser amounts (curve C) to 3.7% of the total light flux (curve A).

But the efficiency is supplemented by other favorable points in this combination. The unit is practically dustproof. No dirt can hang on to the inner diffusing or reflecting surfaces, so the maintenance cost is low.

The size of the diffusing envelope depends upon the size of the lamps used, so that for a small lamp small units are fabricated and for large lamps, large ones.

Before I go over to the practical application of this unit as an efficient illuminant for the lighting of working planes, I wish to emphasize that from no point beneath the fixture can the filament itself been seen through the clear glass surfaces. Eye protection is therefore afforded to the fullest extent.

Innumerable applications can be made of this unit when suspended vertically; but with the advent of the wire-type tungsten lamp no necessity exists to use these lamps only in a vertical or upright position. By means of the patented diffuser described, we can with equal efficiency employ the lamp at any desired position.

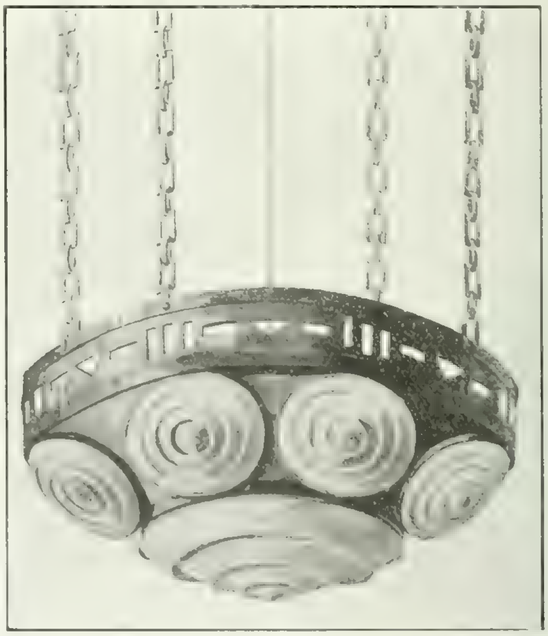


Fig. 5.

It is widely known that a series of sources of light, distributed in a given space and employing one type of reflector hanging vertically, give an even light distribution only when given a certain spacing distance and placed above a certain height.

For a light source in a reflector placed on an angle, the light distribution being of the focusing type, it is different. It is only necessary to find the angle which would correspond to an even illumination of a zone on the working plane, and any lowering or raising of the fixture does not affect the even distribution of light in one zone on the working surface. In Fig. 4 such a condition is shown. By the point-by-point method the illuminating values are projected on the working plane and the resulting illumination values computed.

A material saving of light is thereby effected, as the highest intensity is actually brought in the working zone. Further, by using a cluster, a saving of outlets required, results.

For instance, in the conditions considered, two 60-watt lamps, each placed in a unit as described and standing at

45° against the vertical, thus being grouped as a cluster, the spacing distance would be about 15 ft., with a vertical hanging distance of 6 ft. 6 in. from the working plane.

In Fig. 5 a fixture is shown built up of the above units, which is designed for use as a church fixture. This fixture is built up of the following: First, a group of six diffusers placed at 45° to the vertical, each 12 in. in diameter, and enclosing one 100-watt tungsten lamp; second, one diffuser placed vertically 16 in. in diameter and holding three 100-watt tungsten lamps; third, three reflectors each holding one 60-watt tungsten lamp, these being used for ceiling illumination.

From the picture it can be noted that the framework of the fixture is such that the reflectors are hidden from view. The bulb, also, of the electric lamp, which as I found really never adapted itself to be brought into an artistic shape, is covered up and a compact and efficient arrangement is found in which all parts serve a useful purpose, readily adaptable to decoration.

Many styles of fixtures can be created, almost all of which appear artistic and attractive in form.

The principle laid down through the combination of lamp, reflector and an efficient diffusing envelope is not exhausted. The field for application is a very large one to employ these means to eliminate glare. The combinations and applications of these units are so numerous that it is almost in order to call it a new system of illumination created through the employment of a diffusing envelope having a very high efficiency in connection with reflector into one unit.

To recapitulate, we have in this system:

(1) Means provided to reduce the intrinsic brilliancy of a source of light to any desired extent.

(2) The disc, being of flat shape, adapts itself admirably for building fixtures to give any desired lighting or artistic effects.

(3) The reflector unit, being totally enclosed, makes it practically dustproof, which means minimum attention after installation.

(4) On account of its independence upon actual surroundings it has a very large field for application.

(5) Our experience in Europe shows that the high commercial efficiency, together with the small attention required after installation and the low cost of installation, more than offsets the slightly higher factory cost.

AMERICAN ROAD CONGRESS.[*]

By E. A. James.[†]

The American Road Congress, a conference composed of road users, road builders and road machinery men, held at Atlantic City, October 1st to 5th, was successful beyond expectation. Although held at the very busiest season of the year, yet the attendance was large, the exhibits varied and extensive and the papers and addresses of a high order.

In the exhibition hall the exhibitors of the United States Road Department and of the various state departments clearly demonstrated the progress being made in highway construction, both in theory and practice, while the displays by the manufacturers show clearly that they appreciate the large field opening in road work on this continent.

The delegates were welcomed by Woodrow Wilson, Governor of New Jersey, and in view of his place in the public mind at the present some of his remarks are of unusual interest. Governor Wilson said in part:

"The question of highways is a question which has interested by thought, particularly in recent years, because it is one of the few great instrumentalities of our public life and of our communial life with which the government is of necessity connected. The government is not, in the United States, expected to build railroads. The government is not as yet expected to own railroads. Railroads differ from other highways, though we often speak of them as the highways of our commerce, in this important particular, that only those who own them can use them in the matter of putting vehicles upon them—that a particular set of individuals by reason of their control of the road, have the exclusive right-of-way over it.

"We must more and more engage the government in providing the general facilities of the common life. There is no breach in that of any of our older understandings of the function of government. We have never doubted that the government had the right to supply these facilities which private endeavor has never been expected to supply. Therefore, we are not upon a new ground of theory; we are merely upon a new ground of tactics, and when I think of what the highways mean, I seem to be thinking of the whole history of the human race. Whenever I used to read stories I remember my imagination was most fascinated when the characters went on a journey and met the rest of the world.

"On the old highway, particularly the old English highways, you met everybody from the King to the beggar, from the King to the highwayman. You were there in a way to have the adventure, the whole experience and adventure of English life, because it was there that English life interlaced and crossed and was fluid, flowing from one region to another, and by the same token it was upon the highways that men got the contacts which result in the building up of public opinion.

"I was trying to illustrate the fact one day that in some of our great cities there is no public opinion, in a way which led me into trouble. I said, that what generally happened to a man in a city was that when he got in a public vehicle or on a highway, he doesn't talk to anybody, but if he can hold himself steady enough, that wherever he happend to be he plunges his head into the morning newspaper and experiences a reaction which he calls his opinion, but it is not an opinion at all, it is simply the impression that a piece of news or an editorial has made upon him and he cannot be said to be participating in public opinion or in opinion at all until he has laid his mind alongside the minds of his neighbors and discussed with them the incidents of the day and the tendencies of the time.

"Where I got into trouble was, that I ventured to use this illustration. I said that public opinion was not typified on the streets of a busy city, but was typified around the stove in a country store where men sat and probably chewed tobacco and spat in a sawdust box and made up, before they got through, what was the neighborhood opinion both about persons and events; and then, inadvertantly, I added this philosophical reflection, that whatever might be said against the chewing of tobacco this at least could be said for it: that it gave a man time to think between sentences. And ever since then I have been represented, particularly in the advertisements of tobacco firms, as in favor of the use of chewing tobacco.

As a means of reflection, I dare say that it is wholesome; otherwise I will not declare my opinion about it at all.

"But the illustration, nevertheless, was an illustration of what I think is pertinent to us, or rather pertinent to my thought in connection with what you are doing. You know how the Roman empire used to throw its great highways out from Rome until they touched the limits of the empire—until they threaded even the distant island of Britain; and it was like throwing thongs out to bind all the empire together. Now, the initial purpose of those highways was to afford an open road for the armies of Rome so that she could throw her power rapidly in any direction; but Rome also, in my imagination at any rate, prepared her destruction by those highways because she could not open them to her own armies without opening them also to the people that lived upon their edges, and they could not touch one another without forming an opinion about the Roman power, without intermingling the influences of different nations, for these roads did not stop at national confines, and the Roman roads threaded the opinion of the world together into an axus and pattern, and I tell you very frankly that my interest in good roads is not merely an interest in the pleasure of riding in automobiles, it is not merely an interest in the very much more important matter of affording the farmers of this country and the residents in villages the means of ready access to such neighboring markets as they need for their economic benefit, but it is also the interest in weaving as complicated and elaborate a net of neighborhood and state and national opinion together as it is possible to weave.

---

[*] *The Canadian Engineer* will publish from week to week verbatim reports of the more interesting addresses.

[†] Engineer for the York Highway Commission.

"It is of the most fundamental importance that the United States should think in big pieces, should think together, should think ultimately as a whole, and I felt, in my enthusiasm for good roads something of the old opposition that there always has been in me to any kind of sectional feelings, to any kind of class feeling.

"The reason that city men are not more catholic in their ideas is that they do not share the opinions of the country, and the reason that some countrymen are rustic is that they do not know the opinion of the city and they are both hampered by their limitations. I heard of a lady the other day who had lived all her life in the city and in a hotel. She made a first visit to the country and spent a week in a farmhouse. She was asked afterwards what interested her most about her experience and she said that it was hearing the farmer page his cows.

"A very urban point of view with regard to a common rustic occurrence, and yet that language showed the sharp, the inelastic limits of her thought. She thought much more narrowly than in the terms of a city. She thought in the terms of a hotel, and in proportion as we are confined within the walls of one hostelry or city, or one state, we are provincial, and national thought cannot successfully build itself upon those foundations in a way that will be permanent; so that I believe that the development of great systems of road[illegible] speaking, as well as physically speaking, a task in statesmanship.

"I believe that it is the primary study of the statesman to bind communities together and open their intercourse so that it will flow with absolute freedom and facility. No one argument ought to be omitted; every class has its argument for good roads, and putting them all together they form an irresistable mass of arguments, but the result of [illegible] the United [illegible] the energies of the [illegible]

[illegible]

to lend the aid of the government to the actual task of development.'

"That has been the general attitude of our government up to this time. It cannot be that attitude any longer. There are things of this sort for example, you take not merely the matter of good roads and the carrying of goods to market, but of what goods there are to be carried to market, the production, the agricultural production per acre in the United States does not favorably compare with the production per acre in the older countries of the world and the margins are approaching one another.

"We used to lead the world and our grain exports were our chief exports, but the exports of grain are going down and down because the other margin is coming up, the margin of domestic demand and the population is increasing faster than the product so that a great deal of our commercial history is about to be altered by the circumstances of agricultural production, and I believe that it is the proper function of the government to see to it that by the extension of all the varied modern knowledge about agricultural process and about the characteristics of different soils ought to be so extended, so carried everywhere to the farmer as to build up by the aid of the government this thing that feeds us and ought to continue to feed the world; and whenever you speak of that, whenever you increase what the United States is doing, you must immediately increase the facilities of the United States for handling what it has made after it has made it. You cannot rationally increase the prosperity of this country without increasing the road facilities of this country."

"I remember having a very interesting and, for me, enlightening conversation with a mountaineer once in the North Carolina mountains. He was very hot against the excise taxes which made it practically impossible for him, without becoming a criminal, to make whiskey out of his corn, and I discussed it somewhat minutely with him in order to get his point of view. His point of view was simply this; he had a little farm that was a fertile pocket in a remote part of the mountain. It didn't pay him to take his corn to the market as corn, because by the time he got to the market, the very horses that were hauling it would have eaten it up, but he could profitably get it to the market as whiskey.

"His point was simply this, that it was unreasonable for the government to forbid his getting a market for his corn in the only way in which it was possible for him to get a market. Now, while we might say that it was not desirable that there should be any market at all for the product that he wished to sell, nevertheless, the illustration will point my moral, namely, that it is not worth while producing until you can release what you produce and that the only way of releasing it is by the most facile methods of inter-communication and transportation.

"We are merely threading the energies of a nation together, linking them in a single pattern, or rather, we are merely setting them free when we facilitate and promote the interests of a congress like this. I need not tell you, therefore, that I am in deep sympathy with the purposes of this congress, because in my judgment that would simply be like claiming that I was a rational being and I hope that does not require argument.

"I would rather admit it than try to prove it, and if you will allow me to admit I am a rational being, you will allow me to say that as a matter of course, I am profoundly interested in the purposes of this Congress, and I consider it an honor that the State of New Jersey should have the pleasure of harboring you for a little while and entertaining you for a little while in consultation about what is, at bottom, a great national interest."

Good Roads an Economic Necessity.

Dell M. Potter, Arizona and California:

"I do not own an automobile," said Mr. Potter, "nor do I own stock in any automobile corporation, but I know that the men who have money own automobiles, and if you want to get them into your States and have them learn the climate and soil conditions, together with their other attractions, you must furnish good roads upon which they may travel in comfort. The prosperity of the country depends upon the automobile, and the sooner we come to a realization of this fact the better it will be for us. Governor Wilson rightly said in his speech of yesterday that there is a limit upon farm products in this country because of poor roads. The roads of our country are in worse condition than those of any nation of the world. The policy of this United States Government as it affects the prosperity of the country is a thing wonderful to behold.

"Within the past year we have driven out of the great Northwest from 25,000 to 40,000 of our best citizens because they were not able to make a living on their farms, and all that prevented them was the vile condition of our roads. Nine-tenths of the money appropriated by Congress for public improvements goes into our rivers and harbors and but a small fraction into good roads. I have no fault to find with the practise of appropriating money for the rivers and harbors, even though it does benefit only the great corporations, but I contend that it is time the niggardly policy maintained towards our highway system was abandoned.

"There are 850,000,000 acres of farm land in this country and less than half of it is under cultivation, because of the inability of those who would work the land to get their produce to a market. Upon the products of these farms depends the prosperity of the country, and good roads are vitally essential to such production."

Marking Highways.

As a preface to his address on the establishment of a National Department of Highways, Frank D. Lyon told of the plan adopted in New York of designating various routes through the State by colors, and of the use to which telegraph and telephone poles were put in this connection. By this system, he said, it was possible for tourists to make their way from one point to another throughout the State without the aid of books or maps. Then, launching into his scheme for the establishment of the Federal Department for the supervision and construction of roads, he elaborated upon the plan and explained many of the details as they had been worked out by him. With the establishment of such a department, he said, its head could go from State to State, urging the establishment of similar departments and guaranteeing Federal aid in the construction of whatever roads were considered necessary. Whatever highways in the various States were designated as national highways would be maintained by the State and Federal Government sharing equally in the expense. The plan so appealed to the delegates in attendance that it was freely predicted some definite scheme towards its adoption would be worked out before the congress came to a close.

Maintenance of Roads.

It was admitted by all that American road systems were failing because of poor maintenance.

Logan Walter Page, president of the congress, was enthusiastic in reference to work accomplished. He said in part:

"Never before have there met in this country so many people or so many interests having for their object the betterment of the public roads. When we consider the great activities manifested during the last few years for the promotion of this most necessary work, it is astounding that so much has been accomplished in so short a time. As a matter of fact, more has been done in the last two decades than in the previous two thousand years. It engenders something more than the methods of construction and maintenance. Back of these problems are intricate questions of finance, which are involved in the issuance of bonds, the levying and apportionment of taxes, the accounting and safeguarding of road funds. Co-ordinate with the question of finance we may place those of promotion, legislation, organization, administration, construction and maintenance. Probably few other questions have been productive of so much legislation as that of roads. It is absolutely essential to sound progress in the road movement in this country that our highway be simplified and perfected.

"It is not admitted that the policy of placing convicts at work in the construction of roads or the preparation of road materials is wise in all cases.

"Although it is generally conceded that the most serious defect in our road system in this country is lack of maintenance, we have been making progress at a very slow rate to remedy this defect. It is high time that action is taken leading to a strong, concentrated and intelligent campaign in every State, not only in the maintenance of our roads in the highest state of efficiency, by the enactment of legislation that will provide definite annual appropriations and continuous and skilled attention, but the administrative phase of the question as well."

The speaker declared that the road situation, as it is to-day is that "we have two million and a quarter miles of public roads, eight per cent. of which have undergone some measure of improvement or have had something done to them; of this eight per cent. of so-called improved roads, probably not more than a half of four per cent. of the total, really deserve to be classed as improved roads. If we accept the general assertion that twenty per cent. of the roads carry ninety per cent. of the traffic, it follows that we have before us for improvement sixteen per cent. of the total mileage of the country, or 360,000 miles."

He asserted that the annual expenditures for this work in the United States was but half that spent by the United Kingdom on its 150,000 miles of roads; allowing but $417 per mile, or hardly enough for maintenance alone. "When we consider that a very large percentage of the $150,000,000 appropriated for this purpose is wasted, not so much through dishonesty as through ignorance and defective administration, it is apparent that the actual amount expended usefully on the roads is far less than the figures show. I believe that proper administration would save the country annually $40,000,000 of this amount and do the same work that is now being accomplished."

One of the most interesting resolutions proposed was the following:

"Resolved, that the president of this American Road Congress appoint a committee of five to formulate and suggest to several highway associations of the country, a proposed form of legislation to regulate and control the use of the public roads and highways by the automobile truck and other self-propelled trucks and traction engines; to the end that the good roads of the country may be protected from the present destructive tendency of their use by excessively large and heavily loaded vehicles of the class herein described, and for the further purpose of obtaining a general expression of opinion on this subject which may result in uniform legislation throughout the several States to regulate the same."

It is fortunate that action is being promptly taken in connection with this important feature of highways before the vested interest becomes too large.

Mr. W. A. McLean, provincial highway engineer for Ontario, gave a very interesting address on "Road Improvement in Canada." *The Canadian Engineer* expects later to publish this address in full.

◆

COAST TO COAST.

Porcupine, Ont.—The gold shipped from this centre in September will aggregate $500,000.00.

Toronto, Ont.—Fifteen young men of the forestry class, University of Toronto, have left for the study of practical forestry on the shores of Lake Nipegon.

British Columbia.—In order that the $2,000,000 bridge to be erected by the Canadian Pacific Railway across the Pitt River may be started, a large bridge now in use will have to be removed.

Ottawa, Ont.—The management of the Ottawa Light, Heat and Power Company will apply at the next session of the legislature for power to increase their capital from $2,000,000 to $5,000,000.

Guelph, Ont.—The past year has been an excellent one in building circles, as may be readily seen in the report of the city engineer's department. Over one hundred houses, with a value of $294,961.00 have been erected. The total building permits are over $500,000.00.

Montreal, Que.—The harbor commissioners' new grain elevator, officially opened by Hon. J. D. Hazen, October 2nd last, has a length of 456 feet, a width of 100 feet, and a storage capacity of 2,620,000 bushels. It is the largest concrete grain elevator in the world. A complete description of the elevator appears in *The Canadian Engineer* of October 3rd.

St. John, N.B.—New rates for electrical power in this municipality have been published as follows: On installation of 25 h.p. with a base rate of ten cents per kilowatt monthly consumption of not less than $70, 33 per cent. discount; $84, 36 per cent. discount; $100, 39 per cent. discount; $125, 42 per cent. discount; $140, 45 per cent. discount. Additional discount of ten per cent. from the net amount (for cash) if paid within ten days of presentation of bill, is authorized.

Vancouver, B.C.—The survey is completed for the double tracking of the C.P.R. between Calgary and the coast, and work will be commenced at twelve points on the route within six months. The construction will be rushed as swiftly as possible and there is a prospect that the line will be completed almost as soon as the Panama Canal is open for traffic. The second line will be approximately parallel to the present main line of the C.P.R., but the grade through the Rockies will be materially reduced. The cost of the undertaking is estimated at about $[illegible], the expenditure in some districts exceeding $100,000 per mile.

Toronto, Ont.—As a number of parties have requested that the time be extended for the return of the comments respecting the proposed rules and regulations for public utilities, the Hydro-Electric Power Commission of Ontario have consented to the extension of the time for the return of these comments to the [illegible] of December next, 1912. Comments should be forwarded to Mr. W. W. Pope, secretary, Continental Life Building, Toronto.

Toronto, Ont.—Professor L. B. Stewart, of the University of Toronto, who has spent the last four months in the new part of Ontario, the Keewatin area on Hudson Bay recently added to the Province of Ontario, has returned to Toronto. During the summer he had been engaged in surveying and laying out a portion of the new district. While the land within fifty or sixty miles of the Bay is mostly marsh and muskeg, the swamp is not of any great depth, and Professor Stewart is of the opinion that it could easily be drained and would offer no serious obstacles to railroad construction. Engineers of the Hudson Bay Railway are in the field locating a line, and contractors are at work grading from Pas Mission northward for several hundred miles.

Fredericton, N.B.—It is reported that the Grand Falls Company, Limited, the new company headed by Sir William VanHorne, which is to spend upwards of $8,000,000 in the development of the water power at Grand Falls and the erection of vast pulp and paper mills, is making the first move towards commencing with its undertaking. At the present meeting of government an order-in-council is being passed empowering Hon. J. K. Flemming, as surveyor-general, to convey by deed to the company the water power and five acres of land along the banks of the river upon payment of the sum of $60,000. Below the falls only one-half the river can be conveyed to the company, the other half being held by the Crown for ordinance purposes. Recently the government was notified that the Grand Falls Company, Limited, was prepared to pay over the $60,000 and take a deed of the property and rights and the deed has been prepared by Attorney-General Grimmer and will probably soon be executed.

Grand Trunk Pacific.—Rapid progress is being made with the construction of stations along the main and branch lines of the Grand Trunk Pacific Railway, and an effort is to be put forth that will result in a station being erected at every stopping place from coast to coast with the completion of the line. Out of a total of 237 stations, 79 have been completed, 58 are in various stages of construction, while 100 remain to be erected. The work on the construction of the G.T.P. stations is as follows: Main line, Winnipeg to Fitzhugh, 159 stations, 69 completed, 44 under construction, and 46 not started. Yorkton branch, 10 stations, 2 completed, 5 under construction, and 3 not started. Regina branch, 17 stations, 4 completed, 3 under construction, and 10 not started. Calgary branch, 32 stations, 4 completed, 3 under construction, and 25 not started. Prince Albert branch, 19 stations, 3 under construction, and 16 not started.

Montreal, Que.—The gates of one chamber of the St. Gabriel lock in the Lachine Canal at Montreal were wrecked September 24 by a boat collision that resulted in draining the adjacent upper level of the canal and caused a total interruption of navigation. The two chambers of the lock are side by side just below the Rue des Seigneurs swing bridge. Below them the basin is crossed by the Wellington Street swing bridge. The steamer "Glenmount" had just passed through the lock and the upper swing bridge, leaving the upper gates still open, when the steamer "Nevada," also up-bound, ran into the lower gates and tore them from their hinges, allowing the water from the upper level to escape in a wave [illegible] ft. high into the lower level. The flood tore one of the upper lock gates from its hinges and carried it, together with the two lower gates, into the lower level of the canal. Although her engines were in operation the "Nevada" was unmanageable and was turned completely around and carried up against the bank at the lower end of the basin, while the "Glenmount," also under steam, was swept down through the lock into the basin. A barge heavily loaded with sand [illegible] from its anchorage above the upper bridge and swept through the lock and basin to the lower swing bridge, where it brought up against the fender and bridge girders, doing some damage. A diver and derrick boat have been put at work in the basin to attempt to raise the gates and [illegible] them. A portion of the gate gear that were torn from their frames have been found uninjured and it is hoped that the gates will be found serviceable.

Toronto, Ont.—The long-pending arrangements for the construction of a union station at Toronto, Ont., seem destined to further delay. Following a conference last week the Railway Commission has called on the Grand Trunk and the Canadian Pacific to present within three weeks a joint statement showing the exact status of the negotiations between the two companies regarding the project. In the meantime the railways announce that they will have entered an appeal to the Governor-General in Council against the viaduct order, thereby re-opening the whole viaduct and union station issue. The Canadian Pacific declares that it is not party to any order respecting the union station yet made by the Commission and therefore is not subject to the present order. The road's counsel declared that the determination of the plans for the union station depended entirely on whether or not the viaduct scheme was to be carried out, and reiterated the unalterable opposition of his company to that scheme. The plans could not be decided until the track level was fixed. It is expected that the railways will ask for the appointment of a board of three independent engineers of acknowledged eminence to prepare a joint recommendation. Such a board could report in time for work to be begun in the spring.

◆

ROYAL ARCHITECTURAL INSTITUTE.

The Royal Architectural Institute of Canada opened its seventh annual meeting in Ottawa on October 7th, addresses of welcome being extended by Mayor Hopewell and C. P. Meredith, president of the Local Chapter of the Ontario Association of Architects.

The Institute will meet next year in the city of Calgary. A resolution was passed by the Institute reorganizing it as the representative body of the Federated Provincial Associations. The Royal Architectural Institute of Canada has a membership of 550 in all parts of Canada.

F. S. Baker, president of the Institute, retired, and the following officers were elected: President, H. C. Russell, of Winnipeg; vice-presidents, Messrs. George Long, of Calgary; A. F. Wickson, of Toronto, and G. A. Monette, of Montreal; honorary secretary, Alcide Chausse, Montreal; honorary treasurer, J. W. H. Watts, Ottawa.

* * * *

MANITOBA ASSOCIATION OF ARCHITECTS.

The annual meeting of the above was held in Brandon, Man., on Saturday, September 28th last. The following were elected officers for the coming season: President, W. Fingland; vice-presidents, W. A. Elliott and J. Prender West; secretary, R. G. Hanford; treasurer, W. F. Nichols. Several important questions were dealt with, including the new Winnipeg building by-laws, the Selkirk memorial competition and the annual meeting of the Royal Architectural Institute of Canada, to be held in Ottawa in the near future.

* * * *

ONTARIO SOCIETY OF ARCHITECTS.

At a meeting of the Ontario Society of Architects the following were elected officers for the coming season. The annual convention of this body will meet in the city of Ottawa during the middle of October. President, C. P. Meredith, Ottawa; first vice-president, Jules F. Wegeman, Toronto; second vice-president, A. C. Bond, Toronto; treasurer, J. P. Hynes, Toronto; registrar, H. E. Moore, Toronto. The other members of the council are: Professor Wright, Toronto, and Fennings Taylor, Ottawa.

CANADIAN STREET RAILWAY ASSOCIATION.

The Canadian Street Railway Association met last week in London. A number of papers were read by members of the association, and officers were elected for the year as follows: President, Mr. Patrick Dubee, Montreal; vice-president, Mr. C. B. King, manager of the London street railway; secretary-treasurer, Mr. Acton Burrows, Toronto; executive committee, the officers and Messrs. R. Hooper, St. Johns, N.B.; J. E. Hutchinson, Montreal; J. D. Fraser, Ottawa; W. Phillips, Winnipeg, and J. E. Coleman, Hamilton.

* * * *

REGINA ENGINEERING SOCIETY.

The Annual Meeting of the Regina Engineering Society was held last week and the following officers were elected. No new nominations were offered and the men who have served during the past five months of the society's existence were unanimously re-elected. They are as follows: Hon. president, J. G. Sullivan; president, A. J. McPherson; first vice-president, H. S. Carpenter; second vice-president, L. A. Thornton; secretary, J. A. Gibson; treasurer, E. I. Wenger; corresponding secretary, R. O. Wynn-Roberts.

The address of the evening was a paper on "Good Roads," read by A. J. McPherson.

Mr. McPherson reviewed the history of road making in Saskatchewan, but dealt chiefly with the progress which had been made since 1906 and the methods adopted. His paper dealt with the whole question from the standpoint of the government, and showed what progress had been made since the adoption of the first policy of having the money provided for this purpose expended under local supervision, which resulted in its being done only when no other work could be undertaken, through successive steps up to the present system under which the supervision of the making of main roads is entirely under the supervision of the commission. He showed how the steps which had been taken had resulted in having a large body of men scattered over the province, all of whom were intelligent road builders.

The work of construction, when of any extent, such as construction of roads through sloughs, through rough country and the building of bridges over twenty feet span, is done by the government while the maintenance of roads built with government assistance and the upkeep of the ordinary roads is left to the municipalities.

In the discussion which followed the paper Mr. Carpenter drew the attention of the engineers to the fact that there was a dearth of road engineers throughout the country and that many municipalities were refraining from entering upon extended plans of road building because they could not get men competent to direct the work.

◆

PERSONAL.

MR. LOUIS B. STEWART, Professor of Surveying of the University of Toronto, who has been north for the Dominion Government, settling the boundary between Manitoba and Ontario, is back in Toronto.

MR. WILLIAM KENNEDY, JR., of Montreal, will in all probability be retained by the fire, water and light committee of Winnipeg as consulting hydraulic engineer in connection with the Point du Bois power plant.

MR. G. C. BATEMAN, B.Sc., late of the staff of the Dome Mines, in Porcupine, has been appointed to succeed Mr. A. D. Miles as Canadian representative of the Canadian Mining and Exploration Company. Mr. Bateman is a gradu-

[illegible] of Queen's University, and is an experienced mining man.

MR. PATRICK WELCH, of the firm of Foley, Welch and Stewart, has resigned from the vice-presidency of the Pacific and Great Eastern Railway Co., and has secured the contract to build this line throughout its length from North Vancouver, B.C., to the Grand Trunk Pacific main line. Mr. Welch has established headquarters at Lillooet and will begin operations immediately.

MR. LOUIS B. STEWART, Professor of Surveying of the Canadian Society of Civil Engineers, has been appointed by the Government to investigate work done in the construction of the National Transcontinental Railway under the old commission. An investigation has been in progress for some months by George Lynch Staunton, K.C., of Hamilton, and F. P. Gutelius, formerly with the C.P.R.

◆

COMING MEETINGS.

THE CANADIAN HIGHWAY ASSOCIATION.—Meeting will be held in Winnipeg, Man., October 9th to 12th. Secretary, P. W. Luce, Room 4, Cunningham Block, New Westminster, B.C.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—Annual Convention will be held at Baltimore, Md., October 15th to 17th, 1912. Secretary, C. A. Lichty, 226 Jackson Blvd., Chicago, Ill.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Powers, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, [illegible] Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P. O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Mayor Lees, Ham.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy.-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; Secy.-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, Chas. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy.-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy.-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
10-24	Construction of about 7¾ miles of Combined Sewers, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 10,400 ft. reinforced concrete pipe, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 1,660 ft. of 48″ steel pipe, bends and specials, New Westminster, B.C. ...(P. & S.)	10-10

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work	Tenders Close.	Issue of.	Page.
Cobourg, Ont., breakwater extension	Oct. 16.	Sept. 26.	67
Franklyn Point, P.E.I., wharf..	Oct. 8.	Sept. 12.	67
Fairhaven, N.B., pierhead to public wharf	Oct. 8.	Sept. 19.	71
Goderich, Ont., breakwater ...	Oct. 10.	Sept. 19.	71
Lanorail, P.Q., extension wharf.	Oct. 10.	Sept. 19.	71
Massett, B.C., pile wharf.....	Oct. 15.	Sept. 19.	71
New Westminster, B.C., ladder dredge	Oct. 8.	Sept. 19.	80
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Ottawa, Ont., bridge	Oct. 9.	Sept. 26.	67
Quebec, P.Q., grain elevator..	Oct. 21.	Sept. 19.	80
Port Colborne, Ont., repair to headblock	Oct. 22.	Oct. 3.	67
St. Pierre les Becquets, P.Q., wharf, approach and dredging of berth for headlock..	Oct. 15.	Sept. 19.	72
Toronto, Ont., shelter, Ketchum Park	Oct. 8.	Sept. 26.	67
Toronto, Ont., work on windows, etc., City Hall......	Oct. 8.	Sept. 26.	67
Toronto, Ont., storm overflow sewer	Oct. 22.	Oct. 3.	76
Transcona, Man., sub-station ..	Oct. 9.	Oct. 3.	67
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78
Vancouver, B.C., installation of light standards	Oct. 17.	Sept. 26.	68
Vancouver, B.C., department store	Oct. 24.	Sept. 26.	68
Vancouver, B.C., grading and bridging	Oct. 10.	Oct. 3.	67
Willow Point, B.C., wharf.....	Oct. 11.	Sept. 19.	72
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., lighting cables.	Oct. 9.	Oct. 3.	67
Whitby, Ont., esplanade wall...	Oct. 22.	Oct. 3.	67
Yorkton, Sask., electrical plant..	Oct. 31.	Oct. 3.	76

◆

TENDERS.

Calgary, Alta.—Construction of examining warehouse: tenders to be received until October 25, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., at the office of Mr. H. E. Matthews, superintending architect of the Dominion Public Buildings, in the Province of Manitoba, Winnipeg, Man.; Mr. W. T. Mollard, clerk of works, Regina, Sask.; at the post office, Calgary, Alta., and Department of Public Works, Ottawa.

Dunnville, Ont.—Tenders for 9,640 feet of four and six-inch water mains, together with the necessary valves, hydrants and specials, will be received until October 21st, 1912, at the office of Alan Mair Jackson, superintendent, Board of Waterworks Commissioners. (See advt. elsewhere in Canadian Engineer.)

Father Point, Que.—Tenders for the erection of one wireless telegraph mast will be received until October 10th, 1912, at the office of G. J. Desbarats, Deputy Minister, Department of Naval Service, Ottawa. Plans, specifications, etc., can be seen at the office of the general superintendent of wireless service, Department of the Naval Service, Ottawa, or at the wireless telegraphy station at Father Point, Que., or at the office of the agent of the Marine and Fisheries Department, Quebec, Que.

Grimsby, Ont.—Tenders for the construction of a public building will be received until October 30, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, specifications and form of contract can be seen and forms of tender obtained at the Independent newspaper office, Grimsby, Ontario, at the postoffice, St. Catharines, Ont., and at this Department.

New Westminster, B.C.—Tenders will be received until October 24th, 1912, for the construction of about 7¾ miles of combined sewers for districts A. B, and "Outfall," in Section No. 2, of Sapperton System. Further particulars may be obtained from J. W. B. Blackman, City Engineer. Plans, etc., at the offices of The Canadian Engineer, and The Contract Record, Toronto. W. A. Duncan, City Clerk. (See advt. in The Canadian Engineer).

New Westminster, B.C.—Tenders for the supply of about 10,400 feet of reinforced concrete pipe of the lock or continuous jointed type, in sizes from 20 to 54 inches, for Districts A, B, and Outfall of Section No. 2, of Sapperton System, will be received until October 24th. Further information may be obtained from J. W. B. Blackman, City Engineer. Plans, etc., at the offices of The Canadian Engineer and The Contract Record, Toronto. W. A. Duncan, City Clerk. (See advt. elsewhere in The Canadian Engineer).

New Westminster, B.C.—Tenders for supply of about 1,660 feet of 48-inch steel pipe, bends and specials, for outfall and syphon of Section No. 2, of Sapperton System, will be received until October 24th, 1912. Further information may be obtained from J. W. B. Blackman, City Engineer. Plans, etc., may be seen at the offices of The Canadian Engineer, and The Contract Record, Toronto. (See advt. elsewhere in advt. in The Canadian Engineer).

Paris, Ont.—Addition and alteration to public building; tenders to be received until October 21, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, specifications and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. Hastings, clerk of works, Postal Station F, Yonge Street, Toronto, at the post office, Paris, Ont., and at this Department.

Seymour Arm, B.C.—Pile bent wharf: tenders to be received until October 29, 1912, at office of R. C. Desrochers, Department of Public Works, Ottawa. Plans, etc., at this department; at the office of C. C. Worsfold, Esq., district engineer, New Westminster, B.C.; F. W. Aylmer, Esq., district engineer, Chase, B.C., and on application to the postmaster at Seymour Arm, B.C.

Sapperton, B.C.—Tenders for the purchase of the Canadian Government steamer "Georgia" will be received until October 25, 1912, at the office of A. Johnston, Deputy Minister of Marine and Fisheries, Department of Marine and Fisheries, Ottawa. Dimensions of steamer: Length of keel, 60 feet; breadth outside, 11 feet; depth moulded, 6 feet.

Seal Cove, N.B.—Breakwater wharf: tenders to be received until October 30th, 1912, at office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at this department, and at the offices of E. T. P. Shewen, Esq., District Engineer, St. John, N.B.; Geoffrey Stead, Esq., District Engineer, Chatham, N.B.; Postmaster at Seal Cove, Grand Manan, Charlotte County, N.B.

Toronto, Ont.—Tenders for the construction of Section No. 13, of the high level interceptor, will be received until October 22, 1912. Plans, etc., may be obtained at the office of the Commissioner of Works, City Hall, Toronto. G. R. Geary, (Mayor) Chairman, Board of Control. (See advertisement in *The Canadian Engineer*).

Toronto, Ont.—Tenders for the construction of concrete sidewalks on Cedarvale Avenue, and bitulithic pavements on Walmer Road, in the Township of York, will be received up to noon of October 14th, 1912, at the office of Frank Barber, Esq., Township Engineer, 57 Adelaide Street East, Toronto, at whose office plans and specifications may be obtained. (See advt. elsewhere in The Canadian Engineer.

Winnipeg, Man.—Tenders for the supply of labor and materials required in the erection of piers, floor and pavement for the bridge across the Assiniboine River at Arlington Street. Plans, etc., at the office of the city engineer, 223 James Avenue. M. Peterson, secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders addressed to the Chairman, Board of Control, will be received until October 12th, 1912, for the manufacture and delivery of 10,000 drawn wire, Tungsten lamps, and 25,000 carbon filament lamps. Instructions to bidders, etc., may be obtained at the office of the City Light and Power Department, 54 King Street. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the manufacture and delivery f.o.b., Winnipeg, of D. C. and A. C. Meters, will be received until noon of October 12th, 1912. Specifications, etc., at the office of the City Light and Power Department, 54 King Street. M. Peterson, Secretary, Board of Control Office, Winnipeg.

◆

CONTRACTS AWARDED.

Eburne, B.C.—Contracts for the erection of a building for the Dominion Safe Works, to be used for manufacturing purposes, have been let to Messrs. Barwick Brothers. Plans were drawn by Architect Edward Sproat. The structure will cost [illegible]

Enderby, B.C.—Contract for the new school building to be erected here has been awarded to Mayor J. L. Ruttan, his price being $50,000. Mr. E. J. Mack has the contract for the excavation work.

Grand Bend, Ont.—Mr. Jas. A. Doyle, contractor, Cross Street, Chatham, has the contract for a ten-thousand-dollar [illegible] for the Dominion Government.

Guelph, Ont.—Messrs. P. H. Secord and Sons, have been [illegible]

Lindsay, Ont.—Drill hall: contract awarded to Mr. Jas. [illegible]

Moose Jaw, Sask. [illegible]

North Toronto, Ont. The high school board have [illegible]

Ottawa, Ont. [illegible]

Peterboro, Ont.—Messrs. Fitzgerald and Paget have secured the contract for the construction of a drill hall here, to cost $8,325.

Port Colborne, Ont.—At a meeting of the council the contract for $2,000 worth of concrete walks was let to the Excelsior Construction Company, of Welland. The contract price is $1.10 a square yard.

Quebec, Que.—The MacArthur Concrete Pile and Foundation Co., 11 Pine Street, New York, has been awarded the contract for placing the foundations for the Dorchester Electric Company's new powerhouse, Quebec, Que.

Toronto, Ont.—The tender of J. J. McFadden, of Renfrew, Ont., for two timber limits in the township of Jocko, New Ontario, has been accepted by the Ontario Government. He will pay the government $13.26 a thousand for pine and $3.08 for spruce.

Transcona, Man.—Contracts for the new school buildings have been awarded as follows: For the construction work, Messrs. Haney, Quinlan and Robertson, for $66,355; for plumbing and heating, Messrs. Cotter Brothers, Winnipeg, at $22,565; for electrical work, Mr. G. R. Andras, at $3,460.

Victoria, B.C.—The Northern Construction Company have sublet a contract for the route of the Canadian Northern Pacific Railway route from the west end of Cowichan Lake for forty miles, to Messrs. Murdock and Mercer, of Vancouver.

Victoria, B.C.—Apartment house: contractors, Messrs. Pinner and Weston; architect, S. McClure; owner, Mr. Wm. S. Maher; cost, $15,000.

Vancouver, B.C.—The contract for the erection of the new building for the Vancouver Club has been awarded to the Norton Griffiths Steel Construction Company. Messrs. Sharpe and Thompson drew the plans. Building will be of fireproof construction, faced with Haddington Island stone, pressed brick and terra cotta.

Vancouver, B.C.—Messrs. Norton Griffiths Steel Construction Company have been awarded the contract to erect a building for the Merchants Bank of Canada, at a cost of $125,000.00.

◆

RAILWAYS—STEAM AND ELECTRIC.

Stratford, Ont.—The ratepayers will vote on street railway proposition which has been made by Sir William Mackenzie of the Canadian Northern Railway. The franchise calls for a twenty-five-year agreement.

◆

LIGHT, HEAT AND POWER.

Ayr, Ont.—The ratepayers of this municipality voted in favor of purchasing the electric light plant.

Moose Jaw, Sask.—The management of the Moose Jaw Electric Street Railway Company will increase in size of their car barns at a cost of $30,000. They will also install a new generator of 500 k.w. capacity.

Ottawa, Ont.—The municipal board of control will recommend that [illegible] new arc lights and 28 tungsten standards be installed at once.

Welland, Ont.—The municipal council have closed a contract with the Hydro-Electric Commission for a supply of power for this town.

Winnipeg, Man.—The municipal fire, water and light committee considered the matter of enlarging the Point du Bois power plant. According to Power Manager Glassco, this must be done previous to next fall, and he estimates the cost of two additional power units at $[illegible]

◆

GARBAGE, SEWAGE AND WATER.

Stamford Township, Ont. Negotiations have been entered into between the officials of this municipality and the management of the Canadian Niagara Power Company regarding the installation of a waterworks system in the township.

Barrett Specification Roofs

On Four Great Granaries

To cover the four huge granaries illustrated herewith the Canadian Pacific R. R. engineers chose Barrett Specification Roofs for good and sufficient reasons.

These practical men know that these roofs will last *20 years or more.*

They further know that they will need no painting or maintenance expense of any kind and that the net cost per year of service will be infinitely lower than could be shown by any other type of roofing.

It is for these very reasons that Barrett Specification Roofs are used on more first-class buildings in the United States and Canada than any other kind

A big roof generally means a Barrett Specification Roof, for the reason that the cost of big roofs is carefully scrutinized and ultimate economy carefully considered. Small roof areas ought also to have Barrett Specification Roofs, because they are just as economical and satisfactory there.

Copy of The Barrett Specification with tracings ready for incorporation into building plans free on request Address nearest office.

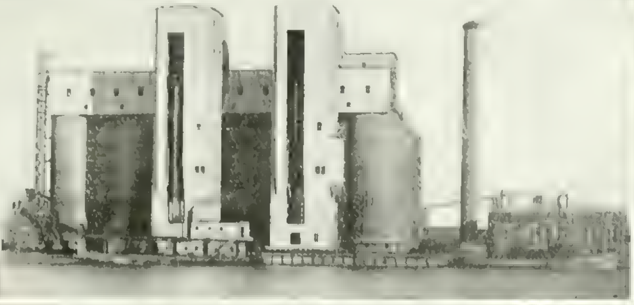
Special Note

We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., Limited
MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.



Sarnia, Ont.—The plans for the new quarter-million-dollar waterworks for supplying pure water from Lake Huron to the citizens of Sarnia and Point Edward have been accepted by the Provisional Board of Health as satisfactory. The by-law will now be prepared and a vote taken by the people.

BUILDINGS AND INDUSTRIAL WORKS.

Brandon, Man.—It is reported that a boot and shoe manufacturing concern are making preliminary arrangements toward locating in this city. Mr. Victor Donaldson is interested in the preliminaries.

Edmonton, Alta.—A. B. Stewart, formerly of Glasgow, Scotland, is opening a factory here for the manufacture of concrete filled steel posts and for making other things of similar construction.

Fort William, Ont.—The plans for the Great West Wire Fence plant to be erected here show a steel and concrete building 125 x 200 feet. The estimated cost is $40,000.

Fort William, Ont.—According to information given by Mr. J. P. Jones, tenders will be called in a few days for the erection of a new financial building to house the Dominion Grain Commission, the Fort William Grain Exchange and the government sample markets.

Fort William, Ont.—A report states that the Grand Trunk Pacific Railway authorities will erect a large freight handling plant in this city.

Fredericton, N.B.—The municipal fire commissioners may erect two new fire stations in this city within the next few months. J. O'Neil, city engineer.

Guelph, Ont.—A number of local men are about to form a brick company and commence manufacturing operations at Monkton. The names of the interested parties so far have not been made public, but Mayor Thorp has expressed his satisfaction of the scheme.

Guelph, Ont.—Plans for the new building for field husbandry in connection with the Ontario Agricultural College have been approved by the Hon. James Duff, Minister of Agriculture. It is to be a two-story brick structure, costing about $40,000 to be taken entirely from the Federal grant.

Islington, Ont.—The management of the Dominion Bridge Company have purchased 10 acres of suitable land at this point and will erect an assembling and storage plant.

Lethbridge, Alta.—The directors of the Lethbridge Brewing and Malting Company are considering a proposition to enlarge their plant at a cost of $[illegible].

Montreal, Que.—Mr. Geo. W. Hill, A.R.C.A., has been commissioned to erect a statue to the memory of the late Sir George Etienne Cartier. This work is to cost $100,000.

Moose Jaw, Sask.—Agreements have been completed whereby the Morley Twine Company, of Sioux City, U.S.A., will establish a plant in this city.

Ottawa, Ont.—The government has purchased from D. D. McGillivray a site for an armory at Port Arthur, the price paid being $[illegible].

Ottawa, Ont.—The addition to the fat stock show building will cost about $19,000.00, according to the lowest tender received, which was from Messrs. Smith Bros. Mr. Burwell is the architect for this work.

St. Felicite, Que.—[illegible]

Todmorden, Ont.—[illegible]

Toronto, Ont.—The management of the T. Eaton Company [illegible]

Vancouver, B.C.—[illegible]

Vancouver, B.C.—[illegible] a new office structure. $125,000.00 is the estimated cost of this work.

Vancouver, B.C.—The members of the congregation of the Kitsilano Methodist Church have planned to erect a new building at a cost of $100,000.00. Rev. Newton Powell is the minister of this church.

Vancouver, B.C.—Twelve houses, to cost between $1,500 and $2,500 each, are to be constructed at Coquitlam, for the Coquitlam Terminal Company by the Coquitlam Construction Company. These houses will be homes for men who are to be employed at the Coquitlam C.P.R. Terminals.

BRIDGES, ROADS AND PAVEMENTS.

Belleville, Ont.—The municipal council have under preparation a by-law calling for a large amount of granolithic pavement. Mr. J. G. Lindsay, city engineer.

CURRENT NEWS.

Middleton, N.B.—Mr. F. W. C. Parsons, chief engineer of the Drummond Iron Mines, states that there is a possibility of an iron and steel works locating a plant near this plant. The plans as proposed at present call for a plant of 250 tons daily capacity with a rolling mill and a bar steel works.

Niagara Falls, Ont.—The municipal council have received the following tenders for the supply and installation of a new centrifugal force pump:

Canadian Foundry Co.	$4,370
Caledonia Iron Works	6,025
Escher-Wyss Co.	4,750
Drummond McCall Co.	6,500
Buffalo Steam Pump Co.	6,244

Ottawa, Ont.—The architects of Canada and the empire are to be invited to submit plans for a new departmental building or group of buildings to be constructed along the bank of the Ottawa River west of the parliament buildings.

Pembroke, Ont.—The management of the Pembroke Shook Mills have been granted a free site and exemption from taxation for 20 years by the ratepayers.

Vancouver, B.C.—According to a report prepared by Consulting Engineer Burwell, the cost of erecting a dam on Seymour Creek will be $632,000. The various items noted in the figures from the engineer were: Construction of concrete dam and intake, $150,000; clearing 400 acres to be flooded by reservoir, $120,000; 48-inch steel main to dam from present intake, 18,600 feet, $186,000; construction of four miles of pipe, line roadway, $20,000; tunnelling, 700 feet, $10,000; cribbing, 600 feet, $3,000; engineering expenses, $27,000; debenture loss and contingencies, $116,000; total, $632,000.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending September 2nd, 1912:

A Scottish firm desire to appoint agents at Calgary, Edmonton, Regina and Medicine Hat, for the sale of their jute cloth, hessians, etc.

A West of England correspondent makes inquiry for the names of Canadian importers of safety pins.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:

A Belgian firm which makes a specialty of importing [illegible] would be glad to hear from Canadian producers seeking export trade.

A London manufacturer of a novelty in gramophone horns desires to communicate with a firm in Canada with a view to arranging exclusive agency for that country.

The London manufacturers of a new portable electric vacuum cleaner are looking for sole agents in Montreal, Winnipeg and Vancouver.

A London firm manufacturing loose leaf account books, and general specialties in stationery and leather goods, wish to arrange for their sale in Canada.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire Machine Banded
WOOD STAVE PIPE
CONTINUOUS STAVE PIPE
RESERVOIR TANKS
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

DEPT. OF RAILWAYS AND CANALS, WELLAND

Superintending Engineer's Office,
Messrs. Wettlaufer Bros., St. Catharines, Feb. 7th, 1912.
No. 178 Spadina Ave., Toronto.

Dear Sirs:—Replying to yours of the 6th, I beg to say that the two Mixers received from you last summer proved to be very handy, useful machines. They turned out excellent concrete and we had no trouble with them at all.

Yours truly, J. L. WELLER, Superintending Engineer.

CANADIAN NORTHERN RAILWAY

Belleville, Ont., Feb. 14th, 1912.
Wettlaufer Bros.,
178 Spadina Ave., Toronto, Ont.

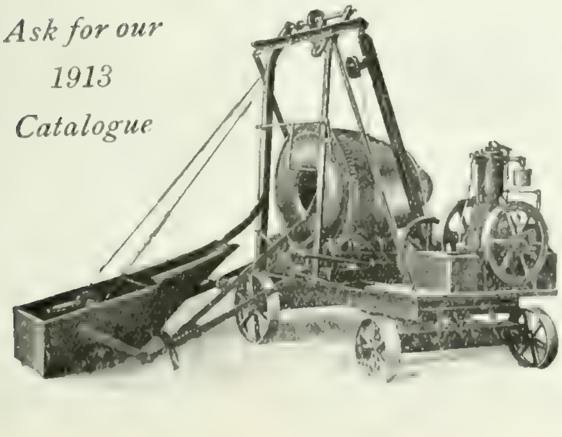
Dear Sirs:—I think it is my duty to inform you that I am entirely satisfied with the two Concrete Mixers purchased from you last season. I have tested them in every way possible, and in every case I have found them capable of doing first-class work.

Yours sincerely, J. O. GIROUX.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

Compare the thoroughness, simplicity and durability of our mixer with other makes. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing and the saving of power.

Ask for our 1913 Catalogue



WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE,
WORKS AT MITCHELL, ONT. **TORONTO** DETROIT, MICH. BUFFALO, N. Y.

HOOTON & MOORE, 613 Ashdown Block, Winnipeg
LAVALLE-ROSS, Alexander Block, Edmonton, Alta.
A. R. WILLIAMS MACHINERY CO. 15 Dock St., St. John, N B.
WETTLAUFER BROS., 316 Lagauchetiere St. W., Montreal, Que.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

17583—September 23—Authorizing C.N.O.R. to construct across public road between Twps. of Field & Springer, Dist. of Nipissing, Ottawa-Capreol Line.

17584—September 23—Authorizing C.N.O.R. to construct bridge across Ground Hog River, Dist. Algoma, mileage 149.7 from Sudbury Junction.

17585—September 23—Amending Order No. [illegible], by substituting for the plan approved thereunder, the plan filed as plan "A."

17586—September 23—Authorizing C.N.O.R. to construct across C.P.R. at Lansing, Tp. York, Co. York, Ont., mileage [illegible] from Yonge St., Toronto, and rescinding Order No. [illegible], dated March 11th, 1912.

17587—September 23—Authorizing the Town of Point-aux Trembles, Que., to extend, at its own expense, Frontenac St., across tracks of C.N. Terminal Ry. Co., in said town.

17588—September 23—Authorizing the Niagara, St. Catharines & Toronto Ry. to construct spur for the Montrose Paper Company, in Town of Thorold, Ont.

17589—September 24—Directing that the Dominion Express delivery limits in Maple Creek, Sask., shall be those enclosed within Pacific Ave., March St., 4th Ave., and Aspen St.

17590—September 26—Authorizing C.P.R. to construct across highway Station 193.4, between Tps. Blanshard, Co. Perth, and East Missouri, Co. Oxford, Ont.

17591—September 25—Authorizing C.P.R. to reconstruct bridge No. 81.5 on its Woodstock Subdivision.

17592—September 24—Approving revised location C.P.R. Lacombe Easterly Branch from a point in S.E. ¼ Sec. 2[illegible], Tp. [illegible], R. 12, W. 4 M., mileage [illegible] to a point in S.E. ¼ Sec. [illegible], Tp. [illegible], R. [illegible], W. 4 M., mileage 146.1[illegible], Alberta.

17593—September 26—Approving replacement of span, bridge 18.9, on the Elora Subdivision of C.P.R. (Plan No. 40504).

17594—September 25—Authorizing C.L.O. & W. (C.P.R.) to connect with K. & P. Ry., at Parham Station, Lot 25, Con. 1, Tp. of Hichinbrooke, Co. Frontenac, Ont., mileage 24.8 from Glen Tay.

17595—September 25—Authorizing C.L.O. & W. (C.P.R.) to construct bridge No. [illegible] over public road.

17596—September 25—Authorizing C.L.O. & W. to construct across 4 highways, mileage [illegible] to mileage [illegible], from Glen Tay.

17597—September 26—Approving revised location G.T.P. Branch Lines Co., Calgary-Boundary Branch from West Line, N.E. ¼ Sec. 12, Tp. 13, R. [illegible] to [illegible] N.W. ¼ Sec. [illegible], Tp. 11, R. [illegible], W. 4 M., mileage 81.41 [illegible] Dist. South Alta.

17598—September 28—Authorizing G.T.R. to reconstruct bridge No. 303 over [illegible] River, mile post [illegible], 13th Dist. Northern Division.

17599—September [illegible]—Approving revised location G.T.R. siding to premises of Western Foundry Co., Ltd., Wingham, Ont.

17600—September [illegible]—Authorizing G.T.R. to reconstruct three bridges [illegible] at mile post [illegible], 12th Dist. at Rockwood [illegible] 13th Dist. at [illegible], and mile post [illegible], 4th Dist. [illegible] Province of Ontario.

17601—September 26—Authorizing C.N.O.R. to construct across public road, Lot 44, Con. 1, Tp. Camden, Co. Addington, Ont., by means of overhead structure.

17602—September [illegible]—Authorizing Alberta Interurban Ry. Co. to construct [illegible] of G.T.P. Branch Lines Co., [illegible] Calgary Branch, [illegible] by means of overhead crossing.

17603—September [illegible]—Authorizing Alberta Interurban Ry. Co. to cross [illegible] C.P.R. Langdon Branch, [illegible], Tp. [illegible], R. [illegible], W. 4 M., by [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

17615—September 25—Extending, until the 15th December, 1912, the time within which the G.T.R. complete bridge across Lachine Road at Rockfield, Que.

17616—September 26—Authorizing C.N.R. to construct across public road between Secs. 28 and 27, Tp. 28, R. 6, W. 4 M., on its Goose Lake Extension.

17617—September 25—Approving G.T.P. Ry. station site at Miniota, Sec. [illegible], Tp. 14, R. [illegible], W. 1st M.

17618—September 25—Refusing application G.T.P. Ry. for authority to construct wye track at mileage 29 west of Yellowhead Pass.

17619—September 25—Directing that joint freight rates to be charged by C.P.R., C.N.R., and G.T.P., on lumber, in carloads, between Port Arthur and Fort William, Ont., and points on Lake Superior Branch of G.T.P. be not higher than 1c. per 100 lbs., over rates of G.T.P. between Westfort, Ont., and said Lake Superior Branch points.

17620—September 2[illegible]—Authorizing Central Vermont Ry. to reconstruct bridge across Yamaska River at or near town of Farnham, Que.

17621—September [illegible]—Authorizing Bay of Quinte Ry. to revise grade of line across 2 highways in Tp. Portland, Co. of Frontenac, Ont.

17622—September 30—Authorizing Heaps Brick Co., Ltd., to cross tracks of Western Canada Power Co., Ltd., at Ruskin, B.C.

17623—October 1—Directing that the Dominion and Canadian Express Companies' delivery limits in city of Fredericton, N.B., be enclosed by River St. John, between Lansdowne St. and Odell Ave., Waterloo Row from south end of Ketchum's bridge, Lansdowne St., University Ave., Canadian Pacific Ry. to station; Victoria St. from Carleton St., Smythe St., Saunders St., and Odell Ave., to River.

17624—October 1—Directing that the Dominion Express Company's delivery limits in town of Rouleau, Sask., be enclosed by Wetmore St., from Railway Ave., Knox Ave., Brownlee St., and Railway Ave., to starting point.

17625—September 26—Authorizing C.N.O.R. to construct across 2 highways, mileage 221.09 and mileage 224.54, Tp. Ferris, and District of Nipissing.

17626—October 2—Authorizing Esquimalt & Nanaimo Ry. to construct industrial spur from point on its railway near intersection of Telegraph and Store Sts., Victoria, B.C., thence in southwesterly direction across Telegraph and Store Sts., and across lands of the Swift Canadian Co., Ltd., being Lot 125, on S.W. corner Telegraph and Store Sts.

17627—September 23—Authorizing C.N.O.R. to construct bridge across Humber River, Tp. York, Co. York, mileage 6.32, west of Toronto.

17628—September 30—Authorizing C.N. Montreal Tunnel & Terminal Co., Ltd., to cross tracks of the Jacques-Cartier and Union Ry. Co., near Jacques-Cartier Junction, Que.

17629—September 28—Certifying that correction, as shown on plan and book of reference, dated September 12th, 1912, of revised location of C.L.O. & W. (C.P.R.) across the mill pond, town of Bowmanville, Co. Durham, Ont., be allowed.

TENDERS CALLED FOR

TOWN OF DUNNVILLE, ONT.

Board of Waterworks Commissioners.

Tenders will be received by the undersigned up to 6 p.m. on the 21st October, 1912, for 9,640 feet (approx.) of four and six-inch water mains, together with the necessary valves, hydrants, and specials.

Specifications and instructions to bidders may be had from the undersigned.

The Board does not bind itself to accept any tender.

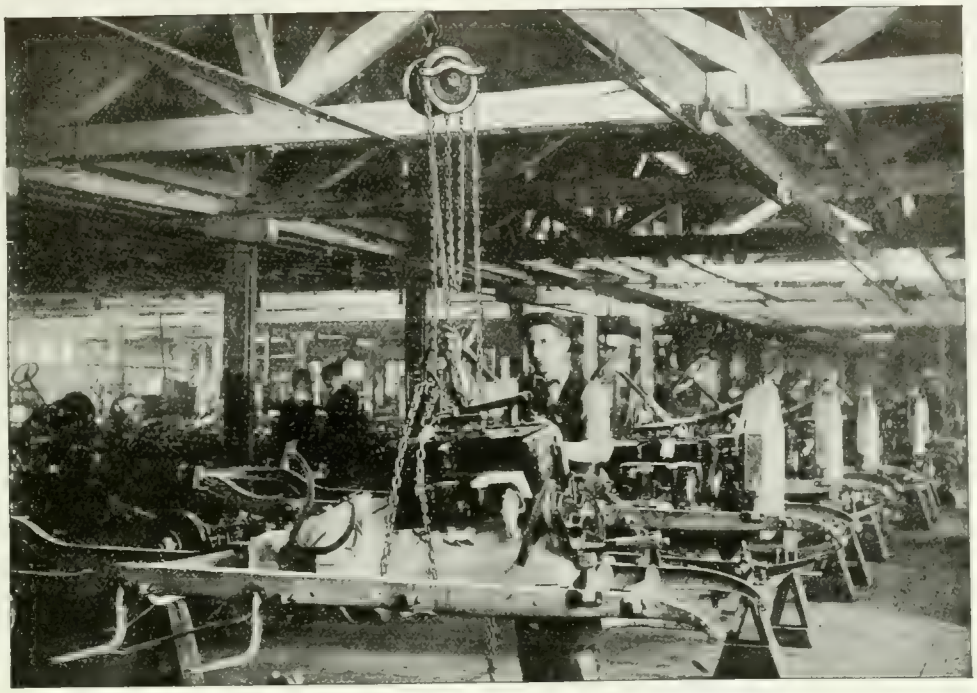
ALAN MAIR JACKSON,
Oct. 7th, 1912. Superintendent.

For further Tenders see page 76.

C. TENNANT SONS & CO.
(Montreal) Limited
C.P.R. Telegraph Chambers, Montreal

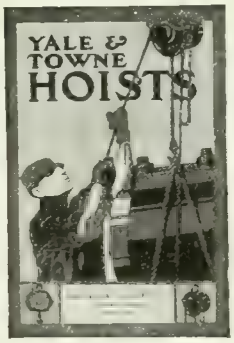
PIG IRON FERRO-MANGANESE
SPIEGEL-EISEN FERRO-SILICON
(Up to 17% Silicon)
ALUMINUM METAL ALLOYS

THE TRIPLEX BLOCK



Placing engine in chassis with a half-ton Triplex Block.

A 100-page Book on Hoists



Practical engineers are all agreed that radical cuts in cost can be brought about by solving hoisting problems. Such problems are not solved satisfactorily by heavy cranes which do not give continuous service. A load that is waiting to be moved is costing money just as much as a load which is taking a gang of workmen to move.

A hoisting problem is not solved until each workman can readily lift and transport any load, single handed, that comes to him.

The new Book of Hoists shows examples of hand and power hoisting and overhead apparatus for conveying in model plants, here and abroad. The information is the most complete we have ever published. We will be glad to send a copy free on request.

Triplex Blocks; **16 Sizes:** One-quarter of a ton to forty tons. **300 Active Stocks** all over the United States. **Every Block Tested to 50% Overload.**

The Canadian Fairbanks-Morse Co., Limited

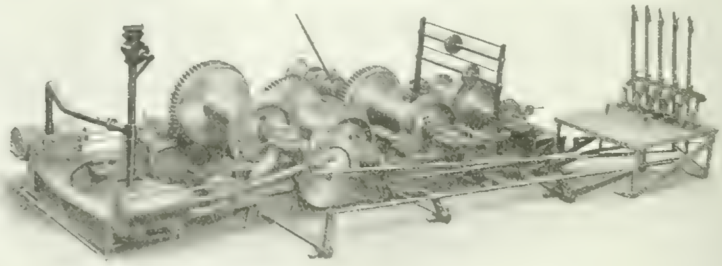
SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

Beatty Hoists

have stood the test of time and given satisfaction wherever they have been placed.

THREE DRUM ENGINE AND SWINGER
showing operating levers brought to one position



Ask the man who has one! We can furnish any size or type and give prompt shipment.

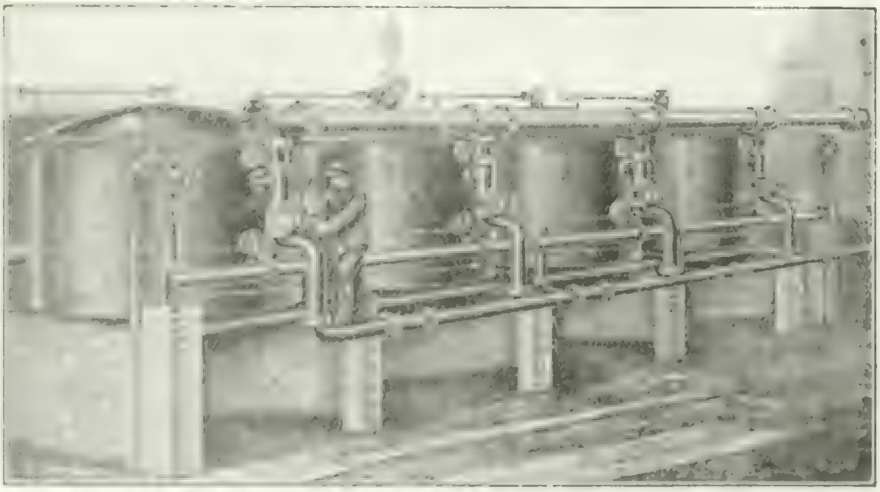
We have shipped engines into almost every part of the Dominion and will gladly put you in touch with our nearest customer. We are proud of every machine that we have ever shipped.

We also build Dredges, Steel Scows, Centrifugal Pumps, Derricks, Derrick Irons, Steam Shovels, etc., and are sole Canadian makers of the Williams "Faivrette" Clamshell Buckets.

M. BEATTY & SONS, Limited, WELLAND
ONTARIO

AGENTS:
H. E. PLANT, 1790 St. James St., MONTREAL
H. W. PETRIE, Limited, TORONTO
DOMINION EQUIPMENT & SUPPLY CO., WINNIPEG
R. HAMILTON & COMPANY, VANCOUVER
E. LEONARD & SONS, St. JOHN, N.B., and CALGARY, ALTA.

WATER FILTRATION AND PURIFICATION



FILTER PLANT [illegible] NEAR MANCHESTER, ENGLAND
[illegible] Gallons Per Hour [illegible] Dirty River Water for Bleach Works

Filtering material does not require renewing.

Filters cleansed in a few minutes by air blast and reversing flow of water.

ROYLES LIMITED, IRLAM, Nr. MANCHESTER
ENGLAND

Volume 23. Toronto, Oct. 17, 1912 Contents of this issue on page 615

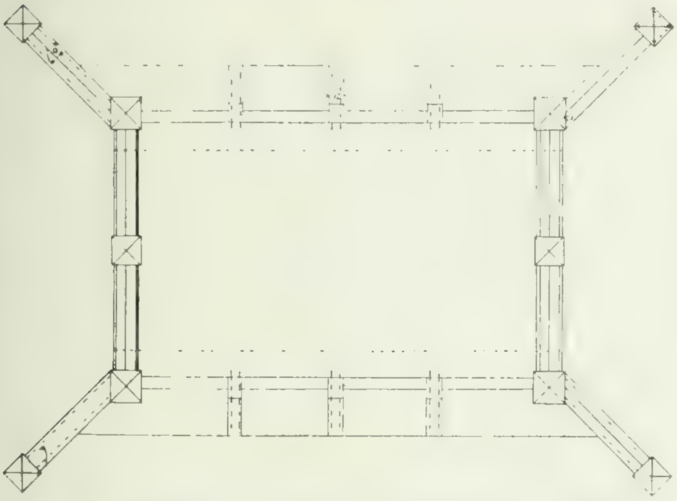
The Canadian Engineer

An Engineering Weekly

REINFORCED CONCRETE ARCH, NORTH TORONTO

By E. A. JAMES, B.A.Sc.*

For the last year the wooden bridge which carried Albertus Avenue across a creek about a quarter of a mile west of Yonge Street has been in an unfit condition for traffic. As this road leads only to land that is just being opened up, the necessity for a bridge has not been felt.

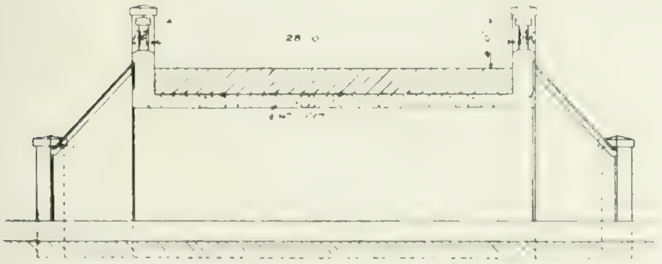


Plan of Bridge for Albertus Avenue, North Toronto.

In the spring of this year, however, it was decided to erect a permanent bridge and one which would harmonize with the surroundings.

The situation is a ravine about 20 feet deep and 150 feet wide. Through the ravine a stream flows in the fall and in winter freezes and forms an ice jam on a small scale. In the summer the bed is quite dry.

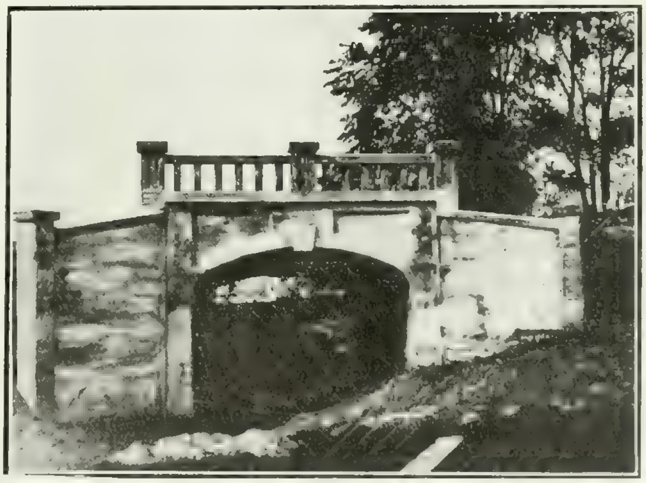
The type of bridge decided on was a reinforced concrete arch on abutment walls and with wing walls to hold back the fill. The span is 14 feet and the height from bed of creek to soffit is 12 feet. The clear width between parapets is 28 feet.



Longitudinal Section Through Bridge.

The foundations were put in during wet weather and are 4 feet below datum (the bed of the stream). The material is a compact sandy clay. The original foundation designs were for a slab foundation 1 foot below datum, but on excavating this did not give a good enough bottom. A 2-foot bed of concrete was placed in the excavation and the foundation placed in this. The material was dumped down in barrow loads from a platform 10 feet high, on which the mixing was done. As the foundation was very soft, the concrete was put down as dry as possible. The concrete was mixed by hand in about ¼ yard batches, the proportions for the foundations being 1 of cement to 7 of pit gravel.

The forms were started about datum level, and consisted mostly of 2-inch by 4-inch uprights with 1 inch planed tongued and grooved boarding. The forms were strutted from the outside with 3-inch by 8-inch lumber, also tied together with wire spaced about 2 feet in either direction. The front forms of the abutment were carried up to springing level and also the uprights of the back, but the boards in the rear were put in as the concrete rose.



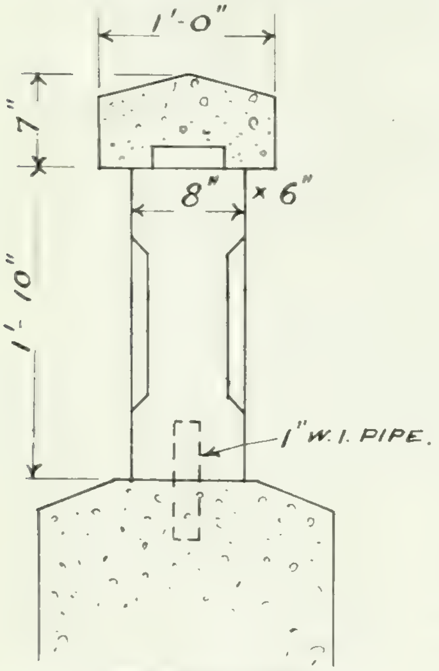
View of Bridge on Albertus Avenue, North Toronto.

The reinforcement in the abutments is ½-inch twisted steel, spaced at 24-inch centres for the vertical rods and 12-inch centres for the horizontal rods. In the wings the reinforcement was ½-inch twisted rods at 12-inch centres both horizontally and vertically. The reinforcement for the wings was ½-inch twisted bars at 12-inch centres both horizontally and vertically tying into the abutments. As the space between the steel in the abutments and the forms was only 2 inches by 3 inches, it was found rather difficult to pack and work the concrete at the face, but good results were secured

---

* Consulting Engineer to Town of North Toronto.

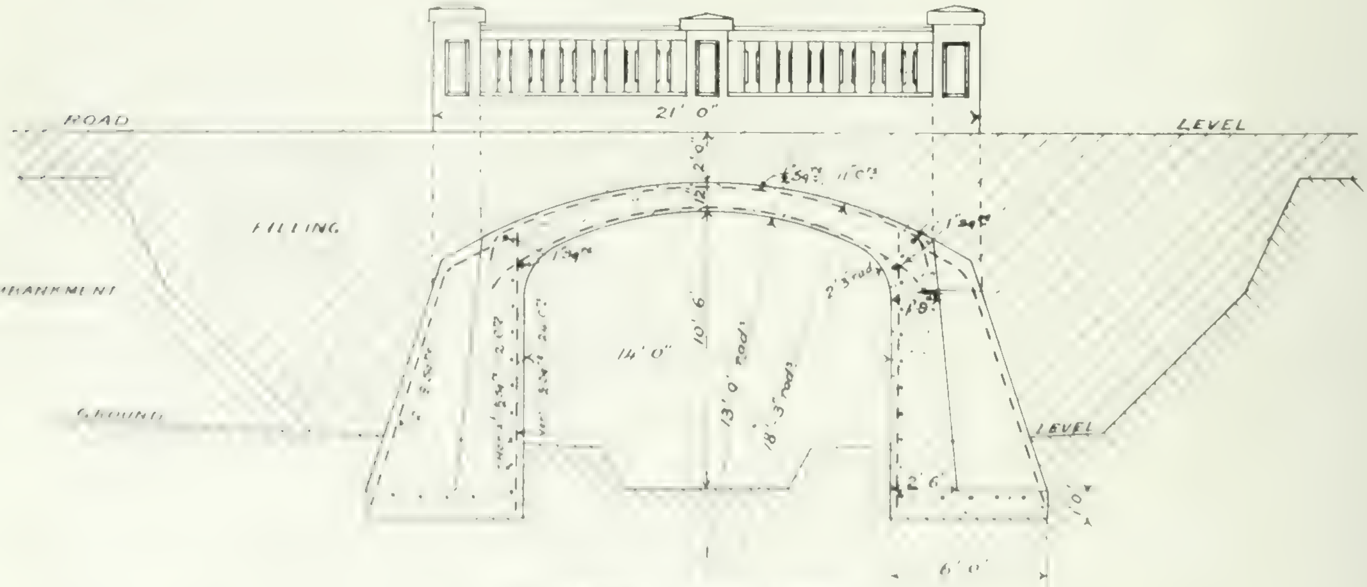
When the abutments were about 4 feet above datum, cracks began to show. These cracks occurred especially where a mark had been made in the surface as with a hoe, or a footprint. As it was thought that the rather heavy rains, experienced about this time, might have softened the ends of the abutments, levels were taken every other day for a while, but these did not indicate enough settlement to account for the cracks.



Detail of Hand Rail.

Tests made of each car load of cement delivered on the work showed good results as to soundness and setting powers. The use of wet concrete was stopped and when a drier mix was used an improvement occurred. The use of gravel without any stone was probably a contributory cause.

The abutments were carried up to within 6 inches of the springing and then the ribs for the centering were put into place. There were ten ribs, made up from 2-inch by 6-inch



Cross Section Through Bridge.

timbers. No wedges were used. The lagging was 2-inch planed lumber, and was covered with tar paper. The arch was put in all in one operation.

The forms for the posts at the end of the railing had about [illegible] with 1-inch pipe placed to bond with the railing of concrete. The railings on the parapets were cast separately with [illegible] at one end such as would [illegible] the railing posts. [illegible] were set up [illegible] and [illegible] [illegible] to [illegible] [illegible] such [illegible] small [illegible] of [illegible] board with the bottoms just at the level of the sills of the spandrel walls. Another sill was then formed over the tops and when these set, the railings were securely held.

The forms for the outside walls were removed in one week and the arch forms in four weeks. The face was filled with a grout of 1 cement to 1 sand and all rough places filled with mortar.

The backing was put in by wheel scrapers.

The cost of the construction work when reduced to unit prices were as follows:

Material Delivered at the Works.

Stone, 2 in., per cubic yard	$ 2.30
Gravel, per cubic yard	2.10
Steel, per lb.	.045
Lumber for forms, per M.	38.00

Labor for Work.

Concrete, per cubic yard	$ 1.10
Forms, per cubic yard of concrete	1.25
Earth excavation, per cubic yard	.29

◆

NIPISSING CENTRAL RAILWAY.

The Nipissing Central Railway Company was incorporated under the Dominion Charter in the year 1907. The following is abstracted from the annual report of the chief engineer: It owns and operates a line of electric railway between Cobalt and Haileybury, having a total length of 5.15 miles. The railway is located, in part, on its own right-of-way, and elsewhere on the streets and highways of the Township of Bucke, and the Town of Haileybury. Agreements were entered into with each of the above municipalities, providing for the operation of an electric street railway.

The T. & N.O. Railway Commission having purchased the capital stock of the Nipissing Central Railway on June [illegible], the Nipissing Central Railway was placed under the management of the general officers of the T. & N.O. Railway. The affairs of the two railways are kept quite separate. There is a local Superintendent and cashier in charge of the Nipissing Central Railway, reporting to the appropriate officials of the T. & N.O. Railway.

Route.—The Cobalt terminus is at the foot of Argentite Street. The location is in a general north-easterly direction from Cobalt, on private right-of-way on the west side of the

T. & N.O. right-of-way, crossing the latter by an overhead crossing at Argentite, thence along the Cross Lake Road to the Townsite of North Cobalt, thence along King Street, Lakeview Avenue, and Main Street, thence across private right-of-way to Georgina Avenue, Haileybury, thence northerly along Georgina Avenue to Blackwell Street, easterly along Blackwell Street to Ferguson Avenue, northerly along Ferguson Avenue to Browning Street.

Service.—A regular half-hour service is maintained between Cobalt and Haileybury from 6 a.m. to 11 p.m. At rush hours and on holidays the service is increased as may be necessary to accommodate the traffic.

Rolling Stock.—The following rolling stock was taken over with the Nipissing Central Railway:

3 42-foot double truck closed passenger coaches, each equipped with 40 h.p. motors, air and hand brakes, air whistle, arc headlamps, pilots, snow flangers, traffic recorders, and all necessary appliances necessary for an up-to-date electric trolley system.

1 combination baggage and passenger car, equipped with appliances similar to passenger coaches referred to above.

2 trailers of the same composition as the coaches, but having, of course, no motors.

1 four-wheel van.

2 thirty-foot flat cars.

1 small industrial standard gauge locomotive.

The locomotive referred to being practically of no use to the Nipissing Central Railway, was disposed of to advantage, brought down to North Bay Junction, where it is at present undergoing a general repair in the T. & N.O. shops, at the request of the firm purchasing same.

The other equipment referred to is all at present in very good condition, some slight repairs having been made to the passenger coaches; air brakes inspected and necessary overhauling done during the months of September and October.

Buildings.—The only buildings in connection with the Nipissing Central Railway are the car barn, which is situated between Haileybury and North Cobalt, and an office and waiting room. The car barn is a galvanized iron structure 150 feet by 60 feet, being 20 feet high at the eaves. A single track runs into this building which branches off into three, one track running over an inspection pit. Considerable repairs were made during the summer months to the roof of barn, rendering it in good serviceable condition.

The sub-station located in car barns consists of two motor generator sets of 400 h.p. and 200 h.p. capacity respectively.

Transmission System.—Power is obtained from the British Canadian Power Company's sub-station at Cobalt. A 2,200-volt transmission line connects the Power Company's sub-station with the Nipissing Central Railway sub-station in the car barns at North Cobalt. Another transmission line connected the sub-station at North Cobalt with power plant of the High Falls Power Company, but this transmission line is not in use, as the High Falls Company is not operating.

The trolley wire is No. 000 grooved section and, having no feeders, carries all the current used. The overhead system is composed of span wire type, with the exception of eighteen pole lengths of bracket type.

Roadbed.—The roadbed was never properly ballasted and some heavy expenditures for ballast will be necessary in the coming year.

Extensions.—An extension of the Nipissing Central Railway from its present terminus, Browning Street, Haileybury, to New Liskeard, also a freight spur to the Government wharf and Foster's Mill, are under consideration. Surveys for these have been completed, and negotiations are now being carried on for the necessary franchises from the towns of Haileybury and New Liskeard and Township of Bucke.

CANADIAN ROAD SYSTEMS.*

By W. A. McLean.†

Efficient system and organization form the key to highway improvement. If the laws and plan of administration are properly arranged, all details will be taken care of. If the system is well designed, ratepayers and citizens will have at their service a powerful machine, perfect in all its parts, that will produce finished highways, durably built, adapted to the service they are to perform, well maintained, and at a minimum cost.

System implies an effective means of procuring necessary funds, a fair and just method of distributing the cost, a general management based on good business principles, the application of engineering skill to design, and construction carried on with the best utilization of power and labor.

The creation of a thoroughly efficient system of highway construction and maintenance is a task which, in Canada and the Canadian Provinces, is being actively considered and dealt with. While some satisfactory progress has been made, measures to the present time have been those of the formative stage. Evolution rather than revolution has been the history of legislation in countries of the north, and highways systems and measures of Canada are following that general rule.

The Canadian form of government is similar to that of the United States in some respects. Canada is a union of Provinces, with a Federal administration at Ottawa, just as the United States is a federation of States with seat of government at Washington. Each of the nine Provinces has its own legislature, as have each of the States; and the provinces are again divided into local municipalities—the rural being townships and counties, and the urban are villages, towns and cities—but as in the States, local government varies in the different provinces.

The Canadian Constitution, "The British North America Act," defines the powers and jurisdiction of the Provincial and those of the Federal or Dominion Government. Under that Act legislation respecting public roads and municipal organization is within the authority of the Provinces, although the Dominion Government has power to subsidize road construction. The tendency in each Province (with certain exceptions) until recently has been to regard the opening and grading of roads in new territory as a Provincial function, while the real improvement and construction of these roads is a municipal function as settlement becomes established and municipal organization is created.

Canada has a geographical backbone, a rocky mineral region about the centre of the continent, extending northerly from Lake Superior to Hudson's Bay. West of Lake Superior the four Provinces of Manitoba, Saskatchewan, Alberta, and British Columbia are comparatively new, having been developed since the construction of the first Canadian transcontinental railway, the Canadian Pacific Railway, in 1886. East of the Lake Superior region are the old Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island.

British Columbia.—British Columbia, on the Pacific coast, is traversed by the Rocky Mountains, and municipal organization is, therefore, interrupted. In consequence, the Provincial Government has always contributed largely to road-building. At the present time a special fund is being spent on the construction of trunk roads at the rate of $5,000,000 annually under the direction of the Department of Public Works. Stone for macadam roads is plentiful, but the grading of mountain highways is expensive. The trunk roads now being built have an important scenic value, and upon completion will attract many tourists. In the past ten years approximately $15,000,000 has been spent by the Province on roads and bridges, but the expenditure of an equal amount in the three years, 1912-14, is now outlined.

---

* Paper delivered at American Road Congress, Atlantic City, October 5th, 1912.

† Chief Engineer of Highways for Ontario, Canada.

Saskatchewan and Alberta.—Saskatchewan and Alberta, occupying the prairie country north of Montana and North Dakota, were granted provincial organization in 1905, and are in a pioneer stage of development. Earth roads, with bridges, are the present need, and very little has been done toward good broken stone or gravel roads. Each of these Provinces has a Provincial Highway Department, however, and is drawing largely on its resources for road expenditure. The Provincial Governments in each case are grading and bridging the main roads. As fast as settlement permits, three or four townships are organized into Local Improvement Districts, with councils, to expend money raised by local taxation. In the case of Saskatchewan, an annual provincial appropriation (in 1910, the sum of $60,000) was set aside to be drawn upon by the municipalities under a plan of Provincial aid. The chief Provincial expenditure in these Provinces is applied, however, to trunk highways by the Provincial Highway Departments through their own foremen. Steel and wooden bridges are also erected by permanent "bridge gangs." The Provincial Departments also carry on educational work. In Saskatchewan a special appropriation of $5,000,000 for trunk roads was made the last session of the Legislature, of which $1,500,000 will be spent this year, in addition to the usual appropriation of $400,000 from current revenue. In Alberta a special grant of $1,000,000 was made this year for a central north and south trunk road in addition to the usual sum of $250,000 from current revenue.

Manitoba.—Manitoba has for several years had a Provincial Highway Commissioner, whose duties were largely educational. At the last session of the Legislature (January, 1912), two important Acts were passed. One of these, the Act Respecting Provincial Highways, set aside $200,000 annually for Provincial aid to main roads. Townships are permitted to lay out a special system of main highways and this plan, with specifications, are to be submitted to the Provincial Highway Department. If approved by the Provincial authorities, the township may issue thirty-year debentures and proceed with the work, receiving a grant of two-thirds of the expenditure from the Province. In this way it is expected that a serviceable system of Provincial roads will be constructed.

The other Act, known as "The Good Roads Act," is one which relates to minor roads, and does not provide Provincial aid; but requires any township undertaking the improvement of these roads to submit the plans to the Provincial authorities, and when approved the township may issue fifty-year debentures to meet the cost, which debentures may be guaranteed or purchased by the Provincial Government. The work done under this Act is also subject to the inspection and approval of the Provincial Highways Commissioner.

Ontario. Ontario is, physically, in two parts—old Ontario settled for over a century, and with complete municipal organizations; and new, or Northern Ontario, now being opened for settlement. In New Ontario the Provincial Government is this year spending about $[illegible] on colonization roads, and grading the road allowances and [illegible] the bridges.

In Old Ontario, the local municipalities are spending yearly about [illegible] in statute labor and [illegible] in cash. A large proportion of the latter [illegible] through [illegible] and [illegible].

The "Highway Improvement Act" of Ontario [illegible] county councils (composed of [illegible] of the local municipalities composing the county) are empowered to pass a by-law assuming for construction and maintenance a system of main highways.

To this work the Provincial Government contributes one-third of the cost of construction as the work progresses. The Provincial Highway Department fixes certain regulations as to construction and management, inspects from time to time, and co-operates with the municipalities to obtain good results, but the active control is vested in the county councils through their own county engineer.

This Act has been in operation for eleven years, and the annual outlay under it is steadily increasing. In 1911 the total expenditure was $711,000, of which the Province contributed one-third.

This Act is largely educational in its aim, but at the same time is producing much excellent work at a low cost. The educational effect has several features:—

(1) It brings about an increasingly high standard of road construction, which teaches the public what good roads are and how they should be built.

(2) It instructs county councillors in road construction and impresses upon them the principles of good organization.

(3) The roads and organization become models which are observed and imitated by the township councils, so that all roads are affected.

(4) It enables the Provincial Highway Department to prescribe good principles, and the results of investigation, in an effective way.

The Ontario Highway Department is also constructing, at various points, model roads at the sole cost of the Province, or with a partial contribution from the municipality in which the road is built.

Quebec.—The Province of Quebec has been extremely active in the matter of road construction, and has adopted several measures of a progressive character:—

(1) The Province loans road-making machinery to municipalities making request, and has ten complete outfits for this purpose.

(2) Grants are made to local municipalities which dispense with the labor tax, and build an extent of durable gravel or stone road. Nearly 600 out of a total of 1,000 townships are this year taking advantage of the measure.

(3) The sum of $10,000,000, borrowed under 41-year bonds, has been set aside for main highways. Municipalities may, for their construction, draw upon that sum, and are only required to meet one-half the interest (2 per cent.) on the moneys so used for the term of the bond issue, the Province meeting the sinking fund and remainder of the interest.

(4) Three Provincial highways, aggregating 350 miles in length, are now under construction. To this work the local municipalities pay $1,000 per mile, and the Provincial Government contributes the remainder.

New Brunswick.—New Brunswick has not as yet developed a broad policy leading to permanent road construction, but the Provincial Engineer, by means of a contribution to county and parish construction, is enabled to bring technical instruction to bear on the work. The Province appropriated $[illegible] annually for this purpose.

Nova Scotia.—Nova Scotia is very actively canvassing the road question. The Province is subdivided by county organization only, and the counties levy a statute labor tax amounting to about $[illegible] annually. But the Province spends about $[illegible] annually on road construction through an active and well-organized Provincial Highway Department. The Province constructs all bridges costing over $500.

Prince Edward Island.—Prince Edward Island, the smallest but one of the most fertile of the Provinces, has an isolated position in the Gulf of St. Lawrence. Except in the case of two cities, there is no municipal organization.

and the Provincial Government exercises direct control of all the roads. The Province is divided into thirty-eight districts, each having about 100 miles of road, and a road overseer is in charge of the work in each. The Province spends about $32,000 annually in maintaining earth roads, and very little macadamizing has yet been done.

The Federal Government.—The Dominion Government at the last session introduced a bill to provide for grants to Provinces to aid in highway improvement to be distributed according to population, and also to provide for direct expenditure on construction by the Dominion. The bill passed the House of Commons, but the Senate, while approving of subsidies, objected to the Dominion Government making direct expenditures. The amendments of the Senate were not acceptable to the Government, the bill was not re-introduced into House of Commons, and the measure thus failed to become law.

Summary.—Canadian road systems have been, to the present, without enormous Government appropriations or other spectacular features, and construction, as a rule, has been of a comparatively inexpensive type. Rather it is sought to build as substantially as possible for present requirements, and to establish efficient systems of maintenance that will thicken and widen the road crust as traffic requires. Such a policy will, we believe, lead to the more rapid and economical extension of good roads without creating large public debts that will embarrass the future.

Summarizing the situation briefly, Canadian Provinces have about 250,000 miles of public highways. Each of the Provincial Governments contribute directly to road improvement, generally in the form of Provincial grants, where municipal organization permits. Such grants, rightly directed, help the people to help themselves, combine all energy into one effort, and have a highly educative value. Each of the Provinces has a Highway Department for building roads with which the educational object is more or less associated. The Canadian Highway Association is now carrying on an extensive propaganda to construct a road 4,000 miles in length from Halifax to Victoria while the Ontario Good Roads Association, the Manitoba Good Roads Association, and other organizations are doing much to form public opinion. As a result of the interest created, Provincial appropriations are now being made in millions where they were formerly made in thousands. This year the total Provincial expenditures, apart from municipal levies, will amount to $10,000,000. Canada has developed splendid railway and waterway systems, but it is evident that an era of common highway building is being entered upon, that will connect the trunk lines of transportation with the homes and daily life of the people.

◆

DURABILITY OF PORTLAND STONE.

"Experiments on the Weathering of Portland Stone," was the subject of a paper by Dr. J. S. Owens, before the Engineering Section of the British Association. The investigation was initiated by Dr. Des Voeux and was being made for the Coal Smoke Abatement Society. Its object was to find the connection between smoke and the well-known deterioration, by sulphating, of stones containing a large proportion of calcium or magnesium carbonate, when exposed to city air.

The stones were subjected to the following conditions for periods varying from 105 to 687 days: (a) Broken without exposure; (b) broken after exposure to natural conditions out of doors in the country and in London; (c) broken after having been kept indoors in the country and in London; (d) broken after having been exposed, while embedded in soot, to country and London air. The experiments were still in progress.

THE USE OF MOTOR TRUCKS IN ROAD CONSTRUCTION AND MAINTENANCE.

The use of motor trucks has rapidly increased during the last year. In a recent issue of the Concrete-Cement Age, Mr. Rollin W. Hutchinson, Jr., gives some data and costs regarding their use on road construction and maintenance. He says that those who have made a careful study of economic road maintenance have generally conceded that the neglect on the part of cities, towns and townships promptly to repair their roads has brought about an excessive maintenance cost. It is generally accepted as a truism that $50,000,000 is being spent for road building in the United States every year and not 1 per cent. of this is expended for their maintenance.

If two men with the proper equipment were kept constantly employed going over the roads in their territory equipped with materials and tools with which to properly repair trifling defects, the annual expense of such repair work would be considerably less than is now the case with the plan of periodical repair work.

From all information obtainable, it appears that a new piece of road is generally allowed to take care of itself for the first year or two, and at the end of that time the neglect properly to repair what were originally trifling defects has allowed the road to get in frightful disrepair, requiring a very considerable sum to restore it to its former condition.

Very many miles of road could be taken care of by a motor truck operating daily and covering all of the roads in the care of the city or county where it is to work. This truck could be provided with changeable bodies, one of these bodies to be of box construction to carry sand, gravel, crushed stone and top dressing as might be required; at other times tar kettle and material for building roadside fires. The other body could be for water for sprinkling.

A small hole or rut worn in a road, if neglected, will have its sides gradually torn down by continuous traffic and develop into a large hole, requiring the expenditure of a considerable sum to effect proper repairs.

With the advent of the motor truck and automobile it is believed that the business men in every community have come to realize the importance and economy in maintaining good roads.

Depreciation on all vehicles, both horse-drawn and motor-driven, is very considerable where poor roads exist, or where good roads are allowed to get in bad condition for the want of prompt repair.

A manufacturer in advertising the hill-climbing ability of its pleasure cars uses the winding road ascending Eagle Rock Mountain in the Oranges, New Jersey, as a test climb, and many a car has attempted the ascent of this mountain and faded pantingly away before reaching the summit of a grade which runs from 15% to 17%.

Knowing these facts one would hardly look here for a heavy vehicle of any kind operating otherwise than down hill. Modern transportation equipment must however, meet and cope with local conditions, surmounting grades and other difficulties.

The Joseph Murphy Sons C., Hoboken, N.J., employ at Eagle Rock quarry a 7-ton Mack truck with dumping body, on this steep mountain road, hauling broken stone from the Eagle Rock quarry to various points on both sides of the mountain.

The quarry is three-quarters of the distance up the road from the base of the mountain, at a point where the road verges into an abrupt curve, which adds to the difficulty of the ascent, which is here at its steepest.

In the summer of 1911 the truck averaged 55 miles in nine trips a day, hauling 63 tons, or more than five times the work possible with a team of horses making four trips, carrying three tons per trip, or twelve tons in the same time.

There are a number of stone quarries in the vicinity of Baltimore which could use motor trucks to good advantage and with considerable saving. MacMahon Bros., Mt. Washington, with 5-ton and 4-ton Mack trucks, with automatic dumping bodies, and the Schwind Quarry Co., with a 3-ton Packard, are using the motor truck for hauling broken stone for road building. In order to show what could be done in this line, Messrs. Hook and Ford, engineers for MacMahon Bros., ran a week's test with a 5-ton Mack truck with automatic dumping body in competition with a four-mule-team wagon, hauling broken stone for road building from the Dickeyville quarry with the results given below. The truck had to make ten miles to a round trip, as against nine for the team, on account of having to go a mile out of the way on the trip from the quarry in order to avoid a bridge which was too weak to carry when loaded. One mile of the trip loaded was up a 14% grade. The average amount of gasoline consumed was 29 gallons; average amount of oil consumed, 2 gallons; average working hours, 10; average time loading, 3 minutes; average time unloading, 10 minutes; total load carried, 60,000 pounds; number of trips, 6; total mileage, 60 miles. There were three rainy days in the test period, so that most of the time the roads were soft and in bad condition.

Another advantage in the use of the truck is in the spreading of the stone. It took the truck ten minutes to spread the stone as shown, which the contractor stated was done better than could be done by hand and saved the labor of two men working with shovels for one hour. This spreading was regulated by opening the tail board the proper distance and thus letting the truck travel slowly over the road with the body in an inclined position. The results of the comparative tests of motor trucks and mule equipment as made are:

4-Mule-Team Hauling 4½ Tons Per Day 27 Miles.

First Cost.

4 Mules at $325.00 each	$1,300.00
Harness	75.00
Wagon	250.00
	$1,625.00

Mules.

Interest on ½ investment at 6%		$ 48.75
Insurance on team		32.50
Depreciation 20%		325.00
Fixed charges per day (assuming 225 working days per year)		1.85
Wages per day	$1.84	
Feeding at 60c. per head	2.40	
Stable man	0.25	
[illegible]	[illegible]	
[illegible]	[illegible]	
*[illegible]	[illegible]	
Total daily operating cost		$6.18
Fixed charges per day		1.85
Total charges per day		$8.03

5-Ton Dump Truck Hauling 5 Tons Per Day 60 Miles.

First Cost.

Truck	$[illegible]

*[illegible]

Truck.

Interest on ½ investment at 6%		$159.00
Insurance on truck 2½% on 80% of ⅓ value		53.00
Depreciation on truck (not including tires)		480.00
Fixed charges per year		$692.00
Fixed charges per day		3.07
Wages per day	$2.50	
Maint. 4½c. per mile	2.70	
Tires 6c. per mile	3.00	
Gasoline 4c.	2.40	
Oil	0.60	
Total daily operating cost		$11.80
Fixed charges per day		3.07
Total charges per day		$14.87

4-Mule team hauls 13¼ x 4¼ = 57.37 ton miles per day = 13.9c. per ton mile.

5-ton truck hauls 5 x 30 = 150 ton miles per day = 9.9c. per ton mile or a saving of 4c. per ton mile or $6.00 per day.

◆

THE TREATMENT OF EFFLUENTS FROM TRICKLING FILTERS.

The effluents from two trickling filters at the Lawrence Experiment Station of the Massachusetts State Board of Health are passed through a settling tank holding about 5½ hours' flow and are then applied at the rate of 10,000,000 gal. per acre daily to a filter having 2 feet of sand of an effective size of 0.23 millimeter. This filter was operated continuously during 1910, much like continuous water filters, except that when clogged the whole body of sand in the filter was washed in place by an upward current of water from below. The filter was washed 68 times during the year, the average quantity of water filtered between washings being about 39,000,000 gal. per acre.

The results obtained with this filter and settling tank furnish an interesting illustration of the future purification of trickling filter effluents by natural means, according to a report by Messrs. H. W. Clark and S. DeM. Gage. The nearly stable worked-over suspended matters coming from the trickling filters settle out readily in the settling tank, but these suspended matters were capable of further fermentation and disintegration, as is shown by the fact that during the warm months, in spite of the frequent removal of sludge, there was some floating scum on the tank, with a certain amount of gas formation. This fermentation must not be confused with putrefaction however, as no appreciable odors were produced. The clarification begun in the settling tank was completed in the filter, and the final effluent never contained more than a slight turbidity.

The purification process going on in the settling tank and in the filter was the reverse of nitrification, the nitrates serving as the source of oxygen for further oxidation of the soluble matters. This is evident by the reduction in the amount of nitrates and increase in the nitrates and free ammonia in the applied effluents in their passage through the settling tank and through the filter. This was in a measure a retrograde process, but is undoubtedly the process taking place when such trickling filter effluents flow into water low in dissolved oxygen. The amount of nitrates remaining in the effluent, and the fact that this effluent always contained an appreciable amount of dissolved oxygen, indicated a complete stability at all times, and this fact was confirmed by negative putrescibility tests throughout the year.

HIGHWAY ENGINEERING EDUCATION.*

By Arthur H. Blanchard, M.Am.Soc.C.E.†

The educational training of the engineer who may enter that branch of civil engineering devoted to the economics, construction and maintenance of highways should be considered from two standpoints: first, the essentials, which, from an educational point of view, are considered as prerequisite to a successful career in highway engineering; and, second, practical methods of securing this training under American conditions.

The American youth who has expressed the desire to enter the profession of engineering has various channels open to him. The usual course followed is to enroll in one of the four-year engineering courses designated as civil engineering, mechanical engineering, electrical engineering, chemical engineering or mining engineering. There are, however, notable deviations. Several institutions and some engineers advocate a broader training for the engineering profession than is possible in the ordinary four-year course, and in fact believe that the profession of engineering demands the same type of training as is now universally recognized as desirable for men entering the legal or medical profession.

Usually the American boy, in entering on a technical career, has not fully made up his mind as to the particular field in which he is most interested. In the four year courses he has in some cases one, and in others two years in which to make up his mind as to which of the five general branches of engineering referred to above he wishes to enter. It is self-evident that the ideal training is one which will prepare a student upon graduation to enter any one of the numerous fields of engineering. At least it is possible that a comparatively wide field of activities will be open to a man whichever one of the above courses he takes in the technical school.

Having these general facts in mind, attention will now be riveted upon the situation which confronts the young man who may be one of our future highway engineers. Let us suppose, for example, that he has decided to devote four years to securing a technical education and that there is offered to him the four-year course in civil engineering and a four-year course designated as highway engineering. Which course should he take? The evils of over-specialization in the undergraduate engineering course have been fully discussed in the Society for the Promotion of Engineering Education. Suffice it to say in this discussion before the general public interested in highway improvement that the graduate of the civil engineering course on the one hand has before him a large field of activities for all of which he is equally well equipped. For instance, he may enter the field of structural engineering, sanitary engineering, railroad engineering, geodetic engineering, hydraulic engineering, highway engineering, irrigation engineering and in many cases mechanical, electrical and mining engineering. On the other hand, a graduate from a so-called four years course in highway engineering has, if the course is made up of the subjects which the title implies, only a limited field in which he considers that he is particularly proficient.

The consensus of opinion of eminent highway engineers and educators is to the effect that the highway engineer of the future requires the broad foundation which the four-year course in civil engineering gives. A knowledge of practically all of the subjects included is found of value in the manifold duties imposed in the various positions which he may occupy in the service of municipalities, states, counties, towns, estates, contractors' organizations, consulting engineers' offices, and manufacturing companies.

In the consideration of the training received and the subjects covered in the four-year course in civil engineering relating especially to highway engineering, it is of interest to note the present status of highway engineering in the civil engineering courses of American universities and technical institutions. An examination of the latest catalogues received from ninety-two institutions in the United States offering courses in civil engineering showed that seventy-eight included a text-book-lecture course in highway engineering in the curriculum. The number of recitation-lecture hours in the various courses may be arranged approximately in the following groups: thirteen, 15 hours or less; twenty-eight, 30 hours; seventeen, 45 hours; six, 60 hours; six, 75 hours; three, 90 hours, three, 120 hours; one, 135 hours; and one, 165 hours. Fifteen give some instruction in laboratory work, while ten include special courses in highway surveying. In the case of institutions devoting over ninety hours to highway engineering, the general civil engineering course covers three years, while a highway option is taken in the fourth year. A comparison of the present status of highway engineering education, as outlined above, with the conditions described by Logan Waller Page in his valuable paper on "Highway Engineering," presented before the Society for the Promotion of Engineering Education in 1909, is certainly encouraging, especially when it is remembered that only three years have elapsed. In 1909, according to Mr. Page, fifty per cent. of the institutions investigated did not include a course on highways in the civil engineering curriculum, while it is noted that of the courses in ninety-two institutions examined by the speaker, eighty-five per cent. now give a course in highway engineering.

The importance of the subject of the economics, construction and maintenance of roads and pavements in the United States at the present time demands that more prominence should be given to the course in highway engineering in civil engineering curricula. Having in mind the various component parts which go to make up the curricula, it appears that a well-balanced civil engineering course under present conditions should contain a three-hour course of one year in length devoted to highway engineering.

In such a course lectures and text book work should cover the following topics: historical review of the construction of roads and pavements; preliminary investigations incident to construction; principles of surveying and mapping peculiar to highway work; design of highways; drainage and foundations; construction and maintenance of earth, sand clay, gravel and broken stone roads, including a consideration of the materials which enter into their construction; general consideration of bituminous materials as such and their use in the construction of bituminous surfaces, and bituminous macadam, bituminous concrete, sheet asphalt and asphalt block pavements; the construction and maintenance of wood block, stone block, brick and cement concrete pavements; dust prevention, street cleaning and snow removal; construction of car tracks and pipe systems; comparison of roads and pavements; construction of sidewalks, bridges and culverts; and a general treatment of economics, highway administration and highway legislation.

Laboratory work should be limited to what is sometimes called lecture demonstration work by the officers of instruction. In other words, although it is advisable that the methods of testing all kinds of bituminous and non-bituminous road materials should be brought to the attention of

---

[*] Presented before the American Road Congress at Atlantic City on October 3rd, 1912.

[†] Professor of Highway Engineering, Columbia University, New York City.

students in civil engineering by actual demonstrations in the laboratory or lecture room, it is not considered advisable to devote the time necessary for each student to run through complete tests as is done by students in the laboratories devoted to the testing of structural materials. In two to five afternoons all the fundamental tests employed in the examination of bituminous and non-bituminous road materials could be demonstrated before a group of from twenty-five to thirty men if the laboratory equipment was properly arranged and the work well planned out. Two to three afternoons would suffice if the testing of bituminous materials were covered in a course given by the department of chemistry. Unfortunately, at the present time very few instructors in chemistry are familiar with bituminous materials, hence the methods of testing will have to be worked up by civil engineering instructors. Eventually some of the time now given by the department of chemistry to carbon compounds or quantitative analysis in courses for civil engineering students can be profitably devoted to the chemistry of bituminous materials.

A limited number of inspection trips covering the economics of highway location, and the construction and maintenance of various types of roads and pavements will be of value.

The time devoted to road or street surveys in some institutions, in addition to the regular work in railroad surveying and general surveying, is of questionable merit. Although there are many problems in highway surveying which are different from those encountered in other branches of surveying, it is doubtful if it is necessary or expedient to use up valuable time on this work considering the number of subjects which it is necessary to include in a broad course in civil engineering. The speaker's experience with civil engineering graduates who have worked under him on highway work has led to the belief that a graduate in civil engineering, who has had a good course in railroad surveying and in railroad curves, together with a comprehensive course in highway engineering, as outlined above, is admirably equipped to occupy the minor positions in a field party on highway surveys. In these positions he may acquire, either through advanced study or special instruction, the information and practice necessary to occupy the position of chief of party and the higher positions in the highway department connected with the bureau of surveys. It is, however, advisable in certain instances, where practicable, to divide the time devoted to railroad surveying so that a highway survey outside built-up districts may be added to the course together with the preparation of plans, cross-sections and estimates.

In further consideration of the special training which will be of benefit to those entering the field of highway engineering, the educational plans which have been evolved to elevate the profession and to equip men thoroughly for this field of engineering work, foreign practice will be given consideration first.

Great Britain affords an illustration of one method by which well trained highway engineers may, under favorable circumstances, be secured. Fortunately for the British engineer, the position of highway work is much more permanent than in the United States. There are several reasons [illegible]. Among these may be mentioned the recognition by the British public that the principle of continuity in office of qualified engineers results generally in economical and efficient construction and maintenance of public works. Those American engineers who visited Great Britain at the time of the Second International Road Congress in 1910 will, without doubt, find the majority of the prominent highway engineers of England occupying the same positions of responsibility when they attend the Third International Road Congress to be held in London in 1913. This is not a long period, but could the same observation be made in regard to the personnel of many of our great state highway departments for a similar period? It should be stated, however, that the subordinate positions in the United States being, in many cases, under civil service regulation are more permanent than those effected by political exigencies. This condition of permanency of position of high officials in Great Britain means that it is possible for young men who are attracted to highway engineering to enter the department of some county or municipal engineer, and, proving capable, to acquire a valuable experience under the continued leadership of an able engineer. In this position a young man of the right calibre, by hard work, including a large amount of home study, may equip himself for the highest positions in highway work in Great Britain. Another safeguard of the British engineer, and an incentive to highway engineers in embryo, is the admirable practice which has been adopted in many cases requiring that applicants for a certain class of positions shall hold certain grades of membership in the Society of Municipal and County Engineers and in other cases certain grades of membership in the Institution of Civil Engineers of Great Britain.

France offers an entirely different type of training for men who are going to enter the field of highway engineering. All the important positions in this branch of the public service are occupied by picked men especially educated and trained for the service. After a preliminary general service covering as a final period that comparable with the four years high school training in this country, men of high standing are admitted to the Ecole Polytechnique, the course in which is practically two years in length. Upon graduation from this school, the men of high standing are allowed to select one of the several national schools, provided openings exist, in which they will secure special training for the public service in a given field. Those who enter the Ecole Nationale des Ponts et Chaussees devote three years to a general course in civil engineering under the leadership of engineers of the highest grade in the Department des Ponts et Chaussees de France. During the vacations these men are allotted to service on the construction of roads and bridges in various parts of France. It is evident that the training thus obtained is admirable and that the personnel of the engineering staff of the department of roads and bridges of France is exceptionally high.

In America, while in some cases an attempt has been made to give as special instruction in highway engineering a four years undergraduate course in this subject, this method has not given particular satisfaction for the reason previously noted. Excellent work has been done by many universities in several parts of the country in giving extension courses to groups of men interested in various phases of highway improvement. Very little advanced work, however, has been done through the medium of the American university. The United States Office of Public Roads has evolved a scheme by which men may secure a certain amount of advanced instruction and training in that part of highway engineering dealing with highways outside of built-up districts. This plan is to place the student engineers in the charge of men in the service of the Office in various parts of the country on different kinds of highway work. When it is impossible to work in the field, the men do a certain amount of office work at Washington, receiving instruction by means of lectures on certain phases of highway engineering and also do laboratory work on the testing of both bituminous and non-bituminous road materials.

In 1911, through the generosity of Charles Henry Davis, president of the National Highways Association, there was founded at Columbia University a graduate course in highway engineering. The object in founding this course was to elevate this branch of the engineering profession and to provide an opportunity for men engaged in highway work to obtain advanced instruction and training in the various phases of highway engineering under the most favorable conditions. For many reasons it is fortunate that the first course of this character should be found at a university presided over by a president and trustees who look upon the work of the university from an exceptionally liberal standpoint. While maintaining the high character of all degrees conferred, nevertheless these men believe in opening the courses of instruction to any mature man provided he has the prerequisites for any given course and earnestly seeks information. Likewise it is fortunate that the administrative authorities allow the introduction of an innovation as far as the period of attendance is concerned inasmuch as the graduate course referred to is given in the period from December 1st to April 1st. An engineer, therefore, who desires to take all the graduate courses in highway engineering and allied subjects which fulfil the requirements for the master's degree will necessarily be in attendance for two winter periods, the equivalent of one collegiate year. The selection of this period in which to give the instruction was based upon the prevailing idea among leading highway engineers that it would be feasible for many men to obtain a four months' leave of absence during the dull period of the year. This prediction has been found to be correct.

As this plan is somewhat of an innovation in engineering education, it may be of interest to cite certain facts in connection with the attendance during the winter period of 1911-1912, which was the first period under this plan. Although the graduate courses were not brought to the attention of engineers until November, 1911, there were in attendance fifteen men affiliated with highway work, thirteen of whom registered as candidates for the master's degree. It is of interest to note that this group included men connected with state highway departments, contractors' organizations, municipal departments, engineering-sales departments of manufacturing companies, county highway departments and consulting engineers' offices. The experience of these men ranged from one to twelve years. They came from widely distributed localities, Connecticut, Massachusetts, New York, Pennsylvania, Maryland, North Carolina, Alabama, Panama and British Columbia being represented.

The curriculum of the graduate work in highway engineering comprises advanced courses in the economics and design of roads and pavements, including a thorough discussion of bituminous surfaces and bituminous pavements; highway bridges and culverts; mechanical appliances used in highway gineering; road and street surveying and highway design; highway laws and systems of administration; management engineering; bituminous and non-bituminous road material laboratory courses; seminars in highway engineering literature; chemistry of bituminous materials; engineering geology; optical mineralogy, and inspection trips covering various types of roads and pavements and manufacturing plants producing highway materials.

A large staff of non-resident lecturers in highway engineering, which includes many of the most prominent highway engineers and chemists in the United States, is employed to give instruction on specified subjects forming an integral part of the various courses. It was decided to throw these special lectures open to the engineering public and to hold the same during evening sessions in order that this feature of the work may be of maximum benefit to all that may find the university accessible. An attendance of from fifty to one hundred engineers at many of the lectures during the past winter period showed the interest taken in the many problems of highway engineering presented.

During the 1912-1913 winter period a special arrangement will be introduced which is considered of particular interest to practicing highway and chemical engineers. Many, who cannot secure a four months leave of absence, have expressed the desire to devote from six to seven weeks at Columbia University in securing information relative to the manufacture and testing of all kinds of bituminous materials and their use in the construction and maintenance of bituminous surfaces and bituminous pavements. Arrangements have, therefore, been made so that courses covering the above subjects may be taken either independently or as an integral part of the unified graduate course in highway engineering. During a continuous period of about six weeks, beginning in the latter part of December and ending during the first week of February, three courses will be offered as follows: Two weeks will be devoted to a demonstration lecture course on the mining, manufacture and testing of all kinds of bituminous materials; the next two weeks will be devoted to a course on bituminous surfaces and bituminous pavements; while during the final period of two weeks will be given a laboratory course in which those enrolled will test various types of bituminous materials, make analyses of unknown materials, and write specifications covering the use of bituminous materials under varying conditions. Each course will comprise forty lectures or eighty laboratory hours, depending upon the character of the course.

During the coming year at Columbia it is expected that another innovation will be introduced inasmuch as, in connection with the graduate work in highway engineering, there will be founded several research fellowships by various manufacturing companies. The research workers holding these fellowships will investigate problems of particular interest and value to the manufacturing concerns founding the same. It is expected that many problems of wide interest to those engaged in highway work will be thoroughly investigated through this medium. While admirable work has been done along many lines in the research laboratories of our universities, the speaker earnestly hopes that more attention will be given in the next decade than in the past ten years to the multitude of problems in highway engineering which demand the best efforts of investigators for their ultimate solution.

◆

COAL FOR PANAMA CANAL SHIPS.

Montreal capitalists, including several of the promoters of the Kingston (Jamaica) Street Railway, are behind a project known as the Port Royal Floating Dry and Coaling Docks, Limited. It is the intention of the company to furnish coal to ships using the Panama Canal, which will pass by Port Royal both ways. As a matter of fact, a steamer coming from Liverpool or New York and going to the Far East or Pacific ports makes the first call for coal at Kingston and her last on the return voyage. It is 5,000 miles to Liverpool, 4,000 to Gibraltar, 1,600 miles to New York, and from Kingston to Colon at the mouth of the canal the distance is but 580 miles.

The intention of this company is to build a first class floating dock in England and then tow it to Jamaica, meantime building the coaling station and work shops on land donated by the government. The government will also give thirty years exclusive franchise, besides the valuable site, will admit all the materials and dock duty free and also take a block of the common stock, paying for the same and allowing the interest to be deferred.

The cost of the enterprise is estimated at $2,000,000, and it is understood that a year will be required to build the drydock and local works. There will be a bond and stock issue.

NEW TYPE OF MINE LOCOMOTIVE.

The haulage of cars in and about a mine is a big factor in operative economics considered either from the operating cost or the danger of gas ignition in mines where gaseous conditions are liable to be met with. There have been up to the present, four methods of haulage in general use, hand power, horse-driven, chain and cable drive or electrical. The new type is operated by an internal combustion motor and is entirely self-contained.

Haulage by hand power is allowable only on the smallest of workings; horse driving is expensive in the extreme; chain and cable drive is troublesome and economical only in the richer portions of the mine. Electrical driving is satisfactory under certain conditions, but must be constantly supervised to insure economical operation; then again, there is a great possibility of sparking, a condition that is almost fatal in mines emanating explosive gases. The gasoline locomotive, considering its many good points, would appear to have a great future.

Figure 1 depicts one of these machines in operation in England, where they are manufactured by Messrs. Ironside Son and Dyckerhoff, 40 Mincing Lane, London, E.C. The engine frame is of most substantial dimensions, and carries not only the engine, but also the transmission gear shafts, change speed gears, clutches, etc. A rigid power unit is produced by this means and owing to the absence of universal joints any trouble that might arise following an accident is eliminated. The engine is of a design prepared by the makers with all the cylinders fitted with liners, which may be renewed with a few minutes' labor, and of the horizontal type, well balanced. The speed of this engine is rated for [illegible] r.p.m., and may be accelerated to about 20 per cent. above this rating, should conditions call for such. When throttled down, as during a rest, the engine speed is only [illegible] r.p.m. and the fuel consumption is economized accordingly. The design of the engine almost eliminates vibration.

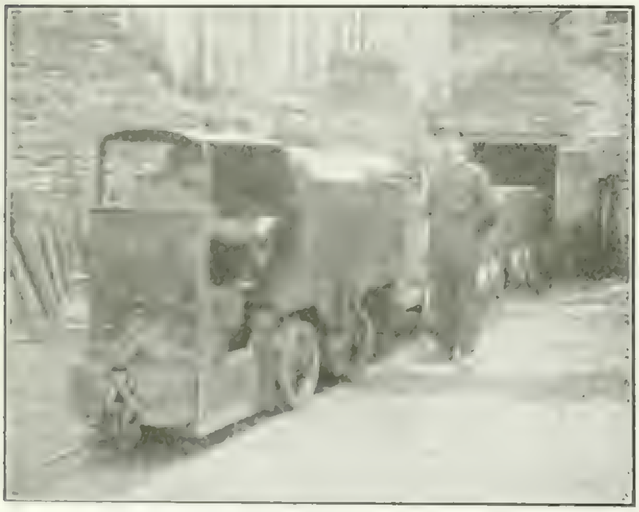


Fig. 1.

In a locomotive of this type, designed with a view of safe working in mines of a gaseous nature, a carburetter that would throw a flame outside the cylinder would be fatal to its use in mines of this type. Consequently the makers have [illegible] attention to this portion of the machine and [illegible] a carburetter that will not give an explosive mixture outside the working cylinder. With this mixing device the [illegible] per British horsepower per hour at full load with petrol as a fuel.

Some of these machines are in operation in the coal collieries in the province of Alberta and for two years have given much satisfaction. We regret that we are unable at the present time to secure photographs of these machines, but as they are much similar to the one illustrated their general outline will be made clear.

◆

SEWAGE TREATMENT VERSUS SEWAGE PURIFICATION.*

By George C. Whipple.

The art of sewage purification has been making progress during recent years. Of this there is no doubt. The nature of the advance, however, has not been that which the popular mind believes it to have been. It has not been in the direction of making sewage more nearly resemble drinking water so much as it has been in adjusting the treatment to particular needs, making the treated sewage fit for discharge into some particular stream or lake, taking into account the subsequent use of this water. The greatest progress has not been in obtaining a higher degree of purity for sewage effluents, but rather in the invention of methods and devices applicable to conditions not previously encountered. To illustrate the general results of that notable series of experiments made a quarter of a century ago by the Massachusetts State Board of Health, at Lawrence, was that the application of sewage to land according to the method known as intermittent sand filtration was the one best suited to the local conditions of that State. Time has proved that this conclusion was correct, and the plants that have been constructed have on the whole given satisfactory results. Intermittent sand filtration gives a relatively high degree of bacterial efficiency. But sandy soils of the proper character do not exist everywhere in the United States; they do not exist in England. Large areas are required and it is not often that these can be found at the proper elevation near large cities. Therefore, this excellent method of sewage purification is much limited in its application. The need of processes to fit other conditions led to the use of improved screens, of chemical precipitation works, of septic tanks, of sprinkling filters, of contact beds, processes excellent in their way, but as ordinarily operated not capable of purifying the sewage to the same extent as the older method of treatment on land.

Yet, and this is the point of my paper, these miscellaneous processes all go popular under the name "Sewage-purification plants." In a certain sense this is correct, for they contribute to the removal of the objectionable ingredients and living organisms in the sewage. The sanitary engineer, knowing the nature of the results, makes a proper mental discount of the term and is not deceived. The layman, however, takes the word "purification" at its face value and is deceived. How many times do we hear city officials proudly boast that the sewage of their city is in no way dangerous because it is purified in a septic tank, when it would seem that the use of one's nose and the application of a little common sense would lead to a different conclusion?

There is no more fatal error in logic than failure to properly define the premises; nothing contributes so much to controversy and misunderstanding as the use of terms of uncertain meaning. The speaker believes that much of the prevailing discussion with respect to the advisability of adopting this or that method of guarding water supplies against infection and of preserving the quality of the water in our waterways has been confused in the minds of many on account of the use of the term "sewage purification" to cover methods and processes that do not make the sewage pure.

---

*A paper read before the general session of the American Public Health Association, Washington, D.C., September, 1912.

It is gratifying to observe that there is an increasing tendency among sanitary engineers to substitute for the term "sewage purification" the words "sewage treatment." Notably, George W. Fuller has adopted this language in his recent admirable treatise on sewage disposal. It is to be hoped that its use will become general. If not, the term "sewage purification" will inevitably become degraded, as people come to learn, as they must, that not all so-called purification plants really purify the sewage. The term "sewage treatment" does not imply complete purification and is, therefore, the more general and the better term.

Using the words in their most obvious meaning, let us ask the question, ought the sewage of our American cities to be purified? Generally speaking, no. To do so would be enormously expensive, and in most cases the results accomplished would not be commensurate with the cost. Ought the sewage of our American cities to be treated in some way before being discharged? Generally speaking, yes. There are relatively few instances where raw sewage can be discharged into streams or lakes without causing objectionable local conditions or dangers of a sanitary character. The nature of the treatment required will vary all the way from a mere straining out of the grosser solids to a combination of processes that results in actual purification.

We hear it said that in England practically all of the sewage is purified. Is this true? Yes, if it is meant that the sewage is submitted to some process that improves its character, but no, if it is meant that these processes completely remove the organic matter and free the sewage of its dangerous bacteria. For example, we like to refer to the interesting sewage works at Manchester and Salford with their great septic tanks and contact beds and sprinkling filters, and we speak of them as purification plants. Do we realize, however, that analyses of the sewage effluents show that during a large part of the time they fall below the standard of purity established by the Mersey and Irwell Joint Committee, a standard that cannot be regarded as too strict if we maintain a reasonable meaning of the word "pure." The biennial report of Hugh Stowell, chief inspector for the Mersey and Irwell district, dated May, 1912, states that out of 126 sewage works, 23 per cent. were non-efficient, this being an improvement over 34 per cent. as shown by his previous report. At Manchester 22 per cent. of the samples were below the established limit for organic matter of "one grain of oxygen absorbed per Imperial gallon in four hours," at Salford 12.8 per cent. of the samples were below standard. This is not intended as a criticism of English methods of treatment, which, on the whole, are well adapted to their particular needs, but merely to illustrate the danger of using loose phraseology.

Or to take another illustration, can the water-supplies of our lakes be protected by purifying the sewage that enters them? Many laymen think so, and ardently advocate the construction of sewage-purification plants and oppose water filtration. Would they say the same if they realized that most so-called sewage-purification plants only partially remove the dangerous substances from the sewage, and that complete removal is impracticable on account of the expense and the almost insuperable difficulty of treating all of the sewage at times of storm? Would not these well-meaning people have a clearer conception of the problem if instead of using the broad misleading word "purification," we used the term "sewage treatment," or still better, some term that described definitely he results accomplished by the different processes.

With laws being framed in various States, to control the pollution of rivers and waterways, it is high time that popular misconceptions should be corrected and that the different phases of this complicated problem should be made clear. In the first place it should be more definitely understood that in the treatment of sewage there are two very different functions to be considered. One is to get rid of the foul, putrescible matter with its accompanying offensive smell; the other is to get rid of living disease-producing organisms. One is very largely a physical and biochemical problem; the other is chiefly bacteriological. One does not directly concern the public health; the other may. In practice, these functions overlap but they may be kept separate.

Is it not the popular conception of the function of sewage-disposal plants that they are intended primarily to protect the public health? Is not this the theory upon which some of the recent legislation is based? It certainly appears so. But is this idea correct? Does the treatment of sewage by the ordinary process materially improve the public health? Are sewage works a success from the hygienic point of view? It is a vital question and one that has not been sufficiently considered from the standpoint of cost and result.

Sanitary history has shown that when polluted water-supplies have been purified by filtration, the typhoid fever death rate of the community has lessened and the public health has otherwise materially improved. And it is a matter of easy reckoning to tell that the financial benefits represented by the saving of human lives and the prevention of sickness have far exceeded the cost of filtration. Taking the cost of efficient water purification at $10 per 1,000,000 gallons, and allowing a per capita water consumption of 100 gallons per day, the process pays for itself if it reduces the typhoid fever death rate by 4 per 100,000.

No such record can be shown for the purification of sewage except perhaps in the case of a few small plants built for the protection of the water-supply of some large city, and even here it is difficult to measure the number of lives that have been saved. The complete diversion of sewage from the drainage area of a public water-supply has repeatedly been of hygienic benefit. So has the introduction of sewer systems in cities and towns where none existed before. But the purification plants that have been constructed for the large cities of the world have not the saving of many human lives to their credit, so far as the best available evidence shows. The reason is obvious. They have not, as a rule, been built for that purpose, popular ideas to the contrary notwithstanding.

Sanitarians abroad have long recognized the fact that river water-supplies cannot be protected against the danger of infection by any of the known methods of purifying sewage discharged into the river above the waterworks intake. Instead they depend upon the filtration of the water-supplies themselves. In Germany the filtration of surface water-supplies is required by law and no difficulty has been found in building water-filtration plants capable of purifying water after it has received what would be regarded in this country as a large amount of sewage. In Germany and in England sewage-disposal works are built primarily to remove organic matter and prevent streams from becoming foul. Therefore, when public health authorities in this country compel large cities to construct sewage-purification plants for the avowed purpose of protecting water-supplies taken from the rivers below them, they are attempting to accomplish the impracticable, and are compelling the expenditure of money without adequate returns. The most that can be expected in this direction is to lessen the burden placed upon the water filters and in some instances this may be desirable.

The pollution of water-supplies is not the only thing involved in this matter. Sometimes it is a question of protecting shellfish supplies, or of bettering the sanitary condition of the water at bathing beaches. These may be fairly classed among the direct sanitary benefits of sewage treatment, but here the treatment to be of benefit must be quite complete and, therefore, expensive, while the number of lives saved is probably small.

It would not be right to balance the cost of sewage purification against the saving of human lives, were it not for the fact that our cities are subject to debt limits and that money is needed for many other purposes that affect the public health; for cleaner streets, for better care of schoolhouses, for parks and playgrounds, and for the special needs of the department of health in securing safer milk and food supplies, and for all sorts of hygienic and sanitary inspections. In view of the steadily increasing tax rates in our large cities it behooves sanitarians to find out for each city in which direction money allotted to the saving of human lives will do the most good. In other words, how can the most lives be saved for a dollar? Whatever the answer may be, it is not likely to be found in the purification of sewage.

That the sewage of most American cities should be subjected to some form of treatment is conceded. The need will increase as our cities increase in size and number. The problem at hand is to determine the most appropriate treatment for each case, bearing in mind the results that can be accomplished, the peculiar local condition, the cost of construction, maintenance, depreciation and operation.

Processes of treatment perform one or more of three functions: clarification of the sewage, oxidation of the organic matter and removal of bacteria. The effect of the methods of treatment now available and in common use are given by Fuller in his treatise already referred to as follows:

Method.	Percentage purification. Suspended matter.	Organic matter.	Bacteria.
Fine screens (10 mesh or finer)	15	10	15
Sedimentation	65	30	65
Septic treatment	65	30	65
Chemical precipitation	85	50	85
Contact filters*	85-90	65-70	[illegible]
Trickling filters*	85-90	65-70	90-95
Intermittent sand filters*	[illegible]	[illegible]	[illegible]

* The figures for the last three forms of treatment are on the assumption that the sewage is given some form of preparatory treatment before it is applied to the filters, and [illegible] settle.

[illegible] primarily to prevent sewage from producing foul conditions [illegible] sonably complete and useful bacterial removal would very [illegible]

[illegible]

ment; they know how well they work when kept in order, and how grievously they fail when not properly operated and enlarged as need requires; they are able to determine what methods or combination of methods are best suited to any case. Yet in common parlance and in official reports they continue to say "sewage purification" when they mean something less. Perhaps a better term than "sewage treatment" can be found, but let us at least be more particular in the use of terms describing the processes discussed, lest the cause of sanitation suffer a reaction from the over-zealous interest of laymen based on false conceptions.

◆

A METHOD OF RECONNAISSANCE SURVEYING.

A method of making reconnaissance surveys herein described has been used for a number of years by a mining engineer who has been employed in examining small mines and prospects in Central America, and was described some time ago in the Engineering and Mining Journal.

There are few mines near the railroads; a journey of two or three days or more may be necessary to reach them, and often the roads over which one must travel on mule back, have never been surveyed. The question as to whether the mine can be profitably worked is often dependent upon the transportation problem, or the possibility of developing power from the nearby water courses. A map of the roads showing in a rough way the topography of the immediately adjacent country is of considerable advantage when such questions have to be considered.

The method that has been used for such reconnaissance surveying is essentially that used by military men. The data for a map are collected as the party travels over the road. The distances are measured by time, the bearings by compass. Starting from a given point the compass man reads the bearing to a certain conspicuous point on the road ahead; the timekeeper notes the time of starting for and arrival at that point, which gives, approximately, the distance. Arriving at that point, another in the road ahead is selected, its bearing from the first observed, and the time taken to reach it recorded. In such manner the bearings and distances of successive points on the road are determined and from the data a map is plotted.

Allowances must be made for the different gaits of the mules, which will vary from 10 to 80 minutes to traverse a mile—horizontally. To make these allowances, some experience is necessary. In starting out, the mule is "standardized" by taking the time required to walk a measured distance on a level road. Such tests are made several times throughout the day in order that allowances can be made for the slower gait of the animal as he becomes fatigued. It is also necessary to allow a different gait in going up and down hills which will in turn vary with the length of the hill and condition and tortuousness of the road. On a level road a mule will average better than 350 ft. per min., four miles per hour, or a 15-min. gait; on steep, rough hills it may make only 66 ft. horizontally per min., or an 80-min. gait. In time the observer becomes experienced in making allowances for gait and greater accuracy is possible.

In keeping notes, the left-hand page of the note book is ruled vertically for: Course, bearing, time of starting, time of arrival, elapsed time, gait factor (indicated by the time required to traverse one mile), and calculated equivalent horizontal distance. On the right-hand page the note-book keeper writes notes and makes sketches to indicate the topography to each side of the road, the rocks out cropping, their strike, dip and character, the rivers and streams crossed and any other features that may be desirable

It is advisable to make frequent observations by aneroid to determine the relative elevations along the road as profiles of at least certain portions of the maps may be wanted. The plotting of the maps is done each night when stopping in some town and the topographical notations are sketched in from the notes while the day's journey is still fresh in mind.

While these maps are far from accurate they are often most useful for making tentative plans that will eventually be based upon accurate surveys made by the usual methods. The plotting of the outcrops often gives an excellent idea of the formation of the region, and, above all else, the engineer becomes familiar with the country far more quickly than would otherwise be the case. Of course, such work delays traveling but the delay is negligible when the value of such records is considered.

As for accuracy, the engineer who has so extensively used this system in Central America has stated that, with a squad of men having had a little experience, two such surveys, over different roads, each about 80 miles long, measured in a roughly circular course, have checked within a mile. Such checking may seem absurd to surveyors but for the purpose of such work an error of one in 80 is accurate enough.

◆

WATER PURIFICATION VIEWED FROM THE HYGIENIC STANDPOINT.*

By Allen Hazen.

The progress in water purification from a hygienic standpoint has been very rapid in the last decade. This progress has been of two kinds. First, there has been a great increase in the number of water supplies that are being purified with satisfactory hygienic results; second, there has been an advance in the standards of efficiency, and in the methods available for reaching them in practical work.

Filtered Water Statistics.—The growth in the purification of water is shown by Table 1.

Table 1.—Population Supplied with Filtered Water at Different Dates.

Year	Population in U. S. Cities of More Than 2,500 Inhabitants.	Population Supplied with Filtered Water. Sand Filters	Mechanical Filers,	Total.	Per Cent. of Urban Population Supplied.
1870	....	None	None	None	0
1880	13,300,000	30,000	....	30,000	0.23
1890	21,400,000	35,000	275,000	310,000	1.45
1900	29,500,000	360,000	1,500,000	1,860,000	6.30
1910	38,350,000	3,883,000	6,922,000	10,806,000	28.20

From Table 1 it appears that the population supplied with purified water increased more than five-fold in each of three successive decades. In 1910 28 per cent. of the whole urban population of the United States was so supplied.

Twenty years ago a considerable proportion of the largest cities of the United States were supplied with water polluted by sewage and notoriously injurious to health. At the present time this practice has mainly ceased. There are still a few of the larger cities that supply water that, in some respects, is not of as good quality as could be desired. But all of the larger cities that supplied notoriously bad water at the date mentioned have improved their supplies in one way or another, and in many or most cases filtered water of excellent quality is supplied at the present time. The smaller cities have followed in the same way but more slowly. While there are some exceptions, a majority of them now have water of at least fair quality.

The statistics above relate to filtered water. They cover only part of the whole field, for in the last years other means of treating polluted waters have come into general use which are important from a hygienic standpoint. No statistics have been compiled to show what additional population is supplied with water so treated, but if it were taken into account it may be conservatively stated that from one-half to two-thirds of the whole urban population of the United States is now supplied with water that has been purified to a greater or less extent.

Advance in Filtration Methods.—The advance in the methods of purifying water from a hygienic standpoint has not been less important than the increase in population supplied with purified water. Some years ago methods of water purification were in common use for treating highly polluted waters which secured the removal of bacteria to the extent of 97 and 99 per cent., and occasionally with well-built and well-operated plants, higher percentages, up to 99.5 and even 99.9 were obtained. These figures relate either to all the bacteria in the raw water or to some portion thereof shown by the methods of examination commonly used. The presumption was that any injurious bacteria that there might be in the raw water would be and actually were removed in as great proportion as were the kinds that could be counted. This was always a matter of some uncertainty and there was reason for thinking, in some cases at least, that the removal of pathogenic bacteria may have been more complete than the removal of bacteria in general. However this may be, it is true that cities supplied with water drawn from highly polluted rivers purified by filtration to the extent above mentioned, were as free from diseases which could be attributed to the public water supply, as cities supplied with upland water of the best quality.

It was obvious that filtration was a relative and not an absolute protection against the impurities of the raw water. Some bacteria undoubtedly passed through the filters, and if pathogenic bacteria were present in the raw water a few of them might pass the filters and reach those who used the water. If a river had a population of 100 per square mile on its catchment area, and if the filter plant removed 99 per cent. of the bacteria, the water after filtration might be compared with water from a river otherwise similar, but with a population of one per square mile.

There was some indication that a falling off in bacterial efficiency had an appreciable effect upon the health of the community. There were notable cases where filters of inferior or inadequate construction, or operated with less than the usual degree of skill, produced, temporarily or permanently, effluents inferior from a bacterial standpoint to those otherwise produced by the best filter plants; and there were cases where diarrhoea, typhoid fever and other indications of water pollution among those who used the water had followed such falling off in efficiency.

Skilful Operation of Filters.—Skilful manipulation of filters must be regarded as equally important with good design in securing at all times an output of well-purified water. The best designed plants may produce poor or bad effluents with careless or unskilful manipulation, and skilful manipulation will do much to improve the average quality of the effluent from old plants not representing modern standards of construction. As the years have gone by, and the number of water purification plants has increased, there has been found a rapidly increasing number of men who have had experience and have acquired skill in operation; and the fact that such men have been available and have been secured to operate purification works has been a most important element in the improvement in the average results that have been secured.

---

* Paper presented before the International Congress on Hygiene and Demography, Washington, D.C.

It is more difficult to keep filters up to a high standard of efficiency during the cold weather of winter and early spring than at other times, and failures of this kind were most frequent at this season of the year. It was perhaps a fair inference that if the use of raw water caused a very great amount of disease among those who used it, and if poorly filtered water during the winter caused a slight though perceptible increase in the same diseases that were caused by the raw water, that the smaller number of bacteria normally passing into the effluent might produce an effect upon the health of those using the water, even though this effect was too small to be measured by such vital statistics as could be obtained.

In the last years the practice of treating filter effluents, as well as raw waters, with hypochlorite of lime has become very common. Applied in very small amounts to clear waters that that do not contain too much organic matter, it produces an extraordinary effect in killing bacteria. This substance had been used for many years as a disinfectant, but usually in much larger quantities. It was something of a discovery to find how efficient it was in extremely small doses in killing bacteria in water free from turbidity and organic matters. This condition certainly could not have been anticipated from earlier practice with it or from the literature on the subject.

Alternative Germicidal Treatments.—Hypochlorite of lime is by no means the first or only substance that has been proposed and used experimentally, and applied in practice in a few small installations for many years. Ozone has been tried repeatedly, but the practical difficulties of carrying out the ozone process effectively, and the great expense of doing it, have operated as obstacles to its general introduction. Hypochlorite of lime seems to have precisely the same bacterial effect as ozone, and it can be applied more easily and is free from some of the uncertainties that have been found adherent to the ozone process. Ozone has some advantages, and if means can be found for overcoming present difficulties its use will be another step in advance.

Sulphate of copper and other metallic salts have also been proposed for killing bacteria as well as algæ in water. It is permissible to use such a substance if it is applied to the raw water prior to filtration so as to secure a disinfecting action, and then have the metallic residue removed in the process of filtration. Some of these processes proved to have merit, especially in connection with filtration, but their use was always limited by the unwillingness of most of those in charge of waterworks to use metallic substances which were more or less poisonous.

The use of hypochlorite of lime has practically superseded all such metallic substances, as it is more efficient and is quickly decomposed in the water into substances that are not poisonous, and within reasonable limits cannot be, by any possibility, injurious.

Other methods of killing the bacteria in filter effluents have been proposed, among which may be mentioned the use of the ultra-violet rays, but no plants for treating water in this way upon a practical scale have been installed in America, and the process is, therefore, one for future consideration rather than of established position.

Hypochlorite of lime has considerable power from a hygienic standpoint, even when applied to the raw water and without filtration. In this case a larger dose must be used and it [illegible] enough must be applied to furnish oxygen for organic and other matters in the water capable of rapid oxidation by its presence, and still leave a sufficient excess to perform its germicidal work. The amount required by the oxidizable matters obviously depends upon the composition of the water, and this frequently fluctuates rapidly from day to day and even from hour to hour. The treatment of raw water has been less efficient and is less satisfactory than the treatment of filtered water, and has not infrequently resulted in occasional overdoses which have been objectionable in the water.

From a hygienic standpoint, the use of hypochlorite of lime is probably the most important event, after the extension of filtration works in the last decade, and where filtration is employed it permits the delivery of water in which the bacteria have been removed uniformly and certainly to the extent of 99.9 per cent. or more.

The use of this process has made it possible to deliver from filter plants of good construction water that is uniformly of excellent hygienic quality. There is no reason to believe that any appreciable danger will result from the use of such water, even when drawn from the most highly polluted sources that are now in use for public water supplies.

With the great extension of filter plants and the development and use of these supplementary processes, the time is rapidly approaching, and has, in fact been reached for a large part of the urban population of the country, when public water supplies cease to be agents for the transmission of disease. On the other hand, many experiences in widely separated cities should teach that constant care is the price of safety, and that every reasonable effort must be made to prevent the occurrence of any condition that would interrupt, even temporarily, the efficiency of the processes that are relied on for safety.

Sewage Purification.—The processes that have been successfully applied for the removal of bacteria from water may be applied, with modifications adapting them to the change in conditions, to removing bacteria from sewage. There has been a renewed effort under the stimulus of these new methods, to secure the disinfection of all sewage to be discharged into rivers and lakes from which public water supplies are taken. This impulse represents a most commendable interest in public water supplies and a desire to protect them from pollution.

It must be recognized, however, that it is more difficult and expensive to remove bacteria from sewage than from drinking water, and the process, even under the most carefully controlled conditions, is at the present time far less certain in its operation when applied to sewage.

The question of the combined or separate system in sewers, the treatment of storm overflows and the treatment of street washings discharged by drains which do not carry sewage, all have to be considered in connection with this general question.

Up to the present time improvement in public water supplies has come almost entirely through methods of improving the water used. Improvement of water supplies by purifying the sewage that flows into the water from which they are taken has played hardly an appreciable part in the improvement of water supplies in America.

Looking at the matter broadly, these conditions must be expected to continue for the present, and further improvement in water supplies is to be expected from improvements in methods of purifying the water, and from increased care and faithfulness in carrying them out rather than from the more extended use of sewage purification.

◆

A contract has been signed between the town of Greenfield Park, Que., and the Montreal and Southern Counties Railway Company, in which the town gave the railway company a twenty-five years' franchise, and the latter agreed to give the town a satisfactory electric train service, to be inaugurated on or before July 1st, [illegible]. Suggestions have been made that the service will be in operation by the end of this year.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, OCTOBER 17, 1912. No. 16.

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Municipal Engineer 615
Canada and the Nickel Supply 616

Leading Articles:

Reinforced Concrete Arch, North Toronto 601
Nipissing Central Railway 602
Canadian Road Systems 603
The Use of Motor Trucks in Road Construction and Maintenance 605
Highway Engineering Education 607
New Type of Mine Locomotive 610
Sewage Treatment versus Sewage Purification 610
A Method of Reconnaissance Surveying 612
Water Purification Viewed from the Hygienic Standpoint 613
The Angus Shops of the Canadian Pacific Railway 618
Aspects of Steam Railway Electrification 619
Electrolytic Disposition of Sewage 621
Report on Railway Entrances to City of Ottawa .. 625
Electric Equipment of a Large Planing Mill 627

Coast to Coast 628
Personals 629
Coming Meetings 630
Engineering Societies .... 63[illegible]
Construction News .... [illegible]5
Market Conditions .... 24-2[illegible]
Railway Orders 74

THE MUNICIPAL ENGINEER

The city of London has lost the services of their city engineer, Mr. George Wright. Mr. Wright has handed in his resignation as the result of certain statements and criticisms made by the mayor and members of the city council.

The number of engineers who have held the city engineership of London is rapidly increasing. The most recent to have accepted the position only to leave it at an early opportunity are Mr. Graydon and Mr. A. H. VanCleve. Mr. Wills McLaughlin was city electrical engineer also for a period of a few months. These men are known to the profession throughout Canada as capable men and good engineers. What, then, is the trouble in London? Were these men unable to meet the requirements of the position?

The answer is the same one that may be given to the recent trouble in Calgary, when Mr. J. T. Childs, the city engineer, resigned, and to the investigation now pending in Ottawa into the city engineer's department: the absolute lack on the part of city councils of the elementary principles of fairness in dealing with municipal officials, and their utter ignorance of the conditions of engineering work.

Mr. Childs was forced to retire from the city engineership of Calgary after many years of service as the result of a most absurd accusation. Mr. Wright now resigns from the city engineership of London on the trivial charge of poor construction of certain sidewalks. A knowledge of the facts which led up to both of these resignations must convince an unprejudiced observer that the day of usefulness of city councils is rapidly passing.

Suggestions have been made recently as a result of the constantly recurring troubles between city councils and city engineers, that the Canadian Society of Civil Engineers should take up an active policy with the aim of securing more just treatment for the members of the profession following this line of work. We doubt very much if any good purpose would be served by interference on the part of the Canadian Society in the endeavor to ameliorate conditions. The constant criticism and the nagging and fault-finding of municipal councils is due primarily to their comparatively low order of education, and, therefore, to their consequent inability to understand the engineer's work. The members of municipal governing bodies are chosen, as a general rule, on account of their political ability and wire-pulling capacity; and these qualifications are not usually developed in marked degree in the modern, well-educated man. The doctrine of the survival of the fittest is well exemplified in the usual city council of to-day; and the fittest there, is the vote-getter, the man who may be called a "good mixer."

The present method of election of city council by popular vote is not conducive to the obtaining of a high standard of municipal governing body, and it is the city engineer who has been the first to feel the evils of the system.

As we have said, we do not believe that the Canadian Society of Civil Engineers can do anything to help conditions. The trouble lies in the city councils, and the remedy is there also. Until the commission form of municipal government is brought into force, trouble will continue to develop between the city engineer and the municipal governing body.

Engineers with municipal training, and inclination for municipal work, will be cautious in accepting a position as city engineer of London after the past history of the position.

CANADA AND THE NICKEL SUPPLY

While it seems unlikely that the Dominion government will prohibit the export of nickel from Canada except to Great Britain—a suggestion made recently—the hint is a key to an interesting story. Prior to the time of war crisis, such a prohibition might prove an effective weapon. The official reports of mineral production in Ontario show that in 1910, the latest year for which such figures are available, there were raised from the nickel-copper mines of Sudbury 652,392 tons of ore, of which 628,947 tons were smelted in the blast furnaces and put through the converters. The product was 35,033 tons of Bessemerized matte, 23.6 tons of ore being thus required on an average for one ton of matte. In this quantity of matte there were contained 18,636 tons of nickel, last year's output, 13,141 tons, being exceeded by 5,495 tons, or over 41 per cent. The production of 1910 was much the largest since the nickel mines of Sudbury were opened, a quarter of a century ago, and stamps this field as being the most important source of nickel in the world. The value of the nickel contents of the matte, on the basis of what it is worth —or estimated by the producers to be worth—at the point of production is $4,005,961.

To the output of the Sudbury mines must be added, for the sake of completeness, the nickel contents of the silver ores raised at Cobalt, estimated to amount to 504 tons, bringing the total yield of nickel in 1910 up to 19,140 tons.

Monel metal, an alloy of nickel and copper, which has been placed on the market by the Canadian Copper Company, and which is produced by that company without separating the metals or either of them from the matte, has aroused great interest. It is asserted that the proportions in which the nickel and copper occur in the Canadian Copper Company's ores are almost precisely those required for the alloy, which are about 67 per cent. nickel and 27 per cent. copper, and that by careful attention to the furnace charge a Bessemer matte can be produced within one per cent. of that required in making Monel metal. Considerable quantities of this alloy are now coming into use. It is claimed to possess great strength and to be practically non-corrodible. It has been employed as castings in the manufacture of propellers for vessels of the United States navy and private yachts, in pump linings, steam turbine nozzels and valve fittings for superheated steam, in dairy machinery, refrigerating plants, and pickling apparatus in steel mills; in rod form, for pump rods, bolt and nut stock, steam turbine parts, stock for drop forgings, electrical apparatus, motor boat shafting, pickle pins and valve stems; as sheets, for roofing railway terminals and other large buildings, for mine screens and chutes, smelter roofs, skylights and window frames, boat sheathing, cooking utensils and chemical apparatus, also for steam turbine blades; in the form of wire for wire cloth, motor cycle spokes, rope for mine hoists and cableways, nails, screws, rivets, etc.; and many other applications where high tensile strength, combined with non-corrosive features are essential.

The use of nickel for coinage purposes is spreading. In 1910 the Government of Turkey was authorized to put out an issue of coins made of nickel or aluminum. The latter metal, upon being tested, not having given satisfactory results, nickel was decided upon, and it has been resolved to issue 120 millions of 5-para pieces, 120 millions of 10-paras, 70 millions of 20-paras, and 20 millions of 40-paras, in all 330 million pieces. The money is all to be coined in four years and issued in twenty.

The only other important source of nickel is the island of New Caledonia, whose output, however, in proportion to the whole, is now much less than that of Sudbury. Societe le Nickel, whose production is of New Caledonian ores, operates refineries in France, England and Germany. From 1900 to 1909 the French production fell from 1,700 to 1,200 tons, while that in England rose from 1,500 to 2,800 tons, and in Germany from 1,400 to 3,100 tons. Thus in 1909 the total output of nickel from New Caledonia was 7,100 tons. In the same year the yield from the Sudbury mines was 13,141 tons.

◆

EDITORIAL COMMENT.

A statement from Ottawa this week does not bode well for the success of navigation in Hudson Bay. The naval service department, it is said, has had to abandon the scheme to send coal to points in the Hudson Straits for steamers owing to the refusal of the insurance company to insure the vessel which was to be sent. The vessel chartered was the Eric, owned by the Job Brothers, St. John's, Nfld. It is a sealing vessel, strongly built and equipped for ice work, yet the insurance company would not take the risk, chiefly because in case of accident very few vessels are in the vicinity to render assistance. The Pacific Coast outlet for Western Canada has no such drawback.

◆

GENERAL NOTES.

The precipitation of the month of September was somewhat less than average the larger part of British Columbia, and over Eastern Quebec and the Maritime Provinces, while over the remainder of the Dominion, exclusive of the Districts of Nipissing and Muskoka in Ontario; and of Southern Saskatchewan and perhaps some areas in Northern Alberta, it was in excess. The excess was particularly marked in Southern Manitoba, and in the Lower Ottawa Valley, where almost double the average quantity was recorded. Light snow fell in some few localities in the Western Provinces, and severe thunderstorms occurred in all the Provinces.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for September, 1912:

	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta	2.8	1.56
Edmonton, Alta	1.1	−0.40
Swift Current, Sask.	1.1	−0.23
Winnipeg, Man	5.5	+3.58
Port Stanley, Ont	[illegible]	+0.11
Toronto, Ont.	3.28	+0.43
Parry Sound, Ont	3.5	0.06
Ottawa, Ont	4.3	+1.68
Kingston, Ont.	4.8	+2.20
Montreal, Que	6.4	+3.01
Quebec, Que	3.3	−0.47
Chatham, N.B	2.3	−0.83
Halifax, N.S.	3.4	—0.61
Victoria, B.C.	0.7	−1.40
Kamloops, B.C	0.8	−0.19

SPILLWAY CAISSON DAM.

Enough of the material for the floating caisson for Gatun Dam Spillway has arrived on the Isthmus from the United States to allow the contractors for its fabrication and erection, the McClintic-Marshall Construction Company, to begin the erection within a short time, is the statement in the current issue of The Canal Record. Inasmuch as the caisson will not be required until after the coming dry season, it will be erected at an elevation between 55 and 60 feet above sea level, on the lake side of the east wing of the dam, there being ample time to complete the caisson before the rise of the lake surface above elevation plus 50 feet; while shortly after the spillway gates have been closed, further to raise the lake, the caisson can be floated off and held ready for service.

The caisson is to be used as a temporary dam for the passages between piers of the spillway dam, when it is desired to repair the Stoney gates by which the passages will ordinarily be controlled to regulate the surface of the lake. When a gate is to be repaired, the caisson will be towed from its moorings at the side of the spillway, and swung into place between the piers supporting that gate. Water will be let into the caisson through intakes below the water line until it sinks into position on top of the ogee and against the vertical seats provided on either side. The downstream side of the caisson will then be six feet six and three-fourths inches from the face of the gate After the placing of the caisson, the gate will be raised slightly to unwater the space between it and the caisson. This will cause a heavy pressure from the lake on the caisson, forcing it more tightly in place, and will afford room for workmen to operate on the upstream side of the gate.

When it is desired to remove the caisson the gate will be lowered and the space between it and the caisson will be filled with water, to the level of the lake, through a pipe passing through the caisson and controlled by a valve. The pressure of backwater having been relieved, the caisson will be pumped out and floated away.

In outward appearance the caisson will be a simple rectangular box. The framework, consisting of vertical and horizontal girders, supporting a system of intercostals to form the skeleton, will be covered on both sides with steel sheathing plates, so as to form a watertight box into which will be put a sufficient amount of concrete ballast to cause it to float upright and at the proper depth in the water. Timber keels and side sills are provided to make tight joints with the ogee between piers and the vertical seats against which the caisson will rest when in use.

The horizontal girders, three in number, and the top truss will be 49 feet 6 inches long by 4 feet 3 inches wide, with web plates ½-inch thick. They will be bolted at the ends to the two vertical girders, 22 feet 6 inches long, 5 feet 9½ inches wide, and ½-inch thick in the web; and each of the three long spaces thus formed will be crossed at right angles by nine vertical intercostal plates ⅜-inch thick. This sheathing will vary in thickness according to the pressure on it, from ⅜ to 7-16 of an inch All of this material will be of specially tested structural steel.

For ballast, concrete will be laid approximately two feet six inches deep over the entire bottom girder, with a slight grade toward a sump near the centre. A number of movable concrete blocks, eight inches square by six inches deep, will be placed on top of this as a means of adjusting the ballast.

The pipes for letting water into the caisson are located above the second girder, holes in which will allow the water to drain to the bottom. These pipes are two in number, four inches in diameter, and controlled by long-stemmed valves operated from the girder above. Swash bulkheads will minimize the rolling of the water within the caisson, assuring steadiness. The flange pipe, through which water will be let into the space between caisson and gate at the conclusion of repairs to the latter, is at the same level as the filling pipes and between them. It will be ten inches in diameter, of cast-iron, and controlled by an extension valve similar to those for the filling pipes.

The pump for unwatering the caisson, to float it, is to be of the horizontal force type, hand-operated by two handles. It will have a 6-inch stroke, and will draw water from the sump in the ballast through a 3-inch suction pipe and force it out through a 2½-inch discharge pipe, emptying through the side of the caisson about a foot below the top. When the caisson is sunk in place on its seat, its top will be two feet eight inches above the surface of the lake at the maximum elevation of 87 feet above sea level.

Trap doors and ladders will be provided to allow workmen access to the interior of the caisson. The top truss will be decked over with yellow pine lumber; and the keels and end sills will be of white oak. The caisson complete will contain approximately 53 tons of structural steel. The caisson for Miraflores spillway will be of identical construction.

◆

DETERMINATION OF STRESS.

Professor E. G. Coker read a paper on the "Experimental Determination of the Stresses in Springs and other Bodies by Optical and Electrical Methods" before the Engineering section of the British Association.

He pointed out that usually the chief difficulties in determining the state of stress in a body arose from the great variations of stress intensity which occurred owing to its complicated shape and the loading; and, further, in the case of springs where plates were built up into a matrix, the rubbing friction between the surfaces was usually sufficient to render the assumptions of perfect elasticity of the whole body somewhat untrustworthy for purposes of calculation, although each plate might be regarded as fulfilling the elastic conditions perfectly.

Methods of experiment were described by optical and electrical methods of general application to stress problems. In the first method, models of springs were constructed of transparent materials for which it was shown that the stress distribution was very similar to that in steel. These models permitted of determinations of the difference of principal stresses at any point, and an important result was that the optical effect of a pure shear was proportional to twice the numerical value of one of the principal stresses. Examples of plate springs and flat-coiled springs were considered in detail, and the general distribution of stress was illustrated by diagrams and natural-color photographs of springs viewed in polarized light. The second method depended on the fact that steel and other metals when subjected to stress within the elastic limit experienced a change of temperature—a diminution for tension stress and an increase for compression stress—proportioned to the stress. The effect at any point, therefore, was due to the sum of the principal stresses, and in coses of pure shear the effect was zero—a noteworthy difference from the first method. The paper described some attempts to utilize the difference in the electrical condition of stressed and unstressed metals for determining the stresses in materials.

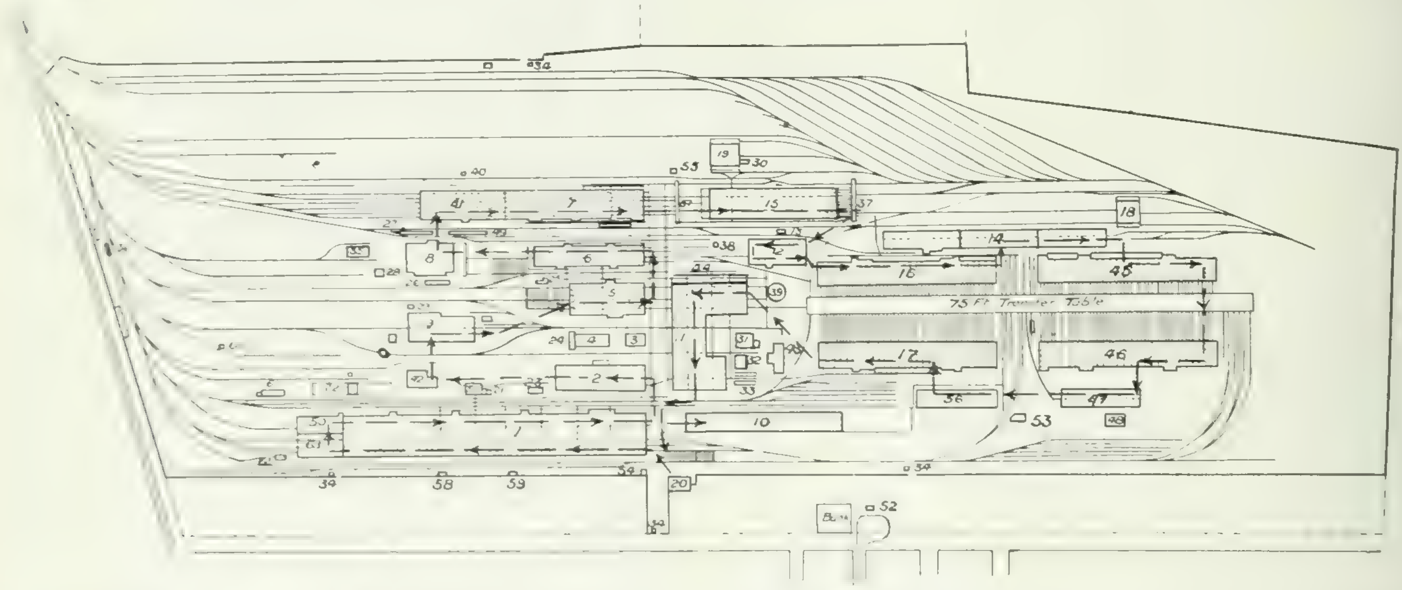
◆

The new United States Navy collier, "Jupiter," is fitted with electrically driven engines. She has a displacement of 19,300 tons, and is designed to carry 12,000 tons of coal as cargo, and for a maximum speed of fourteen knots. The machinery is reported to show a considerable saving of weight as compared with the reciprocating engine.

THE ANGUS SHOPS OF THE CANADIAN PACIFIC RAILWAY.

The Canadian Pacific Railway maintain at this point, which is near the city of Montreal, the largest and best equipped shops in America for the maintenance and manufacture of railway rolling stock. It would be impossible to secure even a slight idea of their immensity from a photograph but in order to show something of their extent the drawing, Fig. 1, has been prepared. The various buildings may be located and identified by reference to the following table, the numbers of which correspond with those on the drawing.

Further information regarding these shops may be secured by reference to our issue of January 24th, 1912, which was one of the daily numbers issued in Montreal during that month.



1. Locomotive shop.
2. [illegible]
3. Pattern shops.
4. Pattern storage.
5. [illegible]
6. Truck shop.
7. Freight car shop.
8. Wheel foundry.
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]
13. Shavings vault.
14. [illegible] shop.

[illegible]

[illegible]

[illegible]

Hardwood kiln.

[illegible]

34. Watchman's shelters.
35. Coke and wood storage sheds.
36. Locomotive track scale.
37. Transfer table.
38. 75,000-gal. tank, elevated.
39. Reservoir, 500,000 gals.
40. Freight car painters' clothes shed.
41. Freight car paint shop.
42. Lunch room No. 1.
43. Lunch room No. 2.
44. [illegible]
45. Passenger car paint shop.
46. S. E. Passenger car shop.
47. Upholstering shop.
48. Carpet beating shed.
49. [illegible]
50. Flue and Flanging shop.
51. [illegible]
52. [illegible]
53. [illegible]
54. Hose house.
55. [illegible]
56. [illegible]
57. Coal bin.
58. [illegible]
59. [illegible]
60. Rail saw office.
61. Coal bin.
62. [illegible]
63. [illegible]

◆

THE SUPPLY OF NICKEL.

The situation in the Sudbury district, Ontario, with respect to the competition in the supply of nickel for use in the nickel-steel industry, has changed considerably in the past few months, states the Iron and Coal Trades Review. The International Nickel Company, acting through its subsidiary company, the Canadian Copper Company, has, up to the present, been the main producer from the Sudbury district, controlling in all about 70 per cent. of all the Sudbury output, which output represents about 75 per cent. of the total nickel product of the world. The Mond Nickel Company has produced about one-fourth of the Sudbury output, while the International Nickel Company has also large interests in the new Caledonia fields. At one time, the International Nickel Company was controlled by Mr. Charles M. Schwab, but about 1907 the control was taken up by Messrs. Converse, Monel, Delamar and Thompson. Prior to Mr. Schwab's advent into nickel, Mr. Joseph Wharton, of Philadelphia, Judge Burke and Mr. Richie, of Cleveland, had been dominating factors in the nickel situation. Recently the International Nickel Company extended its capital from $10,000,000 to $50,000,000. This will result presumably in a close alliance between the International Nickel Company and the United States Steel Corporation, in effect at least. While the International has been strengthening its position and increasing its activities, a Canadian company, known as the Dominion Nickel and Copper Company, has made some important purchases of new properties. This company is controlled by [illegible] represented by Mr. [illegible] of [illegible] and Mr. M. J. O'Brien, of Montreal. [illegible] in the Sudbury district. It had been reported that the American Smelting and Refining Company had made an investigation of the district and [illegible] options. Some smaller interests have sought to enter the nickel field, principally representing [illegible] connections, that are now using nickel extensively, presumably for naval and military [illegible]

ASPECTS OF STEAM RAILWAY ELECTRIFICATION.

The advent of electricity into the steam railway field has not been very rapid. However, several railways in the United States have adopted electricity as motive power for suburban or interurban service. Professor C. L. de Muralt, in an article published in the Railway Age Gazette, outlines the present status of steam railway electrification. We present the article in full.

Let us see what has thus far been accomplished in trunk line electrification and what is likely to be done in the future.

We have to-day at least seven prominent steam railways that are using electricity as motive power on one or more of their main line divisions.

(1) The Baltimore & Ohio, at its Baltimore terminal.

(2) The New York Central, at its New York City terminal.

(3) The New York, New Haven & Hartford, at its New York City terminal and at the Hoosac tunnel.

(4) The Pennsylvania, at its New York City terminal, and on parts of the West Jersey & Seashore.

(5) The Great Northern, at the Cascade tunnel.

(6) The Grand Trunk, at the Sarnia tunnel under the Detroit River.

(7) The Michigan Central, at the tunnel under the Detroit River.

With the exception of the West Jersey & Seashore, every one of these electrifications was caused through the presence of a tunnel, which made further operation by steam locomotives either difficult or impossible. Whatever economies in operation were secured through the use of electricity may be said to have been incidental in all these cases.

Does this mean that electricity will be restricted to places where tunnels form a hindrance to steam operation? A careful examination of the matter shows nothing to confirm such a view. Smokelessness is only one of the advantages of electric traction. As matters stand to-day it will hardly be considered its most valuable one. There is one that is likely to prove of much greater importance. It is the fact that the electric engine possesses inherent qualities, which make it a much more powerful traction machine than its steam rival. To show just how this characteristic has already been utilized and to what extent it is likely to influence further developments is the purpose of this article.

The work which any given engine can do is dependent on three things, tractive power, boiler power and engine power, and it is limited in three ways.

(1) The tractive power is limited by the weight of the engine, or rather by that portion of the weight which is placed on the driving wheels. Any increase in weight on drivers means a proportional increase of tractive power, and for any given weight on drivers there is a certain maximum power which the engine can exert, and beyond which it must necessarily slip its wheels.

(2) The size of the boiler determines the quantity of steam which can be produced in a given time, and thus limits the steam producing or boiler power. If the engine uses more steam than the boiler can produce, the boiler pressure will fall and the engine will then be unable to turn the wheels.

(3) The capacity of the cylinders in a steam engine, or of the motors in an electric engine, limits the mechanical or engine power. If these parts are not sufficiently powerful, then the engine will be stalled, even while utilizing to the utmost a full pressure of steam and while yet unable to slip the drivers.

It may be said at once that the last is in general an unpardonable fault for any engine to have, because it is an absolutely needless sacrifice of a good part of its working capacity. With proper care in the design of its steam cylinders, or proper choice of the electric motors, it is always feasible to make the engine power in excess of either the tractive power of the boiler power, or both. The limit to the work which can be done by a well designed engine need therefore never lie in its motor part. It is always due either to insufficient tractive power or insufficient boiler power.

On these two points the electric engine shows its superiority over the steam engine. The electric engine has the boiler in the power house, and its size can thus be determined without reference to the limitations which are imposed on the boiler of the steam engine by the physical characteristics of the track and of the fireman. In other words, by proper design the limitations of the boiler power can be entirely removed in any system of electric traction.

Similarly, we find that the limitations of tractive power may be practically eliminated wherever electricity is used, because the electric motor lends itself to subdivision of power with such ease, that it is quite possible, in case of necessity, to turn any desired number of axles into driving axles, and thus to utilize any desired part of the weight, up to the full weight of the train, for tractive purposes. The tractive power which is thus made available is away beyond anything that is likely to be demanded in railway work.

Now, let us see how these two characteristics of the electric engine may be utilized.

Our contention is, that electricity is peculiarly suitable for the relief of all congested spots on the present steam roads. We have two main cases of congestion, namely, terminals and ruling grades.

We started by saying that the electrification of the New York terminals of the New York Central, the Pennsylvania and the New Haven railways was largely caused by the necessity of avoiding smoke in the tunnels that form a part of these terminals. But it would be wrong to assume that the matter stopped there. The men who had charge of these installations fully realized the other advantages which were thus incidentally placed at their disposal. In such cases it is especially the removal of the limitations on tractive power which is of considerable value.

It is a fact well known to all superintendents of motive power that it is difficult to make a fast schedule in dense suburban passenger traffic, even with the most powerful steam engines especially designed for such service. The reason is that with steam locomotives there is a distinct limit to the amount of weight that can be placed on the drivers. From this results a limit to the tractive power, and consequently a limit to the ease with which heavy trains can be started and brought up to the speed. Even the highest obtainable rate of acceleration is too low to give a really satisfactory schedule speed when stops average about one mile apart. Furthermore, the number of cars that can be hauled in such a train is distinctly limited.

Electricity changes the situation completely. Any number of axles can be equipped with electric motors, and thus the tractive power can be raised to any desired amount. In actual practice an electric train can readily be accelerated two or three times as fast as even a light steam train, and there is practically no limit to the number of cars that can be placed in an electric train. The congestion is thus relieved in three ways, first, by the possibility of using larger trains; second, by the chance of higher schedule speeds, and third, by the greater ease with which the trains can be moved out of each other's way, that is to say, by the possibility of decreasing the interval between trains. In actual practice all three methods are usually combined with resultant satisfaction to passengers as well as the railway.

In the case of congestion due to severe grades, on otherwise level or low-grade lines, the conditions are reversed. In such instances the maximum tractive power is usually quite sufficient; in other words, the obtainable acceleration is satisfactory, but it is the boiler power which causes trouble. In order to lift the train up the grade, the engine must consume more and more steam until a point is reached when the boiler is unable to produce any longer what the engine requires. Then, either must the train weight be reduced, or its speed, or both. This is what actually happens on the ruling grades of most of the lines crossing the Alleghenies, the Rockies, and other mountain ranges. Helper engines mitigate the nuisance to a certain extent, but there is a limit to the number of helpers that can consistently be used on one train, and when this limit is reached, the trains are made lighter at the bottom of the grade, or their speed is cut down, or both.

Here, again, we find that the use of electricity completely changes the situation. There is no limit to the power which the boilers in the far-off power house can produce, and this power can very readily be carried to the engines in the form of electric current by means of the third rail or overhead contact line. Thus it is possible to concentrate sufficient power in an electric locomotive to take any train up the grade in the same composition in which it arrives at the bottom of the grade, and with the proper type of motor this can be done at the same speed at which it is run on the level. The congestion produced by the grade is thus effectively removed. In fact, one might almost say that for electric operation the vertical profile of a road loses all of its terrors, and trains can be taken over the most broken profile almost as well as over the level road.

We see, therefore, that the excess power of the electric engine can be made useful in at least two ways. The electrification of terminals is likely to make further steady, but comparatively slow progress. As a matter of fact, there are not very many places where terminal congestion has reached such a state as to make the use of electricity necessary, or even very important. The electrification of heavy grades, however, is destined to find more and more favor, especially because the business of the country is on the increase and any congestion now existing is therefore likely to be aggravated in the near future. At the Cascade tunnel of the Great Northern a heavy grade has been electrified in addition to the tunnel, and the results there obtained are certainly quite encouraging.

As regards the kind of system to be used, too much importance has been attached to this subject in the past. There are to-day at least three well established electric systems, namely, the continuous current or direct current system, the single-phase alternating current system, and the three-phase system. Any of these can no doubt be used to electrify almost any [illegible]

Just as there are many different types of steam engines, and at least three types of approved valve gears, so is there room for many different kinds of electrical motors.

The fact which is important is that in the electric locomotive of proper design we have an engine of much greater working capacity than can ever be obtained in a steam engine. This greater capacity can be used, either to give greater acceleration in terminal work or to move heavier trains at higher speeds over ruling grades. the latter employment in particular is likely to prove of great value in the case of roads where a severe grade produces a congestion, and thus a decrease in the traffic capacity of the whole line.

In a future article we will investigate whether grade reduction, or the use of Mallet engines, or both together, can afford as great a return on the capital invested, or offer the same operating advantages as electrification.

◆

SHERBROOKE RAILWAY REPORT

"During the year," states President C. J. McCuaig, of the Sherbrooke Railway and Power Company, in the annual report, "some important steps have been taken in connection with the company's affairs, and the scope of its operations has been extended by the acquisition of several companies, with established businesses, in the district between Sherbrooke and the international boundary line. Legislation was obtained at the last session of the Quebec legislature ratifying these contracts and still further extending the company's powers. The companies acquired consist of the Eastern Townships Electric, the Stanstead Electric and the controlling interest in the Lennoxville Light and Power Companies.

"To provide funds for the purchase and extension of these properties, building transmission lines, and the extension of the company's main system, the company issued $348,500 additional bonds and $348,500 stock, which they have sold.

"Negotiations are pending for the sale of another large block of the company's power and it is reasonable to expect that a market will be found for the greater portion of the remainder of the power developed before the expiration of the year.

The following is the statement of profit and loss for the year ending June 30 last:—

Railway and power operations:—			
Gross earnings		$64,500.71	
Operating expenses		43,616.98	
Net earnings			$20,883.73
Real estate:—			
Rentals			$ 990.65
Stanstead and Eastern Township's Electric Company's			
Gross earnings		$23,148.58	
Operating expenses		12,975.63	
			$10,172.95
Lennoxville Light and Power dividend			$ 800.50
Net profit for 1912			$32,847.83
Balance at credit, 1911			3,694.46
			$36,542.29
Less:—			
Bond interest	$41,077.66		
Less interest charged to portion of system under construction	8,000.00		
		$33,077.66	
Accounts written off:—			
Railway department	$ 532.86		
Power department	590.22		
		$ 1,123.08	$34,200.74
Balance carried forward to the credit of profit and loss			$ 2,341.55

ELECTROLYTIC DISPOSITION OF SEWAGE.

The treatment of sewage is taking on added importance as time goes on and the necessity for preventing further pollution of lakes and streams increases. Mr. F. C. Caldwell, in the June bulletin of the Ohio State University, takes up the present status of electrolytic methods of purification. In the following we present his discussion.

The electrolytic purification of sewage is not new, patents covering the system have been taken out in England nearly a quarter of a century ago. It has, however, been recently revived with such a degree of success, as makes it fitting that it should be considered by this association, to the members of which its general adoption might be of considerable importance.

The material to be handled is made up of domestic sewage, sometimes accompanied by factory wastes and more or less diluted with storm water. Domestic sewage is made up of organic matter that is animal and vegetable, partly dissolved and partly suspended in water. There are also present vast numbers of bacteria often thirty to fifty million in a cubic inch. Factory waste when present may be of any one or more of many kind and affects the problem differently according to its nature. It is therefore not considered in this paper.

The degree of dilution of the sewage to be handled will vary greatly, depending both upon the habits of the population and upon the amount of storm water. In general, it is much more dilute in this country than in Europe. The large proportion of water greatly increases the difficulties of handling the sewage.

The presence and action of the bacteria constitutes one of the most important factors in the problem. They may in general, be divided into two classes, the purifying, also called anaerobic, because they flourish without oxygen, and the oxidizing or aerobic, which as indicated by their name, require oxygen for their best development.

The purifying bacteria operate in the sewers and in any closed reservoir or septic tank in which the sewage may be held. They are helpful in that they digest or liquify any solid portions, but to their action are due the offensive odors which characterize stale sewage. It is therefore essential that their action should be for the most part stopped before the sewage is turned into rivers or other water.

The oxidizing bacteria on the other hand, oxidize or "burn up" the organic material reducing it to simple, stable and inoffensive matter in which condition it ceases to be a nuisance, especially when further diluted with river water. As indicated above, their action is promoted by the presence of air and goes on without offensive results even after the sewage has been turned into the river. They can, however, act only effectively upon finely divided matter, and it is therefore usually desirable for their action to be preceded by that of the putrifying bacteria.

There are also to be considered the disease producing bacteria, originating in the human body. Of these the most notable is the typhoid bacillus. These, if simply run into the river water will remain alive for considerable periods, but they do not flourish under such abnormal environment and are not difficult to eliminate. In many plants it is not considered necessary to sterilize against such bacteria except at times of epidemics.

Any system of purification, to be a success, must leave the sewage inoffensive in appearance and in odor. Practical elimination of the disease producing bacteria is also desirable. Generally, also, the sewage must be to such an extent oxidized that there will be no danger, under the conditions of its disposal of purification again setting in. It is not sufficient to eliminate the putrifying bacteria as there are enough to be found in the river or other water to start the process and once started the rate of increase is enormous. It has been estimated that under unnaturally favorable conditions one bacterium would in twenty-four hours give rise to sixteen and one-half millions.

Granted that a new system accomplished these functions satisfactorily, it would still remain to be demonstrated that it did so more economically than other methods already available.

Before inquiring into the effectiveness of the electrolytic method it will be well to describe its operation. The following relates to the latest plant, a description of which has been published, namely, that at Oklahoma City, (population in 1910, about 64,000). This plant was put in operation on March 29, 1911, and was designed to handle 750,000 gallons of sewage per day. One or more of three flumes 18 x 20 in cross sections and 30 feet long received the sewage. This comes from the city through a conduit about a mile in length and the flow through this is an important factor as it assists in the mechanical disintegration of the sewage as well as serving as a septic reservoir for the action of putrifying bacteria. Each flume is designed to care for 250,000 gallons of sewage per day. The electrolysis is effected by ten groups of iron plates, each group consists of 27 plates, 3-16 x 10-24 spaced ½ inch between surfaces. These may be likened to the elements of a storage battery of such size as to nearly fill up the flume, and with their faces parallel to its sides. Alternate plates are positive and negative, and are connected to bus bars run along the edges so that all the groups of plates are in parallel. The bus bars are supplied by a 3-kw. motor generator set with current at from 1½ to 3 volts. Each flume takes normally 270 amperes. A reversing switch is included in the circuit, and changing the direction of the current once or twice a day equalizes the wear on the plates and removes the deposit which forms upon them.

To prevent excessive electrolysis at the upper edge a copper binding is used. The plates are gradually dissolved and take part in the chemical action upon the sewage.

The effluent is discharged into a so-called "dry gulch," and the sediment deposited in the flumes is periodically flushed out into the same gulch.

The Oklahoma plant was established on the strength of the results obtained from one installed at Santa Monica, California, population 11,000 to 18,000, depending upon the time of year, in June, 1908, and was modelled closely after it. The Santa Monica plant, however, discharges the effluent into the ocean 1,600 feet from shore. In passing, it is interesting to note the surprising lack of knowledge of things electrical evinced in the installation of this system. For example, magnets were placed over the plate electrodes for the purpose of intensifying the action of the current upon the sewage, but were easily removed.

We come to the perplexing question—Does the electrolytic method satisfactorily "purify" the sewage? Two causes of purification are claimed, namely, the production chemicals which are strongly oxidizing or chlorinating in their nature and the production of oxygen itself in the so-called nascent state, in which it is very active chemically. That such chemicals are formed and that they do operate to destroy the bacterial life they reach and to some extent to oxidize the organic matter itself is undisputed. The part played by the nascent gases is more doubtful as it seems to have been well established by Geo. W. Fuller in an extended investigation at Louisville (see his "Sewage Disposal," page 557) that such oxygen is almost entirely used up in attacking the iron plates. Further, the gas ceases to be nascent almost immediately after its formation on the surface of the plates and hence any direct action due to it would only take place in a very thin layer next to the plates, so that a small portion of the liquid would be affected.

An illustration of the efficacy of the electric current in the destruction of bacteria is found in some tests made some time ago by Dr. C. B. Morrey, of the Ohio State University, and the author, on the electrolytic sterilization of milk. In a sample of market milk containing 19,480,000 bacteria per cubic centimeter, an application of 2.5 amp. at 2,000 volts alternating current for 15 seconds reduced this number 99.97 per cent. Another similar test showed a reduction 98.7 per cent. and a third, in which the milk was inoculated with diphtheria bacteria in very large numbers, showed their practically complete destruction. Chemical examination of the milk showed no changes which would account for the sterilization nor could this be accounted for by the heating which took place.

The evidence seems quite conclusive that where the sewage has received suitable disintegrating and digesting or purifying action previous to the electrolytic treatment the effluent, immediately after each treatment, is practically odorless and free from bacteria. The question which does not seem to be satisfactorily answered is "Has organic matter been so far oxidized that it can be relied upon not to again putrify and thus develop a nuisance in the stream through which it flows?"

The experience at Santa Monica where the effluent, in comparatively small amount, is deposited in the ocean over a quarter of a mile from shore cannot be taken as indicative of the results which would follow where a comparatively small stream were made use of. The case of Oklahoma City, where the effluent is run into a dry gulch, is perhaps more instructive, though even here the conditions are so different from those usually met with in this part of the country that they should not be given too much weight. There being presumably no other water in the gulch through most of the year, there might be no such supply of putrifying bacteria as would be found in most streams. Again, if the soil is sandy the effluent may sink in before it has had time to develop further putrefaction. The effluent as it comes from the plant may be somewhat antiseptic, which would discourage the growth of putrifying bacteria for a considerable period. This condition, however, might soon cease if the [illegible] sewage were diluted in a relative small stream.

On the other hand, the advocates of the system claim that the organic material is actually oxidized or rendered [illegible] and most of the evidence given in the published accounts is to the effect that whatever the sewage [illegible] it [illegible] does not putrify after being subject to the electrolytic treatment, and after all "the proof of the pudding is in the eating," though we might not go so far as to say that the proof of the sewage is in the drinking.

[illegible] the available data [illegible] definite [illegible] with great confidence [illegible] particularly as pertaining to the [illegible] and different conditions elsewhere. The evidence, however, [illegible]

So far the operating side of the problem alone has been [illegible]. The financial aspects are even more difficult to pass judgment upon with the available data.

[illegible] competent and experienced sanitary engineer to make a conclusive report based on the experience of the two plants now in operation. Such report would at least apply to conditions similar to those under which these plants are operating, though of course any new proposition would have to be considered on its own merits.

The experimental plant established at Crossness, a suburb of London, by the original inventor, W. Webster, in 1889, and which was identical in principle with those of today, though different in certain details, seems never to have led to any further application of the principle, though all the obtainable evidence is to the effect that it was successful in its operation. The further fact that during the twenty years following in which so many and such costly experiments were made in sewage purification, the process was never further developed by sanitary engineers is significant.

On the other hand, weight must be given to statements that the Santa Monica plant has been enlarged and that Oklahoma City is constructing a second plant with a capacity of 2,250,000 gallons. It is also to be noted that present-day purification methods are much more costly both in fixed and operating charges than those of 20 years ago and hence this system would be in a better position to compete with them. Again, the fact that sanitary engineers are not usually electrical engineers may have induced them in the past to favor methods which were more familiar to them.

The following cost data are taken from the reports published in the electrical press.

First cost of Santa Monica plant (2 flumes, 550,000 gal.) including pumps, buildings, and forebay, $18,000. Monthly expenses of operating, including pumping, $400. Cost of energy for the year 1909, $159.95, at three cents per kilowatt-hour. Two men are employed at $85 per month but they do other work for the city. The proposal for a filtration plant to do the same work was:

First cost of Oklahoma City plant, $16,000 (cut about 20 per cent. below this figure in order to introduce the plants).

Operating Costs.

	Per annum.	Per mil. gals.
Current (at 5 cents)	$700.50	$ 2.50
Attendant	660.00	2.41
Lights	40.00	.15
Renewal of plates	200.00	.73
Depreciation	100.00	.37
Interest, 5 per cent	800.00	2.92
	$2,500.50	$ 9.17
Sinking fund, (5%, 20 years)...	1,000.00	3.64
	$3,509.50	$12.81

Another process, also invented by Webster, which employs electricity and was extensively exploited in 1894, makes use of an antiseptic solution produced electrolytically from sea water or salt solution. It seems to have been conclusively demonstrated that such solution has no advantage over antiseptics bought from manufacturing chemists and is more costly for ordinary conditions. Improvements in this method recently suggested by W. B. Ball, but still in an experimental stage may alter this situation.

Another interesting development is the use of ozone electrically produced for sewage purification. It is claimed that [illegible] grams of ozone can now be produced per kilowatt hour by the Mosher ozonizer and that a contract for a complete sewage treatment plant has been entered into with the city of [illegible], N.J. No data are at present available.

In conclusion it appears that the verdict for the electrolytic purification of sewage must be at the present time "Not proven. [illegible]."

HARBOR IMPROVEMENTS AT ST. JOHN'S, N.B.

St. John's activity during the last year is due chiefly to the enormous expenditures being made on harbor works, but there is also an increase in the number of factories. The Norton Griffiths Dredging Company are bringing in a fleet of powerful dredges to work in Courtenay Bay, and there are already five dredges and a stone lifter at work in the western harbor and the channel. The Norton Griffiths Company are steadily enlarging their mammoth plant at the site of the breakwater and dry dock in Courtenay Bay, and work will be continued throughout the winter. At West St. John work has been begun on the foundation of the Canadian Pacific Railway grain elevator, and this work will be steadily continued throughout the winter, as well as also the work of constructing new wharves at that point.

The Canadian Pacific Railway finds it necessary to erect a large addition to its office building at West St. John. It has also asked the city for a considerable strip of land at Fairville for an extension of its railway yards. The Intercolonial Railway is adding to its yard capacity storage room for 300 additional cars. The street railway company will extend its line in the direction of East St. John and its electric light system the whole way

Interesting developments are taking place at Coldbrook, three miles out on the line of the Intercolonial Railway. Formerly there were extensive rolling mills at this point, and it was quite an industrial centre, but of late years industry there had ceased. The Maritime Motor Car Company is building an automobile factory to be ready by February 1st, and has discovered on its property a deposit of fine brick clay and a brick-making establishment will be added. The Coldbrook Realty and Development Company, which has planned a garden suburb there, will erect before spring several cottages for workpeople.

◆

USE OF PEAT IN GAS PRODUCERS.

On account of the lack of suitable coal deposits in the central Provinces of Canada and the rapidly decreasing supply of wood, the Canadian Government has taken an active interest in the exploitation of peat bogs with the view of developing from these deposits a fuel supply independent of outside sources.

Not only has the use of peat as fuel been considered, but the question of its utilization for producer gas has also received attention. A producer has been installed at the Fuel-testing Station, Ottawa, and exhaustive investigations have been conducted to determine the suitability of peat for this purpose. It is stated that very gratifying results have been obtained.

Mr. B. F. Haanel, chief engineer of the Division of Fuels and Fuel-testing of the Department of Mines, Canada, who discussed these results in a paper presented before the Eighth International Congress of Applied Chemistry, explains that the process used in manufacturing peat fuel mechanically treats the raw peat and utilizes the sun's heat for drying.

The raw peat is fed into a pulping mill consisting of a series of revolving knives rotating against fixed knives. By this treatment a homogeneous mass is secured, and by breaking the cell walls the contained moisture evaporates more easily. After thorough pulping the peat is taken to the drying field, spread out, cut into blocks of suitable size and thoroughly dried. The moisture content is reduced by this process to 25 or 30 per cent., below which it is not considered economical to proceed.

On account of the hand labor involved the estimated cost of one ton of peat fuel is about $2, including interest on capital invested and a profit of 15 cents per ton. To put the industry on a paying basis it is recommended that the excavation and spreading should be performed automatically and on a large scale. A plant is now being installed to meet these requirements.

On account of the low heating value of peat fuel it is not considered suitable for steam raising, though well adapted for producer gas production.

The high percentage of nitrogen in Canadian peat thus far examined peculiarly adapts it for plants designed for ammonia recovery. The nitrogen in the peat is recovered as ammonia sulphate, for which there is a large demand in the fertilizer industry.

However, the common type of producer employed for peat is not constructed for the recovery of by-products, but rather to burn the fuel with the highest possible thermal efficiency. The Körting producer erected at the Fuel-testing Station, Ottawa, is of this type, and is designed not only to obtain the complete gasification of all the combustible components in the peat, but to destroy rather than recover any of the by-products.

It was found necessary to modify the type of producer in some details before economic results were obtained but without going into details the investigation, in the opinion of Mr. Haanel, has proved that the peats tested are an economic source of power.

◆

THE EFFICIENCIES OF A HYDRO-ELECTRIC SYSTEM.

The accompanying table gives an outline of the losses and efficiencies, for 1911, of the Seattle Municipal Light and Power Plant. This matter was presented by J. D. Ross in a recent paper before the Pacific Coast section of the American Institute of Electrical Engineers. The figures given are believed to approximate closely the true values, since great care was taken in the measurements made by frequently calibrated instruments. All results have been checked in as many ways as possible.

Outline of Losses and Efficiencies for 1911, Seattle Municipal Light and Power Plant.

	Per cent all-day efficiency	Total 1911 input, kw-hr	Average 1911 input, kw	Total 1911 loss, kw-hr	Average 1911 loss, kw	Per cent loss	Per cent of penstock input	Per cent of total loss
Generating system	[illegible]	52,639,000	6,009	23,990,300	2,739	45.6	[illegible]	[illegible]
Penstocks	97.7	52,639,000	6,009	1,214,900	139	2.3	[illegible]	3.8
Generating station	55.7	51,424,100	5,870	22,775,400	2,600	44	43.2	71.5
Water wheels	60.7	[illegible]	5,795	19,944,400	2,277	[illegible]	37.9	62.6
Generators	93.5	30,814,500	3,518	1,990,800	227	[illegible]	[illegible]	6.2
Exciters		665,200	76	[illegible]	76		1.3	2.1
Station lights and control		175,000	20	175,000	20		[illegible]	[illegible]
Transmission system	91.6	28,648,700	3,270	2,413,500	276	8.4	4.6	7.6
Step-up transformers	96.1	28,648,700	3,270	1,126,000	[illegible]	3.9	2.1	[illegible]
Transmission lines	98.6	[illegible]	3,141	378,000	43	1.4	0.7	1.2
Step-down transformers	96.6	[illegible]	3,098	909,500	104	3.4	1.7	2.9
Distributing system	79.2	[illegible]	2,994	5,448,700	622	20.8	[illegible]	17.1
City substation	98.7	26,235,200	2,994	346,400	40	1.3	0.7	1.1
S. Lights and control		317,400	37	317,400	37	1.2	0.6	[illegible]
Switchboard meters				29,000	3		0.1	0.1
13,000 volt system	[illegible]	[illegible]	1,323	868,600	99	7.5	1.6	2.7
13,000 volt lines	[illegible]	[illegible]	1,323	93,500	11	0.8	[illegible]	[illegible]
13,000 volt transformers	93.2	11,493,500	1,312	775,100	88	6.8	[illegible]	[illegible]
Series street lights	86.3	[illegible]	[illegible]	367,200	42	13.7	0.7	1.2
Transformers	[illegible]	2,672,800	[illegible]	133,700	15	5.0	[illegible]	0.4
Series circuits	90.8	2,539,100	290	233,500	27	9.2	0.4	[illegible]
Cluster street lights	79.1	[illegible]	[illegible]	310,000	[illegible]	20.9	0.6	1.0
Cluster transformers	[illegible]	[illegible]	170	181,000	21	[illegible]	[illegible]	0.6
Underground cables	90.1	1,305,000	149	129,000	[illegible]	9.9	[illegible]	0.4
2,400-volt commercial system	[illegible]	13,178,400	1,612	3,123,700	357	23.8	[illegible]	9.8
Feeder regulators	[illegible]	[illegible]	1,612	178,500	20	1.4	[illegible]	[illegible]
Primary feeders	[illegible]	[illegible]	1,592	521,600	60	4.0	[illegible]	1.6
Transformers	88.8	12,478,300	[illegible]	1,391,000	[illegible]	11.2	2.6	4.4
Secondaries	[illegible]	[illegible]	1,373	782,600	[illegible]	7.1	[illegible]	2.5
Customers meters	[illegible]	10,304,700	[illegible]	250,000	[illegible]	2.4	[illegible]	[illegible]
Direct-current system	35.7	673,200	[illegible]	432,800	[illegible]	[illegible]	0.8	1.4
Motor-generator	38.0	[illegible]	[illegible]	417,000	48	[illegible]	0.8	[illegible]
D-C. circuits	95.0	[illegible]	[illegible]	12,800	1	[illegible]		
Customers meters	98.8	[illegible]	[illegible]	3,000		1.2		

Summary. Total power loss [illegible] kw-hr Average [illegible]

Total power delivered to customers [illegible] kw-hr Average [illegible] kw

Total power delivered to street lamps [illegible] kw-hr Average [illegible] kw

Total delivered power [illegible]

Overall efficiency [illegible]

[illegible]

The Seattle plant is a hydro-electric system delivering water to two 1,500 kw. Pelton units and two 5,000 kw. turbine units under 600 ft. head through two pipes approximately [illegible] miles long, one of which is [illegible], and the other 49 ins. inside diameter. The current is transmitted at 60,000 volts through two lines to Seattle, a distance of 38.7 miles, and is there distributed at 13,000 and 2,400 volts for use by approximately 20,000 customers and for the city street lighting.

SMELTING COBALT-SILVER ORES BY VACUUM ELECTRIC FURNACE.

The problem of smelting the difficult arsenides in the vacuum electric furnace was discussed recently by Colin G. Fink of the General Electric Co. at the April meeting of the American Electrochemical Society. He described experiments carried out with the idea of ascertaining whether ores, particularly complex or "rebellious" ores, such as smaltite, containing arsenic, sulphur, phosphorus or similar elements, could be more readily and more economically reduced in a vacuum.

Experiments were made with the treatment of smaltite ore from Canada, in a vacuum electric furnace. Simple heating of the ore without any additions was first tried, but without great success. Up to temperatures of about 1,500° C., but 40% of the arsenic present in the ore is expelled. It is only after exceeding the melting point of cobalt that a further reduction of the arsenic is brought about. If silver is present in the ore, it distils out at about 1,300° and can be collected in a chamber fitted into the cooler portions of the furnace.

Since it proved difficult to reduce the ore by intense heating, Dr. Fink tried the effect of additions. Of all those he tried the most effective was calcium carbide or a mixture of calcium carbonate and carbon.

With a mixture of 20 parts $CaCo_3$ and 6.4 CaC_2 and 30 parts ore, when the charge was heated at 1,500° C. for 1½ hours, the arsenic in the product was 2.1%. In this case the calcium oxide and carbide react with each other:

$$2CaO + CaC_2 = 3Ca + 2CO.$$

And the metallic calcium combines with the arsenic:

$$CoAs_2 + 3Ca = Ca_3As_2 + Co.$$

Calcium arsenide separates from the reduced cobalt as slag and part of the arsenic is volatilized.

The second part of Dr. Fink's paper describes experiments made with Nipissing ore. One lot analyzed 9.65% cobalt, 4.65% nickel, 28.65% arsenic, 18.06% silver, 39% gangue.

The behavior of this ore was similar to that of the smaltite ore. When heated alone a splendid separation was obtained into crude silver (83% ag), metal speiss, and slag.

The dividing line between silver and speiss is exceedingly sharp in the vacuum furnace product. A number of comparative runs were made in a carbon resistance furnace of the Moissan type, the gas pressure in the furnace being one atmosphere. Although a separation of the crude silver, speiss and slag was obtained, it was very incomplete and the volume of arsenic fumes evolved was very annoying.

In the vacuum furnace it was found convenient to make the runs in two stages. During the first stage the temperature was maintained at about 1,250° to 1,350° for 2 hours. At the end of this time, instead of cooling down or tapping off the three components, the temperature was still further increased to 1,550° to 1,600° and the charge kept there for about 3 hours. At this temperature the silver distilled out, leaving the [illegible] and slag behind.

The composition of the charge at the end of the first stage [illegible] slag, 20%, and arsenic (distillate) 8.5%. The addition of 5 [illegible] allowing the gases to escape readily. The crude silver of [illegible]

IMPROVEMENTS IN ACETYLENE GAS GENERATION.

Acetylene is a gas that has been known to chemists for many years, but its recent introduction before the public is due almost to an accident. Some years ago a Canadian chemical experimenter, according to report, was treating a mixture of coke and lime with the electric arc in a confined crucible; just what he was hoping would result from this fusion is not stated, but the results in his first estimation were a failure. A drop of water happened to fall on the discarded mixture and this is the story of the discovery of calcium carbide.

The daily and scientific press of that day immediately seized the discovery as the philosophers stone and simple, sure directions for the construction of an acetylene generator appeared in almost every technical paper; but they failed to realize what every veteran inventor must come to understand, that there is a long stride between laboratory discovery and a complete successful marketing of the commercial product. Companies that were to manufacture acetylene generators were organized all over the world, but very few have thrived. Of some seventy concerns organized in the city of Toronto for this purpose three are still in existence.

All these generators depend on one of two principles; either the calcium carbide was brought to the water or the water was brought to the calcium carbide. The gas was evolved in tremendous volumes absolutely raw and unpurified, and in this condition was burned on a tip so arranged that a draught of air was created that kept the burner from clogging, for acetylene is very rich in carbon.

An English company taking the name of Carbic, Limited, have revolutionized acetylene gas generation by improving the means of applying the calcium carbide to the water instead of attempting any great novelties in the generator, as so many companies have.

Under the patents of this company calcium carbide, ground to the size of small beans, is mixed with two common and inexpensive substances and then heated to 120 degrees F. The sticky mass which results is placed in the die of a power press and forced to assume the shape of a brick or tablet and when this is cool it is ready to be packed and shipped.

There are many advantages in using calcium carbide under this form of which the following are a few.

There is no ash left; all the by-products are in the form of a thin sludge which may be entirely removed by opening a cock at the bottom of the generator.

The cake does not deteriorate when the generator is not operating.

The cake dissolves away from the bottom.

The ingredients in the cake serve as a purifier and the gas comes off very pure and almost odorless.

The generator does not heat.

The gas is generated very slowly.

The cakes may be left exposed to the air for several days without damage.

The cakes are very low in price and quite light for shipping.

A branch of this company has been established in Toronto, and will manufacture the products as well as a fine line of generators. Among the generators to be manufactured will be [illegible] night lamp that gives a powerful white light at an exceedingly low cost of operation, and a generator to be used in the production of acetylene for metal welding in conjunction with oxygen. Other lamps for specific purposes will also be manufactured. Reference will be made to the other plants of the company in a future number of The Canadian Engineer.

REPORT ON RAILWAY ENTRANCES TO CITY OF OTTAWA.

A report was made some time ago by Mr. W. F. Tye, Consulting Engineer, and Mr. N. J. Kerr, City Engineer, on the proposal of the Canadian Pacific Railway to enter the city of Ottawa. An abstract of the report follows:—

The city of Ottawa, lying in the horseshoe curve formed by the Ottawa and Rideau Rivers, is curiously hemmed in both by nature and art. The rivers, canals, and railways form three distinct barriers to the city's progress. The outer barrier, formed by the Ottawa and Rideau Rivers, has, independent of the railways, only eight outlets in a distance of nine miles, namely: the Chaudiere, Interprovincial, Sussex Street, Minto, St. Patrick's, Cummings', Hurdman, and Bank Street Bridges. The second barrier, formed by the Ottawa River and Rideau Canal, has only six outlets in six miles, namely: the Chaudiere, Wellington-Sparks Street, Laurier Avenue, Cartier Street, Bank Street, and Bronson Avenue Bridges. The third barrier, to a great extent the same as the second, is formed by the Ottawa River, Rideau Canal, and the Isabella Street line of the Grand Trunk Railway, and has only six outlets in five miles.

The Ottawa River must always remain a deadline to Ottawa's growth in that direction, and can only be crossed by expensive bridges. The Rideau River has not so far proved a serious obstacle, as it is at too great a distance, but it will only be a few years with Ottawa's present rate of growth until many bridges must be constructed to give access to the lands beyond.

The growth of the city has been rapid. The annual report of the Assessment Department shows the population since 1881 to have been as follows:—

Year.	Population.	Increase %.
1881	25,633	
1891	43,229	68.6
1901	60,689	40.4
1902	61,151	
1903	61,597	
1904	63,234	
1905	65,120	
1906	67,572	
1907	76,260	
1908	80,284	
1909	83,360	
1910	86,106	41.8

In twenty-nine years the growth of the city has been 60,473, or equal to the whole population in 1901. It seems reasonably safe to assume that the rate of increase for the last ten years will be maintained for some time to come, and that the population in 1920 will be at least 125,000. If so, the area between the Isabella Street branch of the Grand Trunk Railway and the Rideau River should be completely built up.

The Rideau Canal and the Isabella Street line of the Grand Trunk Railway are at the present time seriously impeding the city's growth. This can be appreciated by noting the very much superior class of buildings on the city side of the Rideau Canal as compared with the very poor class on the other side, and noting a considerable growth at Ottawa East and Ottawa South, where bridges have already been constructed across the canal, and the almost entire absence of buildings between these points where no bridges have so far been constructed. A poor class of buildings and an absence of substantial growth is also to be seen adjoining the Isabella Street line of the Grand Trunk Railway. Both the canal and railway should undoubtedly be diverted to locations where they will be a benefit to the city, and not a detriment as they now are.

The railways, for the convenience of the public, must reach the heart of the city, which is now and probably always will be in the vicinity of the Parliament Buildings. The valley in which the Rideau Canal has been constructed forms the natural access to this portion of the city; and the railways may be located in this valley so as to give the greatest good to the city with the minimum amount of inconvenience. Streets, crossing from one side of this valley to the other, must of necessity be carried on high-level bridges, and the presence of the railways underneath will not seriously add to their cost.

The manufacturing district between the Ottawa and Rideau Rivers is now and probably will remain in the vicinity of the Chaudiere Falls. The future extensions will depend on the location of such connections as Ottawa will have with the Georgian Bay Canal, but it is almost certain that such extensions will be to the westward. Railway facilities must, of course, be given to this manufacturing district, and the problem which now confronts the city is to so connect these two districts by rail as to give the maximum of efficiency to the railways with the minimum of inconvenience to the city.

Recommendations.—The following recommendations are made on an assumption that assurance can be had from the Dominion Government that the Georgian Bay Canal will be constructed in the reasonably near future.

1st—That the Rideau Canal through the city be moved from its present location to a new location in the western portion of the city approximately as shown on the maps, and that it be rebuilt to the same standard as the Georgian Bay Canal, and to a connection with it.

2nd—That a Railway Reserve be established from the deep cut on the Rideau Canal to the Sparks Street bridge. This reserve to consist of the canal bed and a strip 55 ft. wide, on the west side of the canal from the deep cut to Laurier Avenue, and all the canal lands, exclusive of streets, as shown on the plan, from Laurier Avenue to Sparks Street. This reserve south of Laurier Avenue would be 135 ft. wide sufficient for nine tracks, and should be used by all steam or electric railways (the Grand Trunk excepted) now or hereafter seeking entrance to Ottawa, on terms to be decided by the Railway Commission.

3rd—That the city give its consent to the construction of a tunnel between the Central and Union Stations.

4th—That the city purchase from the Grand Trunk Railway Company that portion of its Canada Atlantic Railway lying between the east side of Concord Street, in Ottawa East, and a point at or near Breeze Hill Avenue. That the land so purchased be resold for building purposes, or used for an east and west boulevard, to be extended eastward by way of Echo Drive and Gladstone Avenue, Tempelton or Somerset Street, to and across the Rideau River, and westerly in two branches, one to the Richmond Road and one to Carling Avenue.

5th—That the Grand Trunk join in the construction of the Wellington Street tunnel, or be given running rights through it on equitable terms. That its Parry Sound line be carried through the tunnel, over its Canada Atlantic main line from the west portal of the tunnel to a point near Laurel Avenue, thence with a curve to the right to join the present right-of-way near Bayswater Avenue.

6th—That no additional railways be hereafter permitted in the area bounded by the present Rideau Canal, Wellington and Preston Streets, except in the Railway Reserve.

7th—When found necessary by the growth of the city, the grades of the Canadian Pacific, Grand Trunk and Canadian Northern be raised at the crossing of the Rideau River at Hurdman's Bridge to permit of proper subways for streets, drives, etc.

The advantages to the city of such a rearrangement of the traffic arteries seem manifest.

Rideau Canal.—The change in the Rideau Canal would give a deep-draught modern harbor connected with the Georgian Bay Canal, and one which could be extended indefinitely up the present Rideau Canal as occasions demand. A definite location is not shown for this canal, as it would require extensive surveys to actually determine, but it would be somewhere in the vicinty of the route shown.

If the Dominion Government spend from $100,000,000 to $150,000,000 in building the Georgian Bay Canal, it should not hesitate to spend an additional one or two per cent. to get direct connection with the city of Ottawa—the greatest traffic centre between Georgian Bay and Montreal.

Such a modern, deep-draught canal, giving entrance to the city of ocean-going vessels, with branch railways on either bank, with a superabundance of power within easy transmission distances, and large deposits of iron within easy reach, should make a manufacturing centre second in future possibilities to none on the continent.

The present Rideau Canal could be closed with a dam in a line with Main Street and Robert Street, Ottawa East, and the portion between that and Dow's Lake used as a pleasure lake in summer and an open-air skating pond in winter. Streets could be carried over it wherever desired at low cost with a large saving to the city. This would at once increase the value of the land between the canal and river and make it available as a high-class residential district. All of this can be done at an actual saving to the city of over $500,000.

Placing the railways in the proposed reserve and through the tunnel would put them where they would be doing the very least damage possible to the city and giving the most effective service. It would firmly anchor the Canadian Pacific main line to the city of Ottawa. It would give the Canadian Northern, the Canadian Pacific, the electric lines, and all other railways, an entrance to the heart of the city, and convenient to the business and residential districts.

Removing the Grand Trunk Isabella Street line would naturally improve what should be a fine residential district, and materially increase real estate value in the neighborhood. The ultimate cost to the city should not be high. The cost of necessary subways, bridges, etc., estimated at $500,000, would be saved. A portion would be recouped by the sale of the land, and additional taxes from the increased values of real estate would materially reduce, if not completely wipe out, the balance.

The suggested change would give the Grand Trunk an equally good line. Some inconvenience would no doubt be found in the necessary change in the Grand Trunk yards, but the heart of a great city is not a fit and proper place for through yards such as these are. They should be located outside the city, as land in their present location is entirely too valuable for such use.

The proposed line could be laid with grades not to exceed [illegible] per cent., and there are many steeper grades on the branch. The [illegible] that a level crossing of the Chaudiere branch of the Canadian Pacific Railway would be necessary, and [illegible] than Perry [illegible] would be rather heavy.

It is a matter of great importance to the city that a Transcontinental Railway, such as the Canadian Northern, [illegible] and the proposed arrangement will give it as good facilities as either the G.T.R. or the C.P.R. and so put it into direct competition with those roads.

The advantages to the city of an Inter-Urban Electric Railway [illegible] of the city.

With the exception of a few unimportant spurs and the Canadian Pacific Railway through Mechanicsville, the proposed changes would eliminate all level crossings, and put Ottawa in this respect in a better position than any city on this continent.

Alternative.—The foregoing recommendations are based on a well-founded assumption that the Georgian Bay Canal will be built in a reasonable time, and if so built, that the Government will rebuild the outlet of the Rideau Canal as a branch of the Georgian Bay Canal to the same standard as the main canal.

If, on proper representation to the Government, it is found that this canal will not be built for many years, and if it is considered undesirable to close the outlet of the Rideau Canal, we recommend that a strip 107.5 feet in width be taken on the west bank of the canal for a railway reserve from the deep cut to Laurier Avenue, together with all canal lands, exclusive of streets, from Laurier Avenue to Sparks Street, and that the foregoing proposals be modified as shown on the accompanying plans. This modification consists principally in raising the proposed grade through the tunnel between eleven and twelve feet, and continuing the 0.4 per cent. grade to the Union Station, where a lift in the grade of the C.P.R. tracks of one to two feet would be necessary. The only objectionable feature in this recommendation to the railways would be the lift-bridge necessary across the canal at the deep cut.

Objections to Alternative Proposition.—It would be objectionable to the city, however, in a number of ways. It would take an unduly large portion of the driveway. The roof of the tunnel being so much higher would interfere with the new relief sewer at Kent Street, necessitating an inverted syphon. The new grade would be so high at Wellington Street as to make necessary a viaduct, and it would also be difficult to get overhead crossing on the streets between Lett and Broad. Should it be necessary to make a level crossing at Broad Street it is recommended that the railway line be deflected to the north of the station.

The new line to connect with the Interprovincial bridge, as shown on the plan, would occupy an undesirable position. It would pass under the post-office and destroy the Customs abode now between the post-office and canal.

A bridge would be required across the Rideau Canal opposite the new G.T.R. station to permit the present G.T.R. tracks to be connected with the tracks through the tunnel.

This alternative is only recommended in the event of the Georgian Bay Canal not being built, and does not in any way affect our recommendation as to the purchase and removal of the Isabella Street branch of the G.T.R. between Concord Street and Breeze Hill Avenue.

The following maps, plans, etc., accompany this report:—

Map of Ottawa, showing proposed changes.

Plan and profile of the proposed new line from the Central to the Union Stations.

Plan and profile of the alternative new line from the Central to the Union Stations.

Cross sections of the canal and driveway, showing lands to be taken for the proposed Railway Reserve.

Profile of the proposed new G.T.R. connection near Bayswater Avenue.

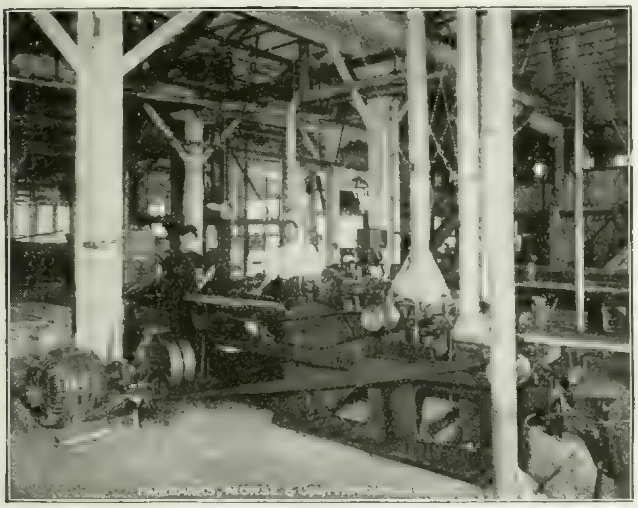
◆

From the British Columbia marine yards at Esquimalt will shortly be launched the steel steamship "Princess Maquinna," the largest vessel ever built in British Columbia waters. She will be employed in the coasting service of the Canadian Pacific Company. The engines and boilers are being built by British manufacturers. The vessel will be fitted as an oil burner.

ELECTRICAL EQUIPMENT OF A LARGE PLANING MILL.

By W. G. Hesser.

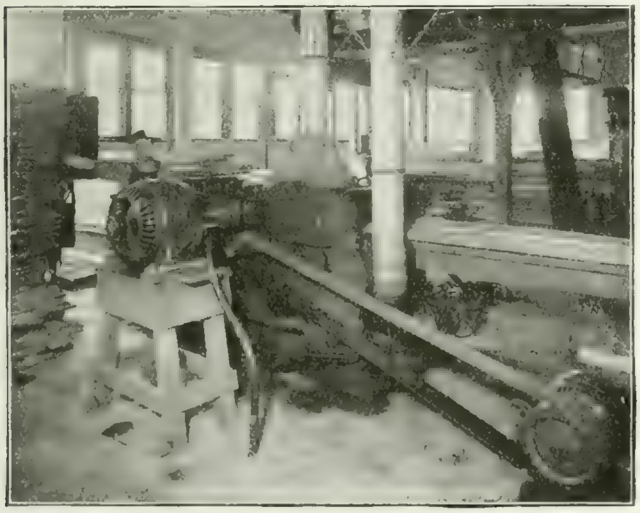
The Louisville Planing Mill and Hard Wood Flooring Co. is incorporated under the State laws of Kentucky for the purpose of manufacturing interior and exterior millwork, sash, doors and high-class stair work. The plant covers approximately 75,000 sq. ft., employs 90 men, and uses about 500,000 ft. of lumber annually, which is manufactured into various kinds of interior and exterior finish.



S. A. Wood Inside Moulder, Driven by 25 H.P. Fairbanks-Morse Motor.

This plant formerly operated its own power plant, but after being destroyed by fire, installed entire new woodworking machinery, operated by motors in the most up-to-date style of drive. Practically, all the machines are direct-connected as shown in the schedule following.

All motors are of the Fairbanks-Morse manufacture, and are 3-phase, 440-volt, 60-cycle. The total horse-power of motors installed is 294, of which 246 H.P. operates on individual drive, and 48 H.P. on group drive as shown in schedule.



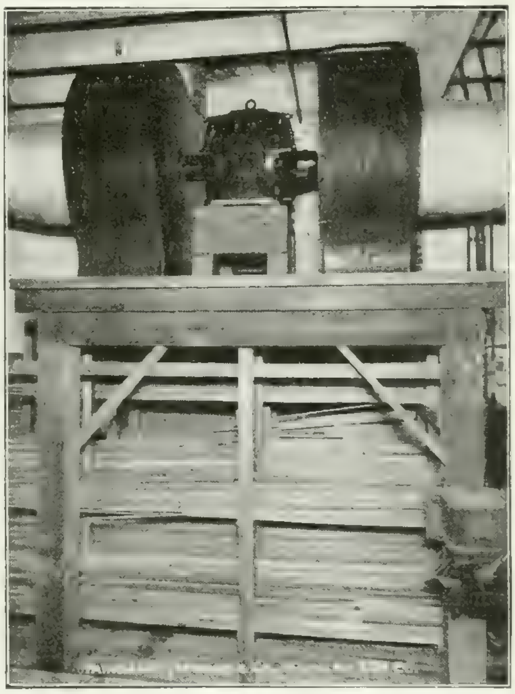
30 x 12 Double Surfacer, Driven by 20 H.P. and 7½ H.P. Fairbanks-Morse Motor.

The principal points of interest in connection with the electrical equipment of this plant is the extreme limit of speed, which is rather unusual for this class of motor. The planers have the motors directly attached to the cylinders, motors operating cylinders at a speed of 3,600 R.P.M., motors being directly connected through flexible couplings.

The double surfacer shown in cut is operated by a 20 H.P. motor at a speed of 3,600 R.P.M., direct connected to the upper cylinder through flexible coupling. The lower cylinders of this machine is belted to a 7½ H.P. 1,750 R.P.M motor.

While there are some few cases where the planer cylinders are operated by induction motors direct connected to cylinders, the direct connecting of motor to the cylinder of the double surfacer is entirely new in this territory, and is proving successful and is giving most excellent satisfaction.

The triple drum sander is driven by a 20 H.P. 570 R.P.M. motor, direct connected through flexible coupling to the countershaft on machine.



70″ Sturtevant Blower, Driven by 40 H.P. Fairbanks-Morse Double End Motor.

The 70″ Sturtevant low-power blower is operated by a 40 H.P. double end motor at 475 R.P.M., the shaft of motor being extended sufficiently for the fan-blades to be directly mounted on each end of shaft. This blower serves readily fifteen motors operating the different machines throughout the plant.

PORT MANN NOT TO BE OCEAN TERMINUS.

Port Mann will be the train assembling centre for the Pacific section, says Sir Donald Mann, at Vancouver. It will be an available centre for the distribution of coal and other freight into the interior, but it will not be our ocean terminus. "We will have our car repair shops and our assembling yards at Port Mann. In all the chief cities of Canada the railways are moving their assembling yards out some distance from the centre of the city. This is being done for several reasons. For one, inside property is too expensive, and another the smoke nuisance caused by shunting has caused many complaints. Most of the yards in Toronto are now five or six miles away from the Union Station. The Grand Trunk has moved its yards out to Mimico and we are moving out also."

COAST TO COAST.

Hamilton, Ont.—The population of this city, according to the [illegible] census, is [illegible], and the assessment $67,000,000.

Moose Jaw, Sask.—The work on the new C.P.R. dam on Manitoba Street East is progressing slowly, but steadily.

Fort George, B.C.—Recently discovered copper deposits found to the west of this town are causing considerable activity among miners residing here.

Winnipeg, Man.—Surveys have been started in order that the line of a proposed railway, to be known as Canada to the Sea, and extending from this city to the Gulf of Mexico, may be ascertained.

Vancouver, B.C.—Vancouver business men, including a few in the immediate surrounding country, have purchased pleasure yachts from Seattle parties, during the last two years, to the amount of over $250,000.

Montreal, Que.—The Canadian Pacific Railway has arrived at an agreement with the owners of the collier Helvetia, which was sunk in the St. Lawrence by the Empress of Britain on July 27th last, and have paid them the sum of $300,000 as compensation.

Ottawa, Ont.—A delegation representing the National Builders' Exchange waited upon Hon. W. T. White with a demand for an imposition of higher duty on every kind of building stone, save rough quarry blocks, coming in from the United States. Consideration was promised the delegates.

Ottawa, Ont.—The medical health department of this municipality recently added a dose of hypochlorite to the water about six times stronger than ordinarily prescribed, and advised the citizens to allow their taps to run in order that the mains might be sterilized. In conjunction with this all dead ends of mains were opened.

Nelson, B.C.—Experiments to show the existence of the platinum group of metals in the ores of the Granite-Poorman mine have been commenced by A. Gordon French and his son, Thomas French, before W. Fleet Robertson, provincial mineralogist. The demonstration is taking place at the Granite-Poorman mill and will probably occupy several days.

Montreal, Que.—The students attending McGill University are working to have a printing press installed for the printing of all the materials required by the various organizations. The faculty heartily endorsed the scheme, but were unable to make financial contributions; the students, however, are making every effort for the installation, and it is probable that such will be made in the near future.

Montreal, Que.—The management of the Canadian Ex[illegible] a new [illegible] transportation of expressage by installing to their service a number of electric trucks. Three are of two-ton capacity and two of one-ton capacity. They have a speed of from 10 to 12 miles an hour, which is more than double the efficiency of the old horse truck, [illegible] miles on a single charge. The large vehicles are 166 inches in length over all [illegible] The others are [illegible] inches in length and [illegible] in width, respectively.

Winnipeg, Man.—[illegible] tons of foodstuffs of all kinds [illegible] by the city health department [illegible] according to the [illegible] The largest [illegible] tons of [illegible] were the other [illegible] During the month the [illegible] were taken [illegible] standard [illegible] in [illegible] and all [illegible] taken for analysis.

Ottawa, Ont.—The Department of Trade and Commerce is issuing a circular letter to the principal boards of trades throughout Canada, asking for information on the possible development of natural resources in each locality. This information, when obtained, will be forwarded to the Imperial Royal Commission, which is now in session in England, with Hon. G. E. Foster as a member. The letter asks for details as to what industries could be suitably developed to work up raw materials which are already produced under profitable conditions, and as to existing obstacles in lack of capital, labor or means of transportation hitherto preventing development of these industries.

Montreal, Que.—A company has been incorporated under the Dominion Companies Act with the title, Siemens Company of Canada, Limited, who will act as sole representatives of the "Associated Siemens Companies" in Canada. The head offices of the new company will be situated in the Transportation Building, Montreal, and the existing offices in Toronto and Winnipeg will be taken over in due course as branch offices. Mr. Arthur S. Herbert, the present Canadian manager, has been appointed general manager; Mr. J. W. Brooks, manager of the Toronto office, and Mr. C. W. Stokes will continue, as hitherto, manager in Winnipeg.

Spokane, Wash.—Plans for the entertainment of delegates to the fifteenth Annual Convention of the American Mining Congress, which meets in Spokane, November 25th to 29th, include a big excursion to the Coeur d'Alene district in Idaho. Civic bodies and owners of the great lead producers will join in perfecting arrangements that will throw the entire district open to inspection. Trips will be made through the big tunnel of the Bunker Hill and Sullivan mine to some of the immense stopes now being mined; to the Morning and other properties of the Federal Mining and Smelting Company, and to the Hercules at Burke. It is expected that fully 500 visitors will be transported on the special train that is scheduled to leave the city early on the morning of the last day of the week. The return will be made either Sunday evening or Monday morning.

Niagara Falls, Ont.—An attempt was made to run a car over the new girder rails laid by the N.S. and T. on the curve at the corner of Erie Avenue and Bridge Street, with the result that one of the large St. Catharines cars was almost derailed. The test showed that the gauge of the track is too wide, the flange of the car wheel which should engage with the flange of the rail being more than an inch from true, and it is probable that the work will have to be done over. The track at that point is entirely completed, and the tearing up and relaying of the rails will involve great additional expense and loss of time. The rails are laid on steel ties, which are firmly embedded in concrete and brick, making it a difficult task to tear them loose. The rail is of the girder type, but different to the rail approved by the city council, in that the flange is narrower, leaving no room for free play of the car wheel flanges. The rail approved by the council had a wider flange and does not turn up at such an acute angle.

◆

CORRECTION.

In the issue of *The Canadian Engineer* of October 10th, page [illegible], in the article on "Briquetting Bituminous Coal," the statement was made that the Inverness Railway and Coal Company are installing a briquetting plant at Inverness, C.B. The context would lead the reader to believe that this plant is of Belgian manufacture. Our attention, however, has been drawn to the fact that this plant is of English make, and we are therefore glad to make this correction.

ESTIMATORS AND ENGINEERS.

Attention is called to the card on another page of this issue of a new engineering firm in Toronto.

The firm, Kortright & Greene, estimating and quantity engineers, will undertake estimating, taking off quantities from plans, foundation reports, supervising, and all branches of engineering for contractors and engineers. There is undoubtedly a great necessity here for such a firm, and the idea of technically trained men with practical experience in this field work, deserves the hearty encouragement of all. Both members of the firm have had wide engineering experience, which, combined with their technical training, thoroughly qualifies them for such work.

◆

PERSONAL.

MR. GEO. WRIGHT, City Engineer of London, Ont., has tendered his resignation to the City Council.

MR. WM. WORTHINGTON, B.A.Sc., has been appointed assistant engineer in charge of sewers for the city of Toronto.

Mr. E. M. HAMILTON is at Cobalt, engaged in completing the new Nipissing mill, which will shortly be put in commission.

DR. WILLIAM B. MUNRO, a native of Almonte, Ont., has been appointed Professor of Municipal Government at Harvard University.

DR. REGINALD A. DALY, a native of Napanee, Ont., has been appointed to the head of the Geological Department of Harvard University.

MR. JOHN P. WAGNER, sales-manager of the Consolidated Expanded Metal Companies, of Pittsburg, Pa., was a visitor to Toronto last week. It will be remembered that we noted in a recent issue that Messrs. Alfred Rogers, Limited, had obtained the exclusive selling-rights in Ontario for the expanded metal manufactured by the above firm. Mr. Wagner is a graduate of the University of Berlin, Germany, and has had a great deal of experience both in engineering design and construction. His work has been located both in Canada and the United States, the Simpson and Globe Buildings in Toronto being representative of the work done here.

John P. Wagner.

MR. G. I. EVANS, Mechanical Engineer of the Canadian Pacific Railway, Montreal, Que., has been appointed Superintendent of the locomotive shops at Angus, Montreal.

MR. J. D. SHIELDS, B.A.Sc., assistant engineer in charge of sewers for the city of Toronto, has tendered his resignation. He is going abroad for a short trip and will then look after his private interests which have necessitated the city's employ.

MR. G. HALL SCOTT, of London, England, and MR. ALBERT BROOKS, Montreal, representatives of Sir John Jackson, Limited, of Edinburgh, are in Victoria to look over the site and complete investigations on which to base a tender for the work on the breakwater.

MR. ALEXANDER ALLAIRE, until recently the manager of the Foundation Company, Limited, with headquarters at Montreal, has been appointed the manager for Western Canada of the Foundation Company, with headquarters at Winnipeg and New York. Mr. R. Chadwick, who was Mr. Allaire's chief assistant at Montreal, steps into the managership of the Montreal office. The western interests of the company have developed to such an extent that it became necessary to open the office in Winnipeg.

Alexander Allaire.

Mr. Allaire is of French descent, was born in Brooklyn, N.Y., and received his engineering education at the Stevens Institute of Technology at Hoboken, N.J. He graduated in mechanical engineering in 1901, and, after four years of practical experience in mechanical work, he joined the Foundation Company in the United States. About two years ago this company decided to start an independent Canadian company. A Federal charter was obtained, and Mr. Allaire was selected as manager of the Canadian company, with offices in the Bank of Ottawa Building, Montreal. A number of important works have been carried out by the Foundation Company, Limited, during the past two years, and the opening of the western office is a natural result of the increased amount of work which has developed in Western Canada.

DR. FRANCIS W. MERCHANT, director of Technical and Industrial Education of Ontario, has gone on an extended tour to Europe to study the technical-school systems in operation there.

MR. J. H. CUNNINGHAM, recently resident engineer, has been appointed superintendent of Extension colliery, in British Columbia, owned by the Canadian Collieries (Dunsmuir), Limited. He succeeds Thomas Russell, resigned.

MR. FRANK KOESTER, Consulting Engineer, has removed his office from 115 Broadway to 50 Church Street, New York. Mr. Koester recently finished the plans for a central asphalt repairing plant of 3,000 square yards daily capacity, for which he was retained by the Borough of Manhattan.

MR. W. F. TYE, President of the Canadian Society of Civil Engineers, has been appointed by the Government to investigate work done in the construction of the National Transcontinental Railway under the old commission. An investigation has been in progress for some months by

George Lynch Staunton, K.C., of Hamilton, and F. P. Gutelius, formerly with the C.P.R.

◆

OBITUARY.

MR. PETER ARNOT, proprietor of the firm of Peter Arnot and Son, is dead; he was well known in engineering and contracting circles. Among the important works executed by him are the sea walls at Sunnyside and the Exhibition grounds in the city of Toronto and the lake front at Hanlan's Point, Toronto Island. He was born at Ashburnham, near Peterboro, in 1849. He entered the contracting business in 1875 with Mr. Charles Robertson as partner; this firm was dissolved in 1905 and Mr. Arnot took over the entire business. He is survived by a widow and several children.

◆

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—General Section Meeting will be held in the Rooms of the Society, 413 Dorchester Street West, Montreal, Oct. 24th. Chairman, Henry Holgate.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE · Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are [illegible] other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan Kennedy. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-[illegible] October to April [illegible]

MUNICIPAL ASSOCIATIONS!

[illegible]

[illegible] ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible] Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] OF MANITOBA MUNICIPALITIES.—President, [illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, [illegible] Secretary, H. [illegible] Moore, [illegible] Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, [illegible] Hon. Secretary-Treasurer, J. E. Farewell, Whitby, Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, [illegible] Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. [illegible] Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. [illegible], Winnipeg, Man.; Hon. Secretary, [illegible], No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, [illegible], Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman. Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box [illegible], Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. [illegible], P.O. Box [illegible], Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
10-24	—Construction of about 7¾ miles of Combined Sewers, New Westminster, B.C. ....(P. & S.)	10-10
10-24	—Supply of 10,400 ft. reinforced concrete pipe, New Westminster, B.C. ....(P. & S.)	10-10
10-24	—Supply of 1,660 ft. of 48″ steel pipe, bends and specials, New Westminster, B.C. ...(P. & S.)	10-10

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work	Tenders Close	Issue of	Page
Calgary, Alta., warehouse	Oct. 25.	Oct. 10.	67
Cobourg, Ont., breakwater extension	Oct. 16.	Sept. 26.	67
Dunnville, Ont., water mains, etc.	Oct. 21.	Oct. 10.	72
Grimsby, Ont., public building..	Oct. 30.	Oct. 10.	67
Massett, B.C., pile wharf.....	Oct. 15.	Sept. 19.	71
New Westminster, B.C., sewers..	Oct. 24.	Oct. 10.	76
New Westminster, B.C., supply of reinforced concrete pipe..	Oct. 24.	Oct. 10.	76
New Westminster, B.C., supply of steel pipe, etc...........	Oct. 24.	Oct. 10.	76
Ottawa, Ont., designs for monument	Nov. 1	Aug. 1.	67
Paris, Ont., alterations to public building	Oct. 21.	Oct. 10.	67
Port Colborne, Ont., repair to headblock	Oct. 22.	Oct. 3.	67
Quebec, P.Q., grain elevator..	Oct. 21.	Sept. 19.	80
Seal Cove, N.B., breakwater wharf	Oct. 30	Oct. 10.	68
Seymour Arm, B.C., pile bent wharf	Oct. 29.	Oct. 10.	67
St. Pierre les Becquets, P.Q., wharf, approach and dredging of berth for headlock..	Oct. 15.	Sept. 19.	72
Toronto, Ont., storm overflow sewer	Oct. 22.	Oct. 3.	76
Toronto, Ont., sewer with connections	Oct. 22.	Oct. 10.	76
Victoria, B.C., breakwater, Victoria Harbor	Oct. 15.	Sept. 5.	78
Vancouver, B.C., installation of light standards	Oct. 17.	Sept. 26.	68
Vancouver, B.C., department store	Oct. 24.	Sept. 26.	68
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Whitby, Ont., esplanade wall...	Oct. 22.	Oct. 3.	67
Yorkton, Sask., electrical plant..	Oct. 31.	Oct. 3.	76

◆

TENDERS.

Cap-a-l'Aigle, P.Q.—Construction of an extension to wharf: Tenders to be received until November 11th, 1912, by R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., may be seen at this office, also at the offices of A. R. Decary, Esq., district engineer, Post Office Building, Quebec; J. L. Michaud, Esq., district engineer, Merchants Bank Building, St. James Street, Montreal, and on application to the postmaster at Cap-a-l'Aigle, Que.

Ile aux Coudres, P.Q.—Extension to wharf: Tenders to be received until November 5th, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans and specifications, etc., may be obtained at this department, also at the offices of A. R. Decary, Esq., district engineer, Post Office Building, Quebec; J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal, and on application to the postmaster at Ile aux Coudres, Que.

London, Ont.—Tenders for constructing and erecting a 270 foot span pin-connected Petit truss highway bridge with necessary approach spans, concrete piers and abutments complete, will be received at the office of the city clerk until November 13th, 1912. Plans, etc., at the office of the city engineer. W. E. Robinson, chairman No. 2 committee; George W. Wright, city engineer. (See advt. in Canadian Engineer.)

Ottawa, Ont.—Tenders will be received up to noon on Tuesday, the 12th November, 1912, for the following descriptions of timber: Birch, cedar, spruce, pine, oak, fir, teak, all being for delivery at H.M.C. dockyards, at Halifax, N.S., and Esquimalt, B.C. Forms of tender may be had by application to the Naval Store Officer at either dockyard,, and the office of G. J. Desbarats, Deputy Minister of the Naval Service, Department of the Naval Service.

Quebec, Que.—The Quebec Harbor Commissioners have extended the time for the reception of the tenders for a grain elevator until November 20th, 1912. Raoul Renault, secretary-treasurer. (See advt. in Canadian Engineer.)

Regina, Sask.—Tenders for the construction of drain through Townships 13 and 14, will be received until October 29th, 1912, by H. S. Carpenter, acting deputy minister, Regina, at whose office copies of plan, etc., may be had.

Salmon Arm, B.C.—The engineer has been authorized to call for tenders for the erection of the power house, to be either brick or cement.

Salmon Arm, B.C.—Tenders for the material required for the water supply system will be received until October 15th, at the office of the city clerk, Salmon Arm. Plans, etc., at the office of Messrs. Dutcher, Maxwell & Co., Suite 618 Rogers Building, Vancouver, B.C.

Salmon Arm, B.C.—Tenders for the labor required in the construction of the pipe line and distribution systems for the water supply of this city will be received until October 15th, 1912, at the office of the city clerk. Plans, etc., at the office of Messrs. Dutcher, Maxwell & Co., Suite 618 Rogers Building, Vancouver, and city clerk's office, Salmon Arm, B.C.

St. Boniface, Man.—Tenders for the supply and erection of a variable speed motor and motor-driven pump capable of delivering either 1,000,000 or 1,500,000 imperial gallons per 24 hours, will be received until November 8th, 1912. Plans showing layout and available space may be obtained at the city engineer's office. J. B. Cote, city clerk. (See advt. elsewhere in Canadian Engineer.)

Toronto, Ont.—Tenders addressed to Chairman, Board of Control, City Hall, will be received until noon of October 22nd, 1912, for the construction of asphalt, bitulithic and concrete pavements, concrete curbs, and concrete walks on a number of streets. Specifications may be seen and forms of tenders obtained at the office of the Commissioner of Works, Toronto. G. R. Geary (Mayor), chairman, Board of Control.

Vancouver, B.C.—Tenders will be received until October 15th, 1912, for the construction of that portion of the Canadian Northern Pacific Railway extending from Kamloops, B.C., to points at Vernon, Kelowna and Lumby, B.C., a total distance of approximately 131 miles. The contracts will be let in two divisions, as follows: Kelowna to Vernon and Lumby, 48 miles; Vernon to Kamloops, 83 miles. Tenders to include clearing, grubbing, grading, bridges, trestles, culverts, masonry and fencing. Plans, etc., may be obtained at the office of Mackenzie, Mann & Co., Limited, 719 Metropolitan Building, Vancouver, B.C.

Winnipeg, Man.—Tenders for the manufacture and delivery f.o.b. cars city yards, of a quantity of 20-inch O.D. steel drive pipe with couplings, will be received until October 17th, addressed to the chairman, Board of Control. M. Peterson, secretary, Board of Control office, Winnipeg. Specifications, etc., at the office of the city engineer, 223 James Avenue.

Winnipeg, Man.—Tenders addressed to the chairman, Board of Control, will be received until November 13th, 1912, for the manufacture and delivery of the following apparatus and supplies for the fire department: 2 horse-drawn hose wagons; 2 60-h.p. motor hose wagons; 5,000 feet 2½-inch cotton rubber lined fire hose; 600 feet 3½-inch cotton rubber lined fire hose; 30 fire alarm boxes. Specifications, etc., at the office of the chief of the fire department, central fire station.

Yorkton, Sask.—Tenders for the purchase of a combined automobile truck and extension ladders for fire purposes, will be received by the Fire and Light Committee, until November 4th.

CONTRACTS AWARDED.

Barrie, Ont.—Mr. W. A. Ton, of Collingwood, has been awarded the contract for the alteration and adapting of the public building at this place. Cost will be $19,000.

Brockville, Ont.—A contract for alterations to the Brockville post office, costing $1,450, has been awarded to Mr. Fred W. Clow.

Messrs C. L. McCool and T. H. Moffatt have been awarded the contract for constructing the timber superstructure of a wharf here. The cost will be $15,200.

Dalhousie, N.B.—The Northern Dredging and Construction Co., Limited, will do dredging at this point to the ex- [illegible]

Edmonton, Alta.—Mr. W. R. Eastwood has been awarded a contract to erect a temporary school building at a cost [illegible]

Mr. George Watson has been awarded a contract to erect a temporary school building at a cost of $3,800.

Fort William, Ont.—Contracts for the construction of sewers have been awarded as follows: Edward St. sewer, Messrs. Alto and Jacobson, for $3,595. Francis St. sewer, Messrs. Stewardson Bros., for $1,390.

Kingston, Ont.—Messrs. Jago and Harris, Toronto, have secured the contract for the erection of the thirty mechanics' houses for the Kingston Realties, on its property on Stephen Street.

Little Current, Ont.—The Foundation Company, Limited, Bank of Ottawa Building, Montreal, P.Q., have been awarded the contract for the sub-structure of a bridge from Manitoulin Island to Goat Island, for the Algoma Eastern [illegible] Work has already commenced and it is expected that the foundations will be ready for the erection of steel in the spring of 1913.

Moose Jaw, Sask.—[illegible]

Niagara Falls, Ont.—[illegible]

Nelson, B.C.—[illegible]

Ottawa, Ont.—[illegible]

Ottawa, Ont.—[illegible]

Ottawa, Ont.—The federal cabinet have awarded a contract for the following rolling stock to the Canadian Car and Foundry Company, of Montreal: 500 additional steel-framed box cars; price, $1,210 each. 100 Hart convertible cars of 40 tons capacity. 100 steel underframed platform cars of 80,000 pounds capacity each; price, $1,070. Fifty Otis all-spring dump cars; 20 refrigerator cars; price, $2,058.50 each. One 8,000-gallon tank car; price, $2,695.

Ottawa, Ont.—The federal government have awarded a contract to the Preston Car and Coach Company, Preston, Ont., for the supply of three baggage cars at a cost of $7,500 each. These are for use on the Intercolonial Railway.

Ottawa, Ont.—The municipal board of control have awarded a contract for the supply and erection of a new intake pipe for this city to Messrs. Laurin and Leitch, of Montreal.

Penticton, B.C.—The contract for the construction work on the railway bridge over the Okanagan River has been awarded to Messrs. Butterfield and Armstrong, of Seattle. It will be of steel and will be supported by concrete pillars.

Salmon Arm, B.C.—The city council have awarded the following contracts in connection with electric light power plant: That of the Canadian Westinghouse Company for the supply and erection of the field generator, etc., and the Edmond P. Kay Company, Limited, for the Diesel oil engine.

Summerside, P.E.I.—A contract has been awarded to the Dominion Dredging Company for 150,000 cubic yards of dredging at this point.

Toronto, Ont.—At a meeting of the Property Committee of the Board of Education the following tenders were accepted: Malvern High School, mason work, $23,000, G. T. Gates; carpenter work, $11,600, Cross and Le Drew; plastering, $3,000, Beaver & Co.; roofing, $973, A. Mullhu, Limited; iron stairs, $3,600, Canadian Ornamental Iron Co.

Vernon, B.C.—The contract for a new drill hall has been awarded to Mr. T. E. Crowell, the tender being for $16,811.

Victoria, B.C.—The municipal engineering department acting under instructions from the civic authorities will secure an outfit capable of indicating the conditions of the underground water and gas mains. It is understood that considerable damage has been caused by electrolysis. Ald. Gleason and the city electrician were appointed a committee to secure the apparatus.

RAILWAYS—STEAM AND ELECTRIC.

Guelph, Ont.—A citizen of this city is endeavoring to complete a proposition whereby the interests represented by him will build an electric road from Guelph to Puslinch Lake and Hespeler and the municipal council of this city will hand over the franchise of the railway now operating within the confines of Guelph.

LIGHT, HEAT AND POWER.

Brockville, Ont.—Mr. H. Acres, engineer of the Ottawa Hydro-Electric Commission, after an inspection of the Long Sault dam proposition, has expressed himself as pleased with the situation.

Cranbrook, B.C.—Mr. D. S. Grosscup, of Tacoma, U.S.A., and a party from the United States, have opened negotiations with the [illegible] of the Bull River Power Plant with a view of purchasing the plant.

False Creek, B.C.—The Dominion Government are making arrangements for the erection of a beacon light at this point.

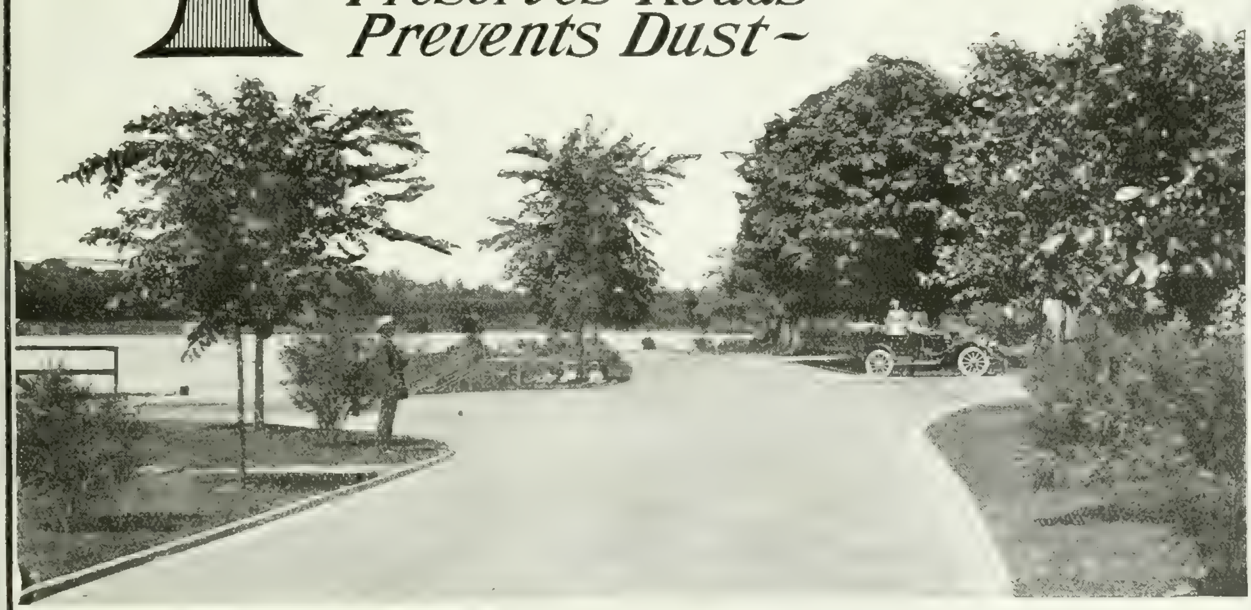
Lindsay, Ont.—The management of the Seymour Power Company are taking steps to interest the farmers of this district in the application of electricity to their daily work.

Toronto, Ont.—The municipal fire and light committee has [illegible] a grant of $[illegible] to be used in the extension of the lighting system of the city.

Township of Yarmouth, Ont.—Seven hundred farmers of this township have petitioned the hydro-electric commission for Niagara power.

Tarvia

Preserves Roads
Prevents Dust~



Section of Government Parkway, Ottawa, Canada, treated with Tarvia B.

The Property Owners' Investigation.

IN the City of St. Thomas, Ont., the property owners on Gladstone Avenue contemplated petitioning the City Council to improve the roadways. They commissioned one of their number to visit various American cities, inspect pavements and make a report. Their investigator, Mr. E. A. Horton, visited various cities in New York and New Jersey. In his report he made the following statements:

> "I saw a 'Tarvia X' road in Rochester which extends from the city to the lake front, a distance of about six miles. It had been in use for eighteen months, and when I saw it, it was in excellent condition, with heavy traffic over it every day. I........inspected a piece of road in Newark........the surface when finished was smooth, and to my mind was one of the finest pieces of road it was my privilege to see. We then inspected another piece of 'Tarvia X' which had been done by the Road Commission two years ago........Constant heavy traffic passes over this road every day, and trucks have loads of from 6 to 8 tons. Steel-tired drays were used with most of their heavy traffic. This piece of road, as I saw it, did not show any wear whatever, and was apparently in as good condition as when it was put down.
>
> "I did not confine my attention to Tarvia roads as I saw (here he mentioned five of the commonest types of road treatment) and every other kind of road that is known.
>
> "I must say after making enquiries from people who were in no way interested, nor did they know I was seeking information, that everyone had a good word to say for the Tarvia road. I have no hesitation in recommending it for use on our street, and at the estimate cost that has been given us, after seeing the many pieces of road that I have seen, I think it is the cheapest road that can be built."

The foregoing is quoted from the St. Thomas, Ont., Journal on February 20th, 1912. Since that date Gladstone Avenue has been constructed with Tarvia X.

Anyone who will investigate the road problem with the same thoroughness will reach similar conclusions. Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B" (applied cold) for dust prevention and road preservation.

Booklet describing the latest developments in methods for building tarviated roadways and pavements will be sent free on request. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

Province of Ontario.—The following are the new rates of the Hydro-Electric Commissioners to be effective in a few weeks:

	Old Rate.	New Rate.
Toronto	$1[illegible]	$10.50
London	28.00	27.00
Stratford	32.00	32.00
Guelph	25.00	23.50
Seaforth	41.00	41.00
Mitchell	38.00	38.00
St. Thomas	32.00	32.00
Woodstock	26.00	24.00
Ingersoll	28.00	27.00
Tillsonburg	32.00	32.00
Norwich	34.00	34.00
Beachville	33.89	32.00
Berlin	25.00	24.00
Waterloo	26.00	25.00
New Hamburg	32.00	32.00
Baden	37.00	37.00
Preston	25.00	23.50
Galt	25.00	24.00
Hespeler	26.00	25.00
St. Marys	38.00	35.00
Dundas	16.50	16.00
Hamilton	17.00	16.50
Watertown	37.50	30.00
Port Credit	36.79	32.00
Brampton	29.00	29.00
Mimico	30.74	30.00
Weston	34.00	30.00

Victoria, B.C.—The firm of Bloedel, Stewart & Welch, Limited, of Vancouver, is applying for a license to store or pen back eight hundred thousand acre feet of water from Green Lake and tributaries; also for a license to take and use two thousand cubic feet of water per second out of Green River and a like amount from Cheakamus River. The water is to be used for power purposes.

◆

GARBAGE, SEWAGE AND WATER.

Bowmanville, Ont.—The ratepayers voted in favor of expending $150,000 on the installation of waterworks and sewage disposal plant. Mr. Willis Chipman, Toronto, is engineer for the municipal council.

Galt, Ont.—Mr. Willis Chipman, consulting engineer, Toronto, in a report to the municipal council regarding the sewage disposal problems of this town, recommends the construction of a trunk sewer along the bank of the Grand River.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Coquitlam, B.C.—The management of the Western Canada Lumber Company are planning to erect a large addition to [illegible] the estimated cost of this work.

Galt, Ont.—Messrs. T. Allison and Sons will erect a two-story business block in this town; it will be of brick, 52 ft. by 35 ft.

North Battleford, Sask. [illegible] Company of England, capitalized at eight million dollars, will install a plant [illegible]

Port Arthur, Ont.—The Shelvin-Clarke Co. will erect a [illegible] Estimated cost, $30,000. The plant will be operated under the [illegible]

Toronto, Ont. [illegible]

Vancouver, B.C. With the completion of their three-[illegible]

Victoria, B.C. [illegible]

Victoria, B.C. [illegible]

Watrous, Sask.—Mr. Norman Plass, according to report, will erect a bottling works, evaporating plant, and chemical laboratory at a cost of $25,000.

Welland, Ont.—Mr. Sam. Shapiro, of Hamilton, Ont., will erect a new hotel in this town at a cost of $75,000.

◆

BRIDGES, ROADS AND PAVEMENTS.

Point Grey, B.C.—The municipal council of this town have decided to experiment in the matter of sidewalks by laying one or more constructed of asphalt.

Winnipeg, Man.—A number of the ratepayers will present a petition to the council asking that a bridge be erected over the Red River at the foot of Market Street East.

◆

FIRES.

High River, Alta.—Fire destroyed the frame building owned by Shaw & Company, and occupied by John Brackley, with a loss of $4,000 on the structure, and $20,000 on the contents.

Vancouver, B.C.—The drykiln and a quantity of lumber, the property of the Vancouver Lumber Company, were destroyed by fire with a loss of $45,000.

◆

CURRENT NEWS.

Province of British Columbia.—It is reported that the management of the British Columbia Telephone Company will spend the sum of $1,000,000 in the near future on the extension and improvement of their plant and system. There is considerable building included in the programme. Mr. George H. Halse is the manager.

Carmangay, Alta.—The ratepayers of this town voted in favor of raising $10,000 for the purpose of installing a complete system of electric light and water facilities. Dr. Wilson, town clerk.

Halifax, N.S.—The Board of Firewards have recommended the purchase of a La France auto fire engine at a cost of $10,800. Other machines and prices to be considered were: Piston—Robinson (a), $12,150; Robinson (b), $11,475; Knox, $10,950. Rotary—La France, $10,800; Simones (a), $10,000; Simones (b), $10,250; Simones (c), $11,000; Webb, $10,200; Argyll, $5,500.

Moose Jaw, Sask.—Mr. F. S. Baker, secretary, Provincial Association of Architects, Traders Bank Building, Toronto, and the municipal clerk of Moose Jaw, will furnish particulars regarding the competition for plans of a proposed city hall.

New Westminster, B.C.—The gas company are the winners of a recent law suit brought by the municipal council in an effort to have their franchise repealed.

Ottawa, Ont.—The municipal council are considering the purchase of a motor tractor to displace three horses now employed to haul a heavy steam fire engine.

Port Dover, Ont.—The ratepayers voted against a by-law which had been framed to grant a franchise to the Dominion Gas Company.

Toronto, Ont.—Mr. R. Dunbar, 347 King Street West, Toronto, will furnish particulars of an architectural competition regarding plans for an Institutional Building for the National Sanitarium Association. The first prize is $400, the second $200.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending September [illegible]th, 1912.

A Birmingham firm manufacturing iron soil pipes desire to appoint agents in Western Canada.

From the Branch for City Trade Inquiries, 73 Basinghall Street, E.C.:

A Lancashire manufacturing company desires to represent upon a commission basis, Canadian manufacturers of [illegible] products and similar goods.

A Belgian firm ask to be placed in correspondence with Canadian importers of zinc and spelter, lead sheets, cement, boiler plates, and also building supplies.

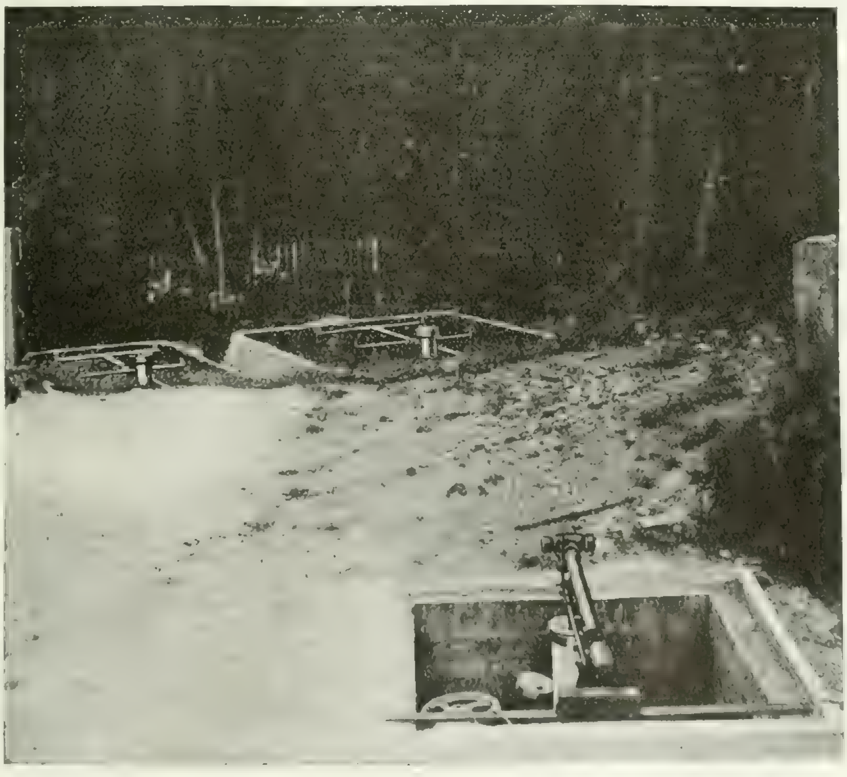
48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.



INSTALLATION OF "**PULSATOR RAM**" SYSTEM AT TANDRIDGE, SURREY.

The Engineer, T. C. Barratt, Esq., writes : "The fixed spray nozzles and pulsating rams supplied by you at Tandridge works last winter gave a very efficient distribution over the surface of the filter."

THE
"PULSATOR-RAM"
SYSTEM
OF DISTRIBUTING SEWAGE
BY FIXED SPRAYS.

KEEPS THE JETS CLEAR.
INCREASES AREA COVERED.
THE NEAREST APPROACH TO PERFECTION IN UNIFORMITY OF DISTRIBUTION YET ATTAINED.

TUKE AND BELL
LIMITED
69 LEADENHALL STREET,
LONDON, E.C.

AGENTS FOR CANADA,

LAURIE AND LAMB
211 BOARD OF TRADE BUILDINGS,
MONTREAL.

ELECTRICAL INSULATING CONDULETS.

The Canadian General Electric Company, Toronto, are now manufacturing condulets for the protection of electric light and power cables; and in this connection have issued a booklet under the tittle of "Type N Condulet" for stucco work and other decorative positions. This book is not intended to act as a catalogue but contains much information of value to persons engaged in this class of illumination.

◆

SUCTION GAS PLANTS.

The suction gas plant consisting of a gas engine and a gas producer appears to be gaining considerable popularity in Western Canada. The British-Canadian Engineering and Supply Company, Limited, 122 Phœnix Block, Winnipeg, are agents for the Ruston-Proctor producer gas engine and plant, and they have supplied a number of towns throughout the middle west with their equipment. The producer and the engine form together a complete system, the suction of the piston in the engine cylinder drawing from the producer the amount of gas the engine requires. The plant is self-contained, no steam boilers being required and the initial cost of installing the plant is small. The British-Canadian Engineering and Supply Company, Limited, have been awarded contracts for the supplying and erecting of electric lighting plants in the following towns, for Ruston-Proctor producer gas engines and plant, together with all electrical equipment both in and outside the power-house: Gull Lake, Sask., 64 brake h.p.; Hanley, Sask., 50 brake h.p.; Outlook, Sask., 72 brake h.p.; Wadena, Sask., 50 brake h.p.; Rapid City, Man., 50 brake h.p.

◆

A NEW CANADIAN COMPANY.

The C. O. Bartlett & Snow Company, of Canada, Limited, have been granted a Dominion charter to deal in, manufacture and install elevating and conveying machinery, power transmission machinery, engines, boilers, hoisting machiney, brick machinery, garbage reduction and destruction machinery, paint machinery, grain and cereal machinery, and to carry on a general line of engineering, manufacturing and construction work.

The head office of the company has been opened at 282 St. Catherine Street West, Montreal, with Herbert S. Hersey general manager.

[illegible] business of the C. O. Bartlett & Snow Company, of Cleveland, O., and although the connection between the Ohio company and the Canadian company will be very close for some time, the organization and management are entirely [illegible]

The Canadian company has been granted Canadian rights to all patents and licenses owned by the Ohio company and this, taken in connection with the vast engineer- [illegible]

◆

[illegible]

NEW INCORPORATIONS.

Neville, Sask.—Trader's Elevator Co., $25,000.

Saskatoon, Sask.—Interior Lumber Co., $23,000.

Macleod, Alta.—Macleod Face Brick Co., $100,000.

Lethbridge, Alta.—Lethbridge Laundry Co., $75,000.

Invermere, B.C.—Invermere Contracting Co., $50,000.

North Vancouver, B.C.—Nelson Tent and Awning Manufacturing Co., $25,000.

Haileybury, Ont.—Bouza Mines, $2,000,000. B. G. Killoran, A. McMillan, W. E. Wilson.

Meaford, Ont.—Georgian Bay Elevator Co., $100,000. G. W. Mason, F. C. Carter, C. F. French.

North Bay, Ont.—Expanse Lumber Co., $100,000. J. R. Moffat, R. M. Rattray, J. M. McNamara.

Quebec, Que.—La Compagnie Electrique Lamartine, $1,000,000. C. A. Paquet, J. C. Paquet, J. H. Paquet.

Alexandria, Ont.—Schell Foundry and Machine Co., $100,000. J. T. Schell, J. C. S. Schell, J. A. Macdonell.

Russell, Ont.—Williams Chemical Company, $100,000. W. F. Kenney, C. E. McCaffery, Russell; W. C. Howell, Ottawa.

Vancouver, B.C.—Indian River Gravel Co., $50,000. Canadian Northwest Steel Co., $50,000. Dominion Gas Co., $200,000.

St. Mary's Ferry, N.B.—Moore Telephone Co., $3,400. D. R. Moore, Stanley; C. S. Goodspeed, St. Mary's; B. M. Mullin, St. Mary's.

Ste. Therese de Blainville, Que.—Dominion Brick Co., $75,000. N. Robillard, St. Martin, N. Dagenais, Ste. Therese de Blainville; J. O. Lacroix, Montreal.

Montreal, Que.—Canada Cement Transport, $50,000. W. J. Shaughnessy, C. G. Heward, A. Charters. Lepage Marble Works, $50,000. E. Lepage, O. Lepage, J. Murphy.

Montreal.—Cotev Motor Truck and Auto Co., $400,000. R. D'Arcy, W. Vass, G. T. Maskell. Public Utilities Construction Company of Canada, $50,000. E. A. Barnard, L. C. Herman, J. R. Law.

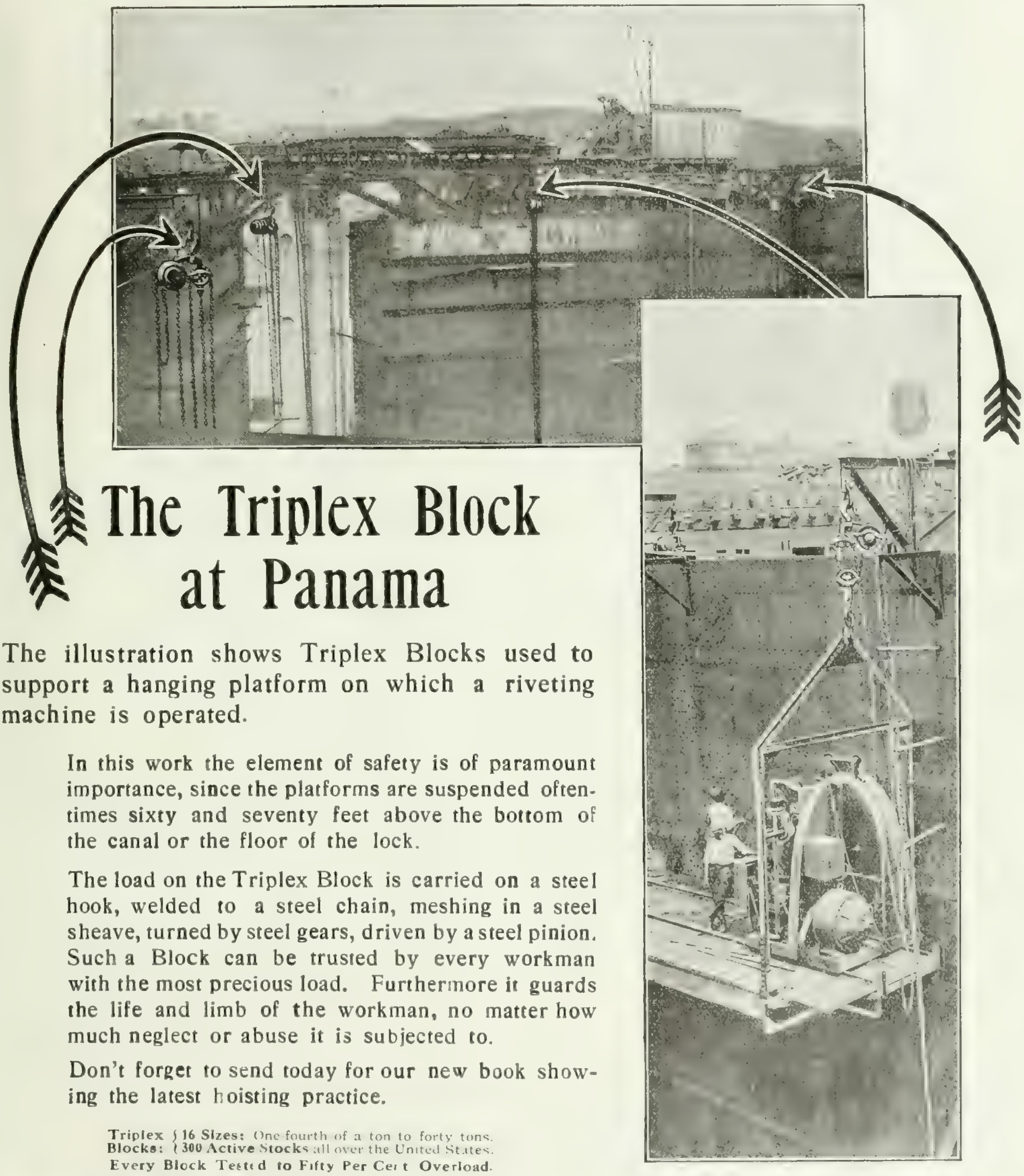
Victoria, B.C.—Automatic Call Company of the Dominion of Canada, $300,000. Victoria, Vancouver Development and Construction Co., $500,000. Great Western Printing and Publishing Company, $10,000.

Toronto.—Canadian Incubator Co., $40,000. D. Henderson, W. H. McGuire, G. F. Rooney. Standard Steel Construction Co., $200,000. J. P. MacGregor, A. MacGregor, A. E. Wilson. Dominion Specialties, $50,000. C. F. Ritchie, J. H. Oldham, E. J. Phelan. City Construction Co., $40,000. A. G. Robertson, W. Leslie, A. Smith.

Toronto.—Rochester Mines, $1,000,000. J. Poucher, H. Williams, J. H. McKnight. Gray Manufacturing and Machine Co., $24,000. A. Gray, Port Credit; J. Gray, R. Gray, Toronto. Price-Cumming Brick Company, $100,000. D. Henderson, W. H. McGuire, G. F. Rooney. Ontario Solid Silver [illegible] W. [illegible], P. R. Morris, H. Obee. [illegible] Pulp and Paper Mills, $[illegible]. G. H. Kilmer, J. [illegible], W. H. Irving.

Toronto.—Parker's Dye Works, $100,000. G. Price, F. R. Harvey, [illegible] Fuel Saving Company, $250,000. [illegible] Porter, J. B. [illegible]. Northern Brick Company, $[illegible]. [illegible], N. P. Dalziel, G. Ruel. Toronto Electric Motor Car Company, $300,000. J. A. [illegible] Electrical Utilities, [illegible], R. A. Hunter. Hayden Gold Mines, $2,000,000. J. G. Shaw, J. Montgomery, H. P. [illegible] Tile Manufacturing Company of [illegible], D. M. [illegible], [illegible] Black, A. A. Adams. Canadian Manufacturers' Agency, $20,000. F. [illegible] Iron Works, $100,000. J. H. Malone, J. E. Russell, C. H. Cunningham. Beaver Auxiliary Mines, $500,000. R. McKay, G. Grant, G. A. Urquhart. Sterling Silver Mines, $1,250. W. M. Wallace, J. C. Stewart, R. B. Law. Forsyth Pulverizer, $250,000. W. F. [illegible] Bulldog Tire Company, $[illegible]. W. G. Moffatt, A. H. Crichton, W. J. Tub- [illegible] H. Riley, D. A. Mac- [illegible] Brick Company, $[illegible] [illegible] Manufacturing Company, [illegible], C. W. Plaxton, W. J. Quinn. Black [illegible] G. M. Kelley, [illegible] D. W. Cooper.

THE TRIPLEX BLOCK



The Triplex Block at Panama

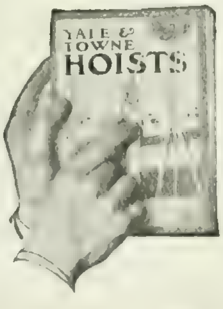
The illustration shows Triplex Blocks used to support a hanging platform on which a riveting machine is operated.

In this work the element of safety is of paramount importance, since the platforms are suspended oftentimes sixty and seventy feet above the bottom of the canal or the floor of the lock.

The load on the Triplex Block is carried on a steel hook, welded to a steel chain, meshing in a steel sheave, turned by steel gears, driven by a steel pinion. Such a Block can be trusted by every workman with the most precious load. Furthermore it guards the life and limb of the workman, no matter how much neglect or abuse it is subjected to.

Don't forget to send today for our new book showing the latest hoisting practice.

Triplex Blocks: { **16 Sizes:** One fourth of a ton to forty tons.
{ **300 Active Stocks** all over the United States.
Every Block Tested to Fifty Per Cent Overload.



THE CANADIAN FAIRBANKS-MORSE CO., Limited *SOLE AGENTS FOR CANADA*

MONTREAL ST. JOHN OTTAWA TORONTO WINNIPEG
CALGARY SASKATOON VANCOUVER VICTORIA

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date [illegible] for ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

17630—October 2—Authorizing C.P.R. to take certain lands for the purpose of enlarging its station grounds at St. Pie, Co. Bagot, Quebec, containing an area of [illegible] hundred and eighty-eight (1,[illegible]88) feet.

17631—October 2—Authorizing C.P.R. to construct extra track across road allowance between Sec. 3, Tp. 15, R. 15, W.P.M., and Sec. 33, Tp. 14, R. 15, W.P.M., at Neepawa, mileage [illegible] on the Minnedosa Subdivision, Manitoba.

17632—September 25—Authorizing Kingston and Pembroke Ry., to construct spur for the North American Smelting Co., Ltd., in city of Kingston.

17633—October [illegible]—Authorizing Toronto Suburban Railway Company to contsruct across the line of the C.P.R., at Mimico River, in Lot 8, Con. B, Tp. Etobicoke, Co. York, Ont., by means of an undercrossing.

17634—October 4—Authorizing G.T.R. to reconstruct four (4) bridges, namely, over Little Sable River, mileage 121.08, Hamilton Creek, mileage 151.18, O'Grady's Creek, mileage 153.28 and over stream, mileage 159.52, on its Middle Division.

17635—September [illegible]—Granting leave to Ottawa Electric Company, to cross, with its wires, the line of C.P.R., at Carleton St., Riverside Park.

17636—October 1—Approving location Toronto, Hamilton and Buffalo Railway Company's passenger station at Silverdale.

17637—October [illegible]—Authorizing Alberta Interurban Ry. to construct across tracks of C.P.R., Calgary-Edmonton Branch, Sec. 13, Tp. 24, R. 1, W. 5 M., [illegible] Southern Alberta, Alta., by means of overhead crossing.

17638—October 4—Approving C.N.O.R. plan of span to replace present timber trestle over Montreal Terminal Ry., Bout de L'Ile, mileage 12 from Montreal, Parish of Pointe aux Trembles, Quebec.

17639—September 26—Authorizing C.N.O.R. to cross tracks of Algoma Eastern Ry. Co., with its main line extension to the Algoma Eastern Ry., on Lot 6, Con. 4, Tp. of McKim, District of Sudbury.

17640—October [illegible]—Extending, until 15th December, 1912, the time within which C.P.R. complete spur for the American Lumber Co., at Sumas Junction, B.C.

17641—October 4—Approving C.P.R. plan showing replacement of double tracking of existing bridge by 30 ft. D. P. G. Span, at bridge 63.3, Lac Du Bonnet Subdivision.

17642—October 4—Authorizing C.P.R. to construct 2 industrial spurs in Block No. 1, which adjoins North Boundary of N.W. ¼ Sec. 34, Tp. 23, R. 1, W. 5 M., city of Calgary, Alta.

17643—October 4—Approving location and style of G.T.R. station at Gobles, Ontario.

17644—October 4—Authorizing G.T.R. to construct branch line for W. Gracey & Sons, town of Barrie, Co. Simcoe, Ontario.

17645—October 4—Authorizing G.T.R. to construct siding for Queen City Oil Co., town of Barrie, Ont.

17646—October 3—Authorizing G.T.P. Branch Lines Company to carry traffic over its Regina-Boundary Branch, Sask., between Regina, mileage 0, and [illegible], mileage [illegible].

17647—October 4—Authorizing city of St. Catharines to construct Berryman St. [illegible] tracks of G.T.R. and N. St. C. & T. Ry.

[illegible] September 4th, 1912, which required derails to be placed on line of B.C. Electric Co., and interlocking [illegible] Vancouver, [illegible] and Southern Ry. Co. [illegible] and cars operating on Nanaimo St., be brought to full stop before making the crossing, at First Ave., Vancouver, B.C.

[illegible] Esquimalt & Nanaimo Ry. to construct [illegible] Victoria.

[illegible] Esquimalt & Nanaimo Ry. to construct [illegible] B.C.

[illegible] Esquimalt & Nanaimo Ry. to construct [illegible] Victoria, B.C.

[illegible] G.T.R. to construct siding for the [illegible] Waterloo, Ont.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

17661—October 3—Authorizing C.L.O. & W. (C.P.R.) to construct across Scugog St., in town of Bowmanville, Ont., mileage 149.2, and crossing to be protected by gates.

17662—September 3—Authorizing G.T.R. to construct spur for the Battle Creek Toasted Corn Flake Co., Ltd., on Lots 18, 6, 5, 4, and 3, of part of Lot No. 10, Con. "C," Township of London, Ont.

17663—September 7—Authorizing C.P.R. to construct additional track across Clavet & Nelson Sts., by means of undercrossings, and across Stephen St., by extending present overhead bridge, all in city of Port Arthur, Ont.

17664—October 7—Authorizing C.P.R. to construct Bassano to Irricana Branch across fifteen (15) highways from mileage 36.8, near Standard to mileage 50.3, near Hussar, Alberta.

17665—October [illegible]—Approving proposed deviation of Nipissing Central Ry. Co.'s line between Cobalt and North Cobalt, District of Nipissing.

17666—October 7—Approving location Interprovincial and James Bay Ry., from mileage 0 to mileage 10.11, through Parishes of Geandreau and Mercier, Co. Pontiac, Quebec.

17667—October 4—Relieving Kingston and Pembroke from erecting fences along certain portions of its railway.

17668—October 7—Authorizing G.T.R. to take certain lands in St. Antoine Ward, city of Montreal, Quebec, for convenient accommodation of the public and the traffic carried over its railway.

17669—October 7—Directing G.T.R. to protect all shunting movements over switch between its Ry. and Central Ontario Ry. Co. at subway leading from Tp. Murray and' Village of Frankford, to town of Trenton, Ontario, by sending a man ahead.

17670—October 7—Authorizing Algoma Eastern Ry. Co. to construct spur from mileage 9.08 to main line, through Lot 9, Con. 3, in Twp. Snider, to the North Star Mine.

17671—October 7—Authorizing C.P.R. to construct 3 spurs for the Sand & Supplies, Ltd., on Lot 31, Con. 9, Tp. North Dumfries, Co. Waterloo, Ontario, near Ayr.

17672—October 8—Approving revised location Can. Nor. Alta. Ry., through Tp. 46, R. 1, W. 6 M., Alberta, mileage 224.66 to mileage 228.36.

17673—October 8—Approving C.N.R. location through Tps. 4-7, Rgs. 1 East of Principal Meridian, to 2 W. P. M., Manitoba, mileage 0 to mileage 18.08.

17674—October 7—Authorizing C.N.O.R. to construct across public road between Lots 242 and 245, Parish of St. Eustache, Co. of Two Mountains, Que., at station [illegible].

17675—October 7—Authorizing C.N.O.R. to construct across 2 highways in Twp. Ferris, Dist. Nipissing, Ont., on its Montreal-Port Arthur Line.

17676—October 8—Authorizing C.N.O.R. to construct bridge across Ottawa River, at Fitzroy Harbor, Tps. Fitzroy and Onslow, Cos. Carleton and Pontiac, mileage [illegible], west of Ottawa.

17677—October 7—Authorizing G.T.R. to construct siding for James K. Kidd, on Lots 6 and 5, east of Queen St., Mount Bridges, Twp. Caradoc, Ontario.

17678—October 9—Authorizing G.T.R. to construct 6 additional sidings across Robert St., and a public lane running from Elgin St. to Ferguson Ave., city of Hamilton, Ont.

17679—October 8—Approving revised location G.T.P. Branch Lines Co.'s Regina-Boundary Branch from East Line, Sec. 11, Tp. 7, R. 10, to East Line, Sec. 13, Tp. 3, R. 4, W. 2 M., mileage 91.13 to mileage 135.93, Dist. Cannington, Sask.

17680—October 7—Authorizing G.T.R. to construct siding for the Canada Pine Lumber Co., Ltd., on Lot 1, Con. 11, Tp. of Bethune, Dist. of Parry Sound, Ontario.

17681—October 8—Authorizing C.L.O. & W. (C.P.R.) to construct across twenty [illegible] highways from mileage [illegible] to mileage [illegible].

17682—October 9—Authorizing G.T.P. Branch Lines Co. to construct its Regina-Boundary Branch across highway on N.E. ¼, Sec. 11, Tp. 17, R. 20, W. 2 M., at mileage [illegible], Dist. Assiniboia, Sask.

17683—October 7—Approving location C.N.O.R. station grounds at [illegible], Tp. [illegible], Co. Renfrew, Ont., mileage [illegible].

17684—October 8—Extending, Until Nov. 15th, 1912, the time within which G.T.P. Branch Lines Co., complete spur from Melville-Yorkton Branch at a point just north of city limits, Yorkton, Sask.

17685—October 8—Authorizing G.T.P. Branch Lines Co. to construct Brandon Branch across two (2) highways, mileage 18.48 and mileage 14.2, Dist. Brandon, Manitoba.

17686—October 9—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible] between Lots [illegible] and [illegible], Con. 1, Twp. Darlington, Co. Durham, Ontario.

17687—October 9—Approving location C.N.O.R. through Tp. Saltfleet, Co. Wentworth, Ont., mileage [illegible] to mileage [illegible].

17688—October 5—Directing G.T.R. to protect West and Front Sts., in town of [illegible], Ont., by gates and day and night watchmen.

[illegible]—October [illegible]—Approving C.P.R. to construct spur for Consolidated Rubber Company, in city of Winnipeg, Manitoba.

[illegible]—October [illegible]—Extending, until December 31st, 1912, the time within which C.P.R. [illegible] for B.C. [illegible] Ltd., in city of New Westminster, B.C.

[illegible]—October [illegible]—Extending, until June [illegible], 1913, time within which C.P.R. complete railway authorized to be constructed under Order No. [illegible]

[illegible]—October [illegible]—Approving location C.P.R., northwesterly from [illegible] Parish [illegible]

[illegible]—October [illegible]—Authorizing G.T.R. to construct siding for the Pratt & [illegible] Co., Ltd., in city of Brantford, Ont.

[illegible]—October [illegible]—Varying Order No. [illegible], dated Dec. [illegible], to provide for [illegible] at [illegible], Ont., between [illegible] and G.T.R. [illegible] to them of the land [illegible]

[illegible]—October [illegible]—Approving Montreal & Atlantic Ry. Co. to construct [illegible]

"THE COVENTRY" CHAIN COMPANY LIMITED
SPON END WORKS COVENTRY

Sole Canadian Distributors—JOHN MILLEN & SON, Ltd.
MONTREAL TORONTO WINNIPEG VANCOUVER

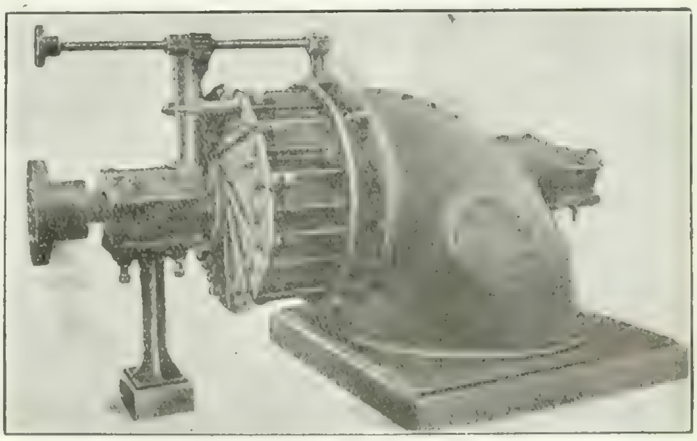
Samson Water Wheels

You can always judge a water wheel by the number of successfully operating wheels of that type there are in use—and besides the successful wheels show that the builders have had the right kind of experience, which is important to you.

The Samson wheels in use are developing about *Two Million Horse Power*.

And all the knowledge gained from this extensive experience is back of each new installation.

Send us your next specification.



William Hamilton Co.,
Limited
Peterborough, - Ont.

WINNIPEG LIGHT AND POWER DEPARTMENT.

The civic light and power department of the city of Winnipeg is now considering the necessity of enlarging the capacity of the power-house facilities owing to the rapid industrial development of the city and the consequent demand for power. The horsepower now contracted for to be delivered this fall will necessitate extensions and additional transformer capacity to that provided in the present building. For the spring of 1913 the manager recommends that two extra units be installed. These turbines and alternators should be in operation by summer in 1914. The department is now getting 95 per cent. of the new business of the city, says Manager Glassco, in competition with a private corporation, which before the completion of the municipal plant last year enjoyed a monopoly in the supply of light and power.

◆

GREATER VANCOUVER'S WATER SUPPLY

The water committee of the city council has appointed a sub-committee to go into the matter of the Seymour Creek water supply and to report on same. It is proposed to construct a huge reservoir in the Seymour Creek Valley, the cost of which, with mains, etc., has been placed by the consulting engineers at $632,000. This irrespective of expense in connection with the acquisition of land in the watershed which may be bought to ensure the city's supply of water for ever. The sub-committee will go into the whole problem and will consider what portion, if not all of the land in the valley, is to be purchased. There is talk this week of the Pacific Great Eastern taking a route along the Seymour, as has been suggested, and this will be protested by the city, for it would mean contamination of the water supply if a railway ran close to the reservoir and along the creek from which the water is obtained. If the city secured the whole valley by purchase it would probably exclude the railway. Once this water supply plan is carried into effect, Greater Vancouver should have a complete and efficient system. Not only will there be an abundance of water, but the pressure will be ample in all parts of the city.

Ratepayers have protested because of an insufficient supply and fire insurance underwriters have hinted that pressure is not what it might be. Now that the city has started to act in earnest, it is to be hoped that the work will be carried forward if a satisfactory report is obtained, and not allowed to lapse at the beginning of the year when the usual change will be made in the personnel of the water committee. Even if delays are absent, the scheme cannot be carried into effect for many months, for the work is a very large one.

MUNICIPALITY OF POINT GREY.

WATER SUPPLY.

CONTRACT NO. 17.

TENDER FOR STEEL PIPES.

[illegible] Steel Pipes [illegible]

[illegible] the office of the Water Superintendent, Municipal Hall, Kerrisdale, (Vancouver), [illegible]

[illegible]

[illegible] any tender

[illegible]

[illegible]

[illegible]

ASPHALT BLOCK
THE PERMANENT PAVEMENT
Makes a Dustless Street.
Is Noiseless and Sanitary.

THE ONTARIO ASPHALT BLOCK CO.
Limited
Head Office WINDSOR, Ont.
Works at WALKERVILLE.

TENDERS CALLED FOR

CITY OF LONDON, ONTARIO.

Tenders for Wharncliffe Road Highway Bridge Over Thames River.

Sealed proposals addressed to the "Chairman and Members No. 2 Committee," will be received at the Office of the City Clerk until 5 p.m. on Wednesday, November 13th, 1912, for constructing and erecting a 270 foot span pin-connected Petit Truss Highway Bridge with necessary approach spans, concrete piers and abutments complete.

Each bidder shall name lump sum for the various parts of the work as described in the general specification and give price for any deductions or additions to the same and make [illegible] by the City Engineer.

Plans, specifications and form of Tender may be seen or [illegible] from the Office of the City Engineer.

Contractors [illegible] a marked check for Ten per cent (10) of the amount of their bids.

The City reserves the right to reject any or all bids and to accept any bid.

W. L. ROBINSON, GEO. W. WRIGHT,
Chairman No. 2 Committee. City Engineer.

DUNNVILLE WATER COMMISSION.

Tenders will be received up to 9 p.m. on Monday, [illegible] for the laying of approximately [illegible] feet of [illegible] water mains, together with the necessary valves and hydrants.

Further particulars and the conditions of tender to be seen at the office of the Town Engineer, Dunnville, Ont.

Lowest or any tender not necessarily accepted.

A. M. JACKSON,
Town Engineer.

For further Tenders see page 76.

Volume 23. Toronto, Oct. 24, 1912

Contents of this issue on page 645

The Canadian Engineer

An Engineering Weekly

BRICK ROADS: MATERIAL, CONSTRUCTION AND MAINTENANCE.*

By THEODORE A. RANDALL, Indianapolis, Ind.†

Permit me to state briefly what I believe constitutes an ideal roadway. It is a pavement which wears smooth and clean and needs no caretaker to keep it in repair, no matter what the character or quality of traffic which passes over it. A pavement which is weather-proof, flood-proof, dirt-proof, wear-proof, and so practically time-proof. A pavement which affords an open and easy highway from country to city every day in the year for any and all sorts of traffic. A roadway over which pleasure vehicles may speed with safety to the driver and without injury to the vehicle or pavement. A roadway over which heavy service trucks may draw loads of several tons at a speed rivalling, if not exceeding, that of the so-called fast freight trains, without damage to the truck or the roadway. A roadway over which a farmer may easily haul with one horse what requires a team on ordinary roads, or with one team as much as two teams will commonly haul. A pavement over which one may journey in comfort, for it is a dustless pavement.

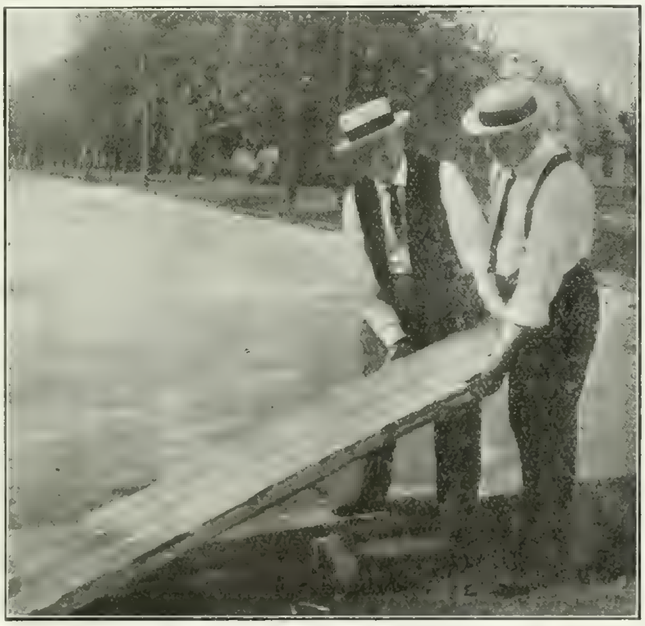


Fig. 1.—A Section of Pavement.
This illustrates the perfect application of the cement filler.

That is precisely the kind of a pavement you can construct of vitrified brick, and that, too, at a cost but little more than is now being paid for our temporary roadways. When you consider that the only cost of such a pavement is its first cost, you must admit that ultimately it is the cheapest pavement you can build. I think I can demonstrate to your satisfaction that practically there is no wear on a properly constructed brick roadway. Here is my proof, and if "seeing is believing," it is most convincing.

Eighteen years ago there lived in Sandusky, Ohio, a wise and painstaking engineer, Mr. John W. Miller; may his tribe increase. Under his direction a mile of brick pavement, part city street and part rural road, was laid, extending from the centre of the town out into the suburbs. Over this pavement during all these years has daily passed much traffic. To-day the pavement is perfectly smooth from one end to the other.

Fortunately, while this pavement has been torn up at times for the laying of gas mains, water pipes, etc., it has, luckily, always been replaced as carefully as it was originally laid, so that to-day it is as good as any new pavement. As you know, most pavements are damaged irretrievably by being torn up, but when such work is done properly, no harm is done to a brick pavement, as demonstrated in this case. During these eighteen years not one dollar has been spent on this pavement for repairs, yet it is still an ideal roadway and bids fair to continue such for another twenty years, or perhaps twice that length of time.

A portion of the main business street of Sandusky was paved the same year (1904) as the other roadway, and with brick of the same grade, but evidently with much less care in the method of construction. To-day, it is a rough and undesirable pavement. This pavement was laid under the same specifications as the good pavement, but as I will show you, some minor but very essential details of construction were carelessly slighted. Mr. Will. P. Blair, secretary of the National Paving Brick Manufacturers' Association, of Cleveland, Ohio, and others who have been studying this subject for some years, determined if possible to learn the real cause of failure in one pavement and the remarkable success in the other. Accordingly, experts recently visited Sandusky and with the co-operation of the city engineer, had a stretch of some fifty square feet of each pavement, the good and the poor, taken up.

The good pavement was perfectly bonded from top to bottom, every course of brick was intact, just as when it was first laid. The foundation was right to begin with, and there was a two-inch sand cushion, thoroughly compressed, affording a smooth, even bed for the brick, and insuring a comparatively noiseless pavement. The cement filler had been so applied that both sides and ends of each and every brick was imbedded in it. You will see by the pictures that the brick and cement formed a solid mass, making the pavement monolithic in character. The result was a perfectly smooth, unbroken surface. From one end of the street to the other, there has been no chipping of brick, or disintegration of the cement filler or binder. A closer inspection of this mile of eighteen-year-old pavement made late in August did not disclose a single defect. The traffic over this pavement has had no perceptible effect upon it, the pavement showing scarcely any wear at all. If left undisturbed this pavement will be just as good at the end of another eighteen years, without a dollar of expense for up-keep.

---

*Abstract of a Lecture delivered before the American Road Congress at Atlantic City, N.J., October 8th, 1912.

†Secretary National Brick Manufacturers' Association.

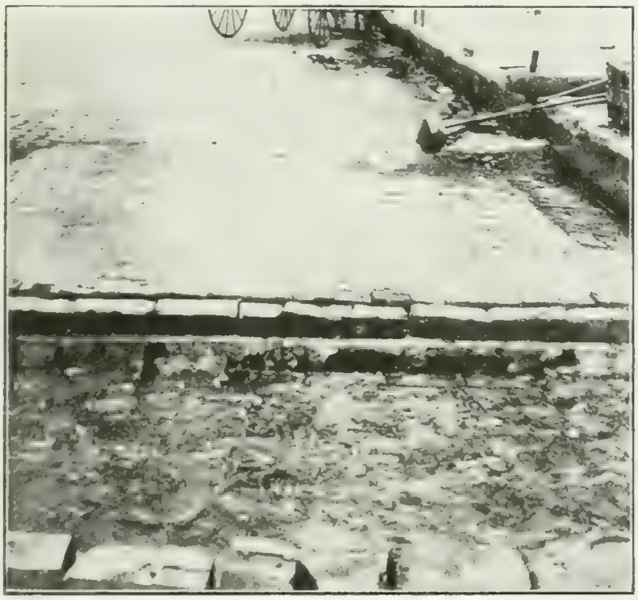


Fig. 2.—A Cut in Pavement.

Showing the imperfect application of the cement filler to which is due the uneven wearing quality of the pavement.

The section of the poor pavement taken up disclosed the secret of its failure, if a pavement can be called a failure which, after eighteen years of use, is, though rough, still doing service, with no expense incurred for repairs. As a fact, it is a failure only by comparison with the perfect pavement. The same grade of brick was used in each pavement, and the traffic is much the same on each street. Why the difference? The answer is easy. It is in the careless construction of one, and the careful construction of the other.

In the good pavement, the cement filler was properly applied. In the poor pavement, not half of the brick were imbedded in the cement. Some of the brick had cement on one end, and not on the other; some of the brick had cement on the upper portion and little, or none, on the lower, and vice versâ. In some small portions of the removed pavement the cement was properly applied. In such portions the [illegible] [illegible] [illegible]; where there was little or no cement, the pavement was the roughest. To my mind, this investigation solves the mystery of good and poor brick pavements. Scientists are at work on the problem and in time a full report of the finding will be made public. I feel [illegible] that the result will justify the opinion I have expressed.

[illegible] have learned how to build brick roadways in Ohio. Every detail of construction is looked after carefully, no [illegible] of the work is neglected, and as a result the roads are so perfect that it [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] hundred miles of brick roads in Cuyahoga county alone, and those who use them constantly and appreciate their excellence and economy, [illegible] [illegible] [illegible] pavements and brick pavements [illegible].

Ohio is not alone in appreciation of good brick roads. They are being built in other States. New York, for instance, [illegible] made a fine start. [illegible] has about one hundred miles of these brick roads in the vicinity of Buffalo, and the State Highway Department is building about one hundred additional miles this year at other points, and when the efficiency and economy of these roads have been demonstrated by actual use, the taxpayers of the Empire State will become veritable Oliver Twists in their demand for more of the same sort. It is estimated that $50,000,000 have been expended in New York State alone on temporary roadways. Think of the many miles of permanent brick roads this sum would build. There is a vast difference between a roadway that must be looked after and repaired constantly, and these brick roadways which cost nothing at all if once properly constructed.

The proper construction of a brick paved roadway is a simple matter. In general, the requirements are the same as maintain in the building of any good road.

1. Proper drainage.

2. The careful compaction of the roadbed to a grade corresponding with that of a finished street.

3. A concrete foundation in the colder climates, and on soils of slow drainage.

4. A sand bed, two inches in depth evenly compressed, intervening and immediately underneath the brick.

5. Laying the brick best edge up, with lugs lying in in the same direction.

6. Rolling the brick to an even surface.

7. Application of the cement filler in proportion of one to one.

8. Protecting the filler from too rapid setting.

A properly constructed vitrified brick roadway is the ideal highway. Its merits summarized are:

It is easily built.
It is economical as to first cost.
It costs nothing for maintenance.
It is most satisfactory in use.
It is the most sanitary pavement known.

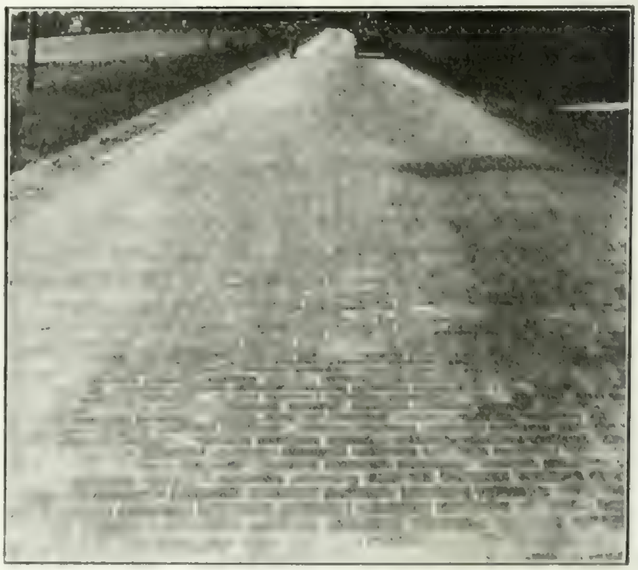


Fig. 3.—Glenwood Road.

Six and one half miles out from Buffalo, N.Y. Wire cut lug brick being used.

It affords the least traction resistance.

It is not a slippery pavement even when wet.

It is adaptable to all climates and all conditions of soil.

It is not an experiment, but a demonstrated fact.

It may be seen and inspected, hundreds of miles of it, in actual use, successfully withstanding excessive traffic.

Its affirmative merits are many and, when the truth is told, there is not one single objection that can be urged against its use for the heavy travelled highways of this country.

If you like speed, you can have it with no "Thank-you-ma'ams" to jar you. If you enjoy beautiful pastoral scenery, you will be delighted. You will be surprised by one feature of these brick-paved country roads—their cleanliness. It is not an uncommon thing for visitors making such a trip for the first time to ask how often the roads are swept. The answer is, "They are swept constantly, but Dame Nature does the sweeping, and she uses no broom." The wind keeps them as clean as the dear old board walk out here that we all love and enjoy.

If, after being convinced, as you will be by such a trip, that the brick-paved roadway is the ideal roadway, and you want to build them in your own district, the National Paving Brick Manufacturers' Association will make it easy for you by supplying you free of charge with complete specifications in which every detail of construction is set forth in plain terms, so that any engineer or road builder can readily comprehend all that is required. If, however, any uncertainty arises, all you need do is to write the National Paving Brick Manufacturers' Association, which is an organization of boosters, which is boosting by methods of education instead of by use of boodle.

In time, brick roads will become universal throughout this country, for there is an abundance of raw materials, shales, and clays, in almost every State in the Union, from which vitrified brick may be made. In sections where paving brick are not now made they can be shipped in, as transportation charges are not prohibitive. On the contrary, brick and cement can be supplied to almost any district in the land at a reasonable price, and the other materials used are found everywhere almost. Indeed, one of the commendable things about brick roadways is the fact that common labor is used in building them, and home products are chiefly used in their construction. They are not a drain on local capital; on the contrary, they stimulate local business by affording employment for labor at fair wages. In short, brick-paved roadways are desirable and commendable from every view point.

◆

CREOSOTING CROSS-TIES.

The annual replacement of cross-ties in Canadian railway lines is about 10,000,000, according to statistics compiled by the Forestry Branch of the Department of the Interior. The average life of a tie, i.e., seven years, could be prolonged to seventeen years if proper preservative treatment were adopted, and an annual saving of 350 million feet, board measure, of timber, could be effected. This is equivalent to three years' cut of one of the very largest mills in the country.

While the initial expense of creosoting would bring the cost per tie from 58 to 93 cents, it would save $1,400,000 annually.

Since 1910 two timber-treating plants have been established, treating, in 1911, 206,209 ties, or 1.5 per cent. of the total cut.

The number of ties purchased in the Dominion in 1911 was 13,683,770, an increase of 4,469,808, or 48.5 per cent. over 1910.

The rapid development of railways in the western provinces is largely responsible for this increase.

Eighteen kinds of wood were used. Jack pine, with 40 per cent.; tamarack, with 19 per cent.; Douglas fir (used to a very great extent in new electric lines in British Columbia) with 14 per cent., and hemlock, with 12 per cent., were the leaders. A remarkable change is that of cedar, in decreasing from 40 per cent. to 5.4 per cent. of the total.

AN ELECTRIC FOUNTAIN OF UNIQUE DESIGN.

By L. M. Edholm.

In San Diego, California, a unique electric fountain has been constructed to stand in a small park on one of the principal streets of the city. The park faces the U.S. Grant Hotel, a magnificent building, and it was necessary to have the fountain harmonize with the surroundings and be an ornament to the park in the day time as well as night.

Mr. Irving J. Gill,* a well-known western architect, designed the fountain after classic monuments of Greece and Rome, not a cheap imitation, but original ideas used, that would take a prominent place among the old masterpieces in art.

The details, many of which are unique, seem to have been very carefully thought out and planned by Mr. Gill.

In a concrete basin stands a granite pedestal from which rise eight marble columns of the Corinthian order. These support a dome of prismatic glass and bronze on the top of which rests a bronze lantern.

View of Fountain in Operation.

Even in the morning before the flow of water is commenced the structure is one that delights the eye, being well proportioned, graceful, quiet and dignified.

Every day at noon the water is turned on. A small electric pump forces the flow up through the marble columns to a point below the bronze lantern from which it flows over the prismatic glass of the dome. The bronze framework of the dome protrudes and causes the water to cascade and foam. Through a perforated sheet of metal under the dome the water falls downward in a shower between the columns. Eight jets shoot at an angle from the sides of the basin to meet the shower and together the waters dash, gurgling and splashing, upon the pedestal and runs into the basin in eight miniature waterfalls. It gives the strange illusion of water rising from the pedestal and terminating in the foam-covered dome.

As a matter of economy the water returns to the starting point and is used again and again.

At night the lights are turned on and the color display is very artistically arranged. All the jets and overflows are illuminated in the different colors. Holoplane reflectors are used under each cluster of lights and a flasher is worked automatically.

Clusters of colored tungsten lights are placed under the prismatic glass of the dome and the subdued glow showing through the glass and foam gives it a jewel-like effect.

One rather unusual detail which Mr. Gill used in his fountain was his idea that in a work of this kind the centre should be the point of greatest interest, and in order to bring this out, the costliness of the material should increase as the centre was reached.

In this arrangement first came the concrete of the basin, the granite of the pedestal, while next in value the marble columns, the dome of prismatic glass and the bronze lantern at the top and centre, which is the most costly material used in the construction.

The fountain was a gift to the city from Mr. Lewis J. Wild, a wealthy resident of San Diego, and was installed at a cost of $15,000.

The mechanism for operating the lights and the small electric pump which sets the water in motion is concealed in a chamber under the fountain.

Five dollars a day covers the up-keep of the fountain and includes the time of the caretaker of the park, whose services are all that are required for the running of the fountain.

CANADA'S COKE SUPPLY

The industrial value of Canada's coke supply is discussed in The London Financier by Mr. J. Lawrence-Hamilton, M.R.C.S. As neither anthracite nor lignite, when heated, coalesces, they are both incapable of making coke, he says. Bituminous coal, on the other hand, when strongly heated in the absence of air in suitably closed ovens, is gradually decomposed, yielding its water, gases, tar, oils, nitrogenous and volatile compounds, which are, of course, separated and collected.

Bituminous coals thus heated first fire, or melt or soften, and then, as decomposition progresses, they stiffen to produce a hard, light, porous, or cellular, coke, consisting chiefly of carbon combined with the contained ash from the original coal. The cellular or quasi-fossil, sponge-like structure of the coke is produced by the expansion of the heated escaping gases derived from the molten mass.

In blast-furnace smelting for treating mineral ores and metals, coke is superior to coal as charcoal is to wood, because both coke and charcoal are rich in carbon. Hence, to manufacture this class of fuel it is necessary to spend time, trouble and money to convert the coal into coke.

For metallurgical and allied purposes a superior coke is required. Such carefully manufactured coke is strong, hard and does not soften or crumple, so that when burning in the blast furnace it can carry a heavy charge of ore without crushing or melting, which would obstruct the blast and diminish the heat required.

Good coke burns without producing tar, oils or smoke. It posses a high calorific value.

Experiments show, and experts know, that Canadian coke [illegible] chemistry, quality and quantity can successfully compete with the cokes from all other countries and Colonies most of which in the near future will be more or less dependent upon the Dominion's cheap coke [illegible], which is practically inexhaustible. To develop Canadian mines and allied industries, cheap, abundant local coke is necessary. Carbonite, or natural coke, made in nature's own laboratory by [illegible], has not yet been discovered in Canada, where, however, it probably exists in large quantities.

Clean, sparkling, pure, solvent water of Canadian "white coal," washes the previously crushed, sized, screened and [illegible] coal [illegible] to the ordinary methods and machines employed in dressing and concentrating metallic ores.

The commercially valuable materials or products in metallic ores are heavier than the contaminating or containing rock. Coal is the lightest of all important commercial minerals, and its natural adulterants, or impurities, are heavier than the coal itself. In other words, in coal washing, the lighter coal escapes at the top, whilst its impurities, being heavier, are discharged separately at a lower exit. In metallic ore washing the lighter contaminating rock escapes above, whilst the metallic ores are discharged at a lower level.

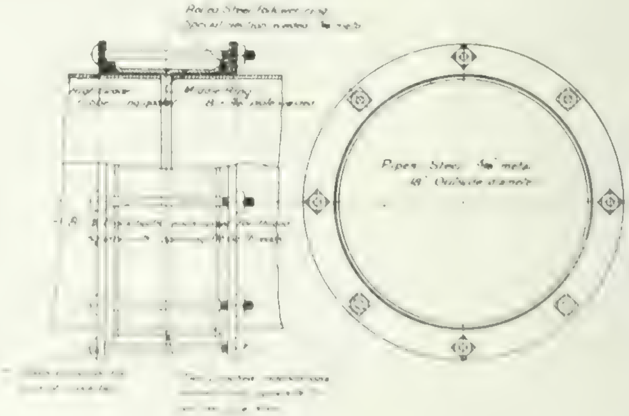
Canada having generally a very dry climate, the quantity of mechanically (not chemically) included water or moisture in Canadian coal as bought or sold averages only about 3 per cent. Of course, during prolonged or excessive wet weather this amount of contained or free water would be augmented, especially where coal is stacked in uncovered yards, or where purposely adulterated or diluted with water from a hose. Evidently small soft coal and coal dust absorb far more moisture than larger harder coals. Damp or damped coal is additionally friable or liable to waste by crumbling. In other words, where coal contains, say, 5 per cent. of free moisture—as it usually does in the United Kingdom—then in every ton there is 1 cwt. of useless water, so that the consumer on every pound's worth of coal purchased gets only 19s. worth of coal and loses a shilling for the coal's contained free water or moisture, which must not be confused with the water chemically combined as a constituent of the native coal.

Good coals as sold in London seldom contain more than 8 per cent. of free water or moisture, with an average probably approximating 7½ per cent.

AN EFFICIENT PIPE JOINT.

A very efficient pipe joint has been used recently on the new pipe line being installed for the Moose Jaw water supply. The water is being brought to Moose Jaw through nineteen miles of eighteen-inch plain end steel pipe.

There are two joints of this kind which are very similar; one is made by the Custer Coupling Company, of Bradford, Pa., and the other by C. J. Dresser Company, of the same place. The Dresser Company prefer a gland detail similar to that used on an ordinary piston rod. The Custer joint, which was adopted on the Moose Jaw water supply, compresses the rubber gasket in a different way, and gives some latitude for variations in the size of pipe and couplings. It is stated that hundreds of these joints were made on the Moose Jaw work in a foot or more of water. The accompanying sketch gives a clear idea of the joint.



The above information, together with the sketch, has been very kindly furnished us by Walter J. Francis & Co., of Montreal, who are the consulting engineers on the Moose Jaw water supply.

THE VENTILATION OF SEWERS.*

By T. De Courcy Meade.†

In England sewers were originally constructed for the purpose of conveying storm waters from roofs, street surfaces, yards, and so forth, to the nearest rivers or streams, and the admission of fæcal matters into sewers was forbidden by law. When the water-carriage system of sewage came into vogue in the early part of the last century sewers were gradually utilized for the reception of the overflow of liquids from cesspools and for the removal of house drainage. The admission of excremental matters into sewers was not only legalized, but made compulsory in London in 1847, and in the rest of England in the following year.

Prior to that time sewers were constructed with large open shafts placed at or near to the sidewalks for the admission of surface waters; these shafts were untrapped and were covered with grids of large size. There were no ventilating shafts in the centre of the carriageways, nor were there any side entrances for gaining access to the sewers. Ventilation was therefore effected by the gully shafts, the effluvium from which gave rise to very general complaint in London as early as 1830, and as the use of sewers for the conveyance of fæcal matter was extended, these complaints became intensified. Public attention was consequently directed to the subject with the object of devising some means of remedying this evil, with the result that in London and some other English towns the gullies were tapped and shafts were erected in the centre of the carriageways to admit of the escape of the sewer gases at points as far removed from the houses and sidewalks as practicable; this system was completed in the city of London by the end of 1848. The arrangement, however, did not remove the nuisance; it merely transferred it from the sides to the centre of the streets, most of which are narrow, with carriageways largely used by pedestrians.

In 1852 the English Board of Health advised the ventilation of public sewers, and in 1878 "suggestions" as to the preparations of plans for main sewers, etc., were issued under the direction of Sir Robert Rawlinson, C.B., the chief engineering inspector to the local government board (the successors to the Board of Health). The local government board advocated:—

(a) Sewers constructed in straight lines.

(b) Manholes or lampholes at each change of direction and gradient, and terminating at the street surface.

(c) The trapping and ventilation of all house drains.

The advice given by the Government Department has been generally followed by English engineers in the design of drainage works in Great Britain, but the sewer-gas problem still remains unsolved, and the nuisance from sewer emanations continues. . . . Numerous proposals have in the past been made for abating the nuisance caused by sewer gas; for example, mechanical ventilation by means of fans, specially constructed shafts with furnaces to extract and consume the gases, flexible screens to regulate the air currents, connections with factory chimneys, and numerous methods of chemical deterioration were suggested and tried more than fifty years ago with varying results.

The old fallacy that the application of the principles successfully used in ventilating mines would be equally successful if applied to sewers is still retained by some theorists. Those who know how widely dissimilar the conditions are can readily appreciate that the remedial measures which prove successful in the one case may be worthless in the other. Plenum or vacuum systems, either separately or in conjunction, can be applied to mines, sufficiency of power being the principal factor; but in sewers dependent on water-sealed drain traps the application of power sufficient to produce an effective current of air throughout a large system is impracticable.

Most municipal engineers are conversant with the methods here referred to, and doubtless with many others too numerous to mention. They are well aware of the conditions that have to be met and of the impracticability of the suggestions put forward by many inventors, whose proposals although sometimes of undoubted ingenuity, are generally found lacking in essential points.

Among the earliest suggestions should be mentioned those of deodorizing the sewer gases by the admixture of chlorine gas and other chemically produced gases, the application of vegetable charcoal as a deodorizer, and the admission of smoke from factory chimneys forced into the sewer by water-driven fans.

The oxidizing effect of charcoal, which had been determined by the researches of Lowitz, Saussure, Thenard and others in the latter part of the eighteenth century, was, at a later period, investigated by Drs. Stenhouse, Grace-Calvert, Letheby, and others; and under the direction of Colonel Haywood, when city engineer of London, this material was utilized for purifying sewer air by means of trays inserted in the ventilating shafts. Several mechanical arrangements were devised for the practical application of charcoal to this use, notably those of Messrs. Bean and Burgess, and later the spiral tray ventilator of Mr. Baldwin Latham.

The ventilator devised by the last-named gentleman possessed many advantages over the arrangements which preceded it, but in practical use it was found that charcoal, however skilfully applied, rapidly lost its power of deodorization, mainly owing to the moist atmosphere with which it was necessarily brought into contact. Charcoal, therefore, failed to act as a useful deodorizer unless the ventilators were recharged with it very frequently. The air currents also within the sewers were reduced by its introduction. This was fully recognized by Lieut.-Colonel Haywood and Dr. Letheby, who were careful to point out that, while charcoal diminished the escape of effluvium into the streets, it was essential that the dilution of the gases generated in the sewers should not be so lessened by the diminished air supply as to render the atmosphere in the sewers dangerous to the men who work in them. These investigations, however, candidly admitted that, on the other hand, the diminution of the air currents did not appear to have any appreciable effect on the condition of the air within the sewers. The use of this material has been abandoned in the city of London and most other British towns where it had been tried.

The necessity for ventilating sewers conveying fæcal matter was generally recognized by most of the leading English engineers, notably by such pioneers as Mr. Frank Foster, Sir Joseph Bazalgette and Lieut.-Colonel Haywood, engineers whose names are well known in connection with the main drainage of London. Recent research, however, indicates that this view must be accepted with some reservation.

Since the period more particularly referred to (1840-70) many methods have been tried experimentally in towns in Great Britain, and much has been written on the subject, not infrequently by those who have had no opportunity for personal research. The author has had the advantage of closely studying the practical aspect of the problem, first under the direction of Lieut.-Colonel Haywood in the city of London, subsequently in other British towns, and more recently in conjunction with Prof. Delepine and other experts in Manchester.

---

[*] Paper read at the recent Congress of the Royal Institute of Public Health in Berlin.

[†] City Surveyor of Manchester, England.

He proposes in the first place briefly to refer to the systems in use in some of the principal English and American towns. A few years ago information was kindly furnished to him by the municipal engineers of upwards of sixty of the principal towns in the United Kingdom, and of several important towns in Canada and the United States, from which it appears that the methods adopted in various towns differ considerably, even in cases where the local conditions are somewhat similar.

For example, we find that Belfast adopted a system of ventilation at the surface of the streets somewhat similar to that already described in relation to the city of London, Birmingham a combination of surface grids and high ventilating shafts, Bristol practically unventilated sewers, and Leicester ventilation by openings at the street surface, superseded by high shaft ventilation.

The cities of Buffalo, Chicago, Detroit, Minneapolis, Philadelphia, Washington, Boston (U.S.), and Toronto adopted surface ventilation with—it is alleged—fairly satisfactory results, the house drains being cut off from the sewers by intercepting taps in seven out of the eight cities named.

Of the sixty towns in England from which information has been derived, we find that eight towns adopted ventilation by surface grids only; five, a complete system of trapped house drains; four, untrapped street gullies; twenty, surface ventilation supplemented by high shafts; twenty-three, a combination of surface inlets and high shaft outlets; four, trapped drains, and sewers ventilated by high shafts only. The sizes given of the ventilating pipes and shafts vary from 4 in. to 12 in. in diameter, according to the size of the sewer. These are usually placed about 150 yds. apart, and in the majority of cases they are fixed against buildings.

In one town the ventilating shafts are supplemented by brick structures 42 ft. in height, with a sectional area of 9 sup. ft.

Bristol.—The method adopted at Bristol is of special interest, as that city is an exception to the rule prevailing elsewhere, being the only large town in England in which no attempt has been made to ventilate the sewers systematically, but the author is informed that the sewer workmen in that city have met with no accident due to poisoning, suffocation, or explosion for many years, although the sewage is combined with trade refuse from breweries, soapworks, tobacco manufactories, cocoa works, tanneries, and so on. The death-rate also compares favorably with that of other towns of similar size and character, being 12.71 per 1,000 in 1911.

In one town, where the brewing industry forms a large proportion of the trade, the sewers are ventilated by connections with tall chimneys. Surface ventilators are not used owing to the objectionable smell arising from the brewery refuse, and the sewers in the residential portions of the town are not directly connected with the main drainage system; sewers in the residential areas are ventilated by high shafts. In another town situated on the South Coast of England the sewage is practically free from trade refuse, but considerable difficulties have been experienced in dealing with the nuisance from sewer ventilators, and many methods, such as open gratings, tall shafts, specially devised [illegible] ventilators, have been tried to obviate the nuisance, but these systems have been found unsatisfactory and [illegible] either wholly or partially.

Taking as another example a [illegible] town in the South-West of England, where the sewage is [illegible] domestic character, there are no [illegible]. Another [illegible] will be found by a residential town of [illegible] far removed from the place last referred to. There is no system of sewer ventilation, the sewage is of a domestic character, the house drains are trapped. Some of the sewers have flat gradients and flushing is resorted to. The public health and death-rate compare favorably with other towns of the same size and character.

In forty-seven of the towns previously referred to the flushing and cleansing of the sewers is systematically carried out. In eleven the sewers have little fall; in four the falls are considerable; in thirty-two the gradients vary; in seven the sewers that have flat gradients are flushed. In six (some of the latter being of considerable size) the sewers are not flushed.

In most of the American towns from which information has been received flushing is systematically carried out.

From the foregoing remarks it will be seen that the modern practice regarding sewer ventilation in England varies greatly, and where ventilation on a uniform system has been attempted the methods adopted have in most cases been subsequently modified to meet the difficulties that have arisen. When nuisance has been experienced by smell from ventilators terminating at the street surface, the remedy most generally adopted by English engineers has been the substitution of vertical shafts fixed in suitable positions and supported by buildings or independently. This arrangement affords a better diffusion of the gases emanating from the sewers, and frequently obviates the complaints by transferring the nuisance from the surface of the streets to a higher point, but it cannot be accepted as a satisfactory solution of the problem. In the city of Manchester the tramway standards have for some years past been utilized as sewer ventilators, and the results have been fairly satisfactory.

Air Currents in Sewers.—The direction and velocity of the flow of air in sewers have been carefully investigated for a period of upwards of sixty years in several towns in England, commencing with the well-known series of experiments conducted in the city of London under the direction of Lieut.-Colonel Haywood about the middle of the last century.

Temperature observations conducted by the author in London and in Manchester show that the conditions in winter and in summer are reversed, the air in the sewers being warmer than the external air in winter and cooler in summer. These conditions, however, vary largely with climate and the character of the sewage, and the latter varies materially in different parts of some large towns where manufactories predominate. Some twenty-five years ago the author made an investigation of air currents in sewers and in pipe ventilators. A number of metal and earthenware pipes varying in diameter and in height were erected; some were placed vertically, both with and without bends, others were erected at different angles for the purpose of experiment. It was found that each pair of right-angle bends diminished the efficiency of an ordinary 4-in. metal pipe in calm weather by from 7 to 10 per cent., but this was largely varied when there was wind. The experiments were carried on continuously for eight months, and the pipes were afterwards used for ascertaining the extracting value of different kinds of cowls. Some of the cowls tested were found useful under certain conditions in preventing down draught, and some of them increased the up current in windy weather.

In experiments on two [illegible] lengths of 4-in. cast-iron ventilating pipe of heavy section it was found that under favorable conditions the heat of the sun's rays was sufficient to alter the direction of the air currents in a length of 76 ft. [illegible] diameter [illegible] drain laid with a fall of 1 in 45. One pipe experimented upon was exposed to the southeast and the other to the northwest. With three exceptions the pipe exposed to the southeast was the upcast shaft in the earlier part of the day and the downcast shaft shortly after the sun's ray passed to the other side of the building. The exceptions occurred on days when the wind was high. The experiments were conducted on these latter pipes during hot weather only.

The observations on air currents in sewers showed that where sufficient free openings were provided the direction and force of the wind exercised a great influence and overbalanced all other local conditions due to temperature, gradients, character of sewage, and so forth.

Before the instruments were allowed to record, it was found necessary to restore the normal conditions within the sewer which are invariably disturbed by the opening of manhole or side entrance covers for the purpose of entry when placing the recording instruments in position. To effect this the writer devised a small case of sufficient size to hold each anemometer. At opposite sides, and facing the fan of the anemometer, were hinged doors; these were opened by pneumatic pressure applied by a small tube brought to the surface. The doors were balanced to close when the pressure was released. By this means the instruments were not brought into use until the normal conditions within the sewer were restored. In order to check the record of each instrument while exposed to the action of the air currents, two anemometers were placed side by side suspended in boxes from the crown of the sewer, and an interval of twenty minutes was allowed to elapse before these instruments were independently brought into action by the means described. Eight instruments in all were used and were carefully corrected from time to time during the progress of the work.

Records were taken under similar conditions with the ventilating spaces in the manhole covers closed and open for a distance of 1 mile on each side of the point of observation, and the results differed so slightly that the author came to the conclusion that the effect produced within the sewer by the ordinary type of ventilating cover was negligible. On the other hand, he found that the action of the wind and variation between internal and external temperatures on the open end of a large sewer, such as a storm overflow, will produce a very material current of air for a considerable distance along the sewer, but the velocity of the current will gradually diminish, and in time cease altogether.

Effect of Wind Pressure.—Where surface ventilating covers are used, wind pressure has undoubtedly an effect upon the air within the sewers, but even with high winds the author has found the effects much smaller than what has often been attributed to this cause.

These remarks apply to large sewers, sufficient for a man to enter. In the case of smaller sewers—pipes varying from 12 in. to 18 in. in diameter—he has found the effect of wind pressure on surface ventilators more pronounced.

In the type of ventilating manhole which has hitherto been in use in the city of Manchester, the proportionate ventilating area amounts to:—

24.5 p.c. of the cross sectional area of 12 in. diameter sewer.
2.7 " " " " " 3 ft. " "
.98 " " " " " 5 ft. " "
.24 " " " " " [illegible] ft. " "

The distances between the ventilating manholes varies from 100 yds. to 150 yds. in the case of the smaller sewers, and from 150 yds. to 300 yds. in the case of the larger sewers. It will therefore be seen that the effect or air pressures under such conditions must of necessity be much less in sewers of large section than in those of a smaller type.

The results of the author's observations may be briefly summarized as follows:—

(a) Where shaft ventilation only is relied upon, some of the shafts become inlets and others outlets.

(b) These conditions are not continuous, the directions of the air currents are at times reversed, the outlets acting as inlets, and vice versâ.

(c) The air currents within the sewers are governed to a large extent by the differences between the external and internal temperature, the flow of sewage, the construction and character of the sewer and other local circumstances.

(d) All these conditions are neutralized, and at times reversed by the change of direction and force of the wind.

(e) Ventilation by metal shafts is affected, and in some cases materially assisted, by the heat of the sun.

(f) No general rule can be laid down which would be applicable to all cases and under all conditions.

(g) Under normal conditions, in properly constructed and regularly flushed sewers not receiving trade refuse, the perceptible odors are less when they are unventilated than when ventilated.

(h) Air currents do not invariably flow from lower to higher levels, the reverse being frequently the case even where gradients are steep.

(i) Air in sewers in partial use is generally more offensive than that in similar sewers which are used to their full or nearly full capacity, other conditions being equal.

(j) That the regular and efficient flushing of sewers with fresh water is a more important desideratum than the introduction of large volumes of air. A case in support of this view may be quoted where intermediate manholes were inserted in an old sewer in fair condition, which increased the ventilation openings by 100 per cent., but did not appreciably improve the condition of the air within the sewer. Flushing was resorted to and a marked improvement was immediately effected.

(k) All methods which replace or retard natural ventilation are inadvisable except under very exceptional circumstances.

(l) Ventilation of sewers is necessary for the safety of the workmen, and for the free escape of air when sewers are rapidly filled in times of storm.

(m) Methods usually adopted in the ventilation of mines cannot be successfully applied to sewers.

Manchester Corporation's Investigations.—In 1902 the Manchester Corporation appointed a special committee with a twofold purpose: First, to determine—on the generally accepted hypothesis that the ventilation of sewers is necessary—the best method of accomplishing this object; secondly, to investigate the composition of sewer air bacteriologically and chemically obtaining under varying conditions, such as are to be found in the Manchester city sewers, and to determine as far as practicable the influence of sewer emanations on health.

The committee appointed Prof. Delepine, M.B., C.M., M.Sc., director of Public Health Laboratory, Manchester University; Dr. Fowler, D.Sc., F.I.C., consulting chemist, Davyhulme sewage works; and the author, to investigate and report. Prof. Delepine undertook the bacteriological work, Dr. Fowler the chemical work, and the author the experimental installations, investigation of air currents, etc.

As a rule, when matters of public interest are about to be officially investigated in England, numerous remedies are suggested by irresponsible persons from outside. These were anticipated by advertisement in the public press intimating that the special committee were prepared to receive particulars of methods for improving the ventilation of sewers. In response to this invitation twenty replies were received. Most of them contained particulars of some proprietary arrangement or method of ventilating sewers. Each case was carefully considered, and four of those who responded were invited to furnish additional particulars, and after further consideration arrangements were made for a practical test of the method advocated in each of these four cases, which will here be referred to by the letters A, B, C, and D respectively.

Method A consisted of an electrically driven fan to extract air from the sewers and discharge it through an outlet shaft into the open air, fresh air being admitted to the sewers through inlet shafts fixed at suitable points to replace that extracted. The fan used in the experiments was 20 in. in diameter, and had a velocity of 650 revolutions per minute. It was driven by a 4 b.h.p. electric motor, placed in a brick chamber under the roadway. The upcast shaft was of steel, 20 in. in diameter, with an outlet 28 ft. above the road level. The base of the shaft was concreted into the side of the fan chamber and connected to it by a concrete duct. There were twenty-two fresh-air inlet shafts, 4 in. in diameter, varying from 5 ft. to 30 ft. high. Twenty were fitted with inlet caps by means of which the amount of air admitted at each inlet was adjusted so that the extracting power of the fan could be equally distributed throughout the whole system to be ventilated.

The area experimented upon in this case was 39½ acres. The sewers within that area has a capacity of about 25,000 cu. ft., and the resident population was about 3,000. The area included two cotton mills, an india-rubber works, a soapworks, an artificial manure factory, etc., two schools attended by 1,175 scholars; 322 water-closets and 186 pail-closets; the length of the sewers was about 5,560 yds. The area was, in fact, selected because the local conditions made the sewers within it the most difficult to ventilate that could be found in a city where from various circumstances the problems regarding the efficient ventilation of the sewerage system are, perhaps, among the most difficult and complicated in England.

The contractor who had supplied the fan had guaranteed that it would discharge 6,000 cu. ft. of air per minute against a water pressure of an inch, but in actual use only 4,036 cu. ft. per minute was registered. Anemometer tests showed that 247 cu. ft. of air per minute was brought into the sewers through the air inlets, and that four of the inlets at times acted as outlets. The water gauge registered a vacuum of ½ in. in the pipe connecting the sewer with the 20-in. upcast shaft.

This system of ventilation produced a considerable dilution of the sewer air where the connections were good, but only a small proportion was drawn in through the regulated fresh-air inlets that were provided, and this notwithstanding that every care was taken, short of relaying the sewers, to make them air-tight; the system was, however, considered worthy of further investigation. The air escaping from the outlet shaft contained no more bacteria than the street air, and on some occasions much less. It had, however, an unpleasant smell, and it was considered doubtful whether there was any advantage in throwing into the street air at one point large quantities of bad-smelling gases such as escaped from the [illegible] shaft.

Method B consisted of a special type of lamp column erected on the footways or carriageways, and connected with manholes in the centre of the road or direct with the sewers by [illegible] pipes. The pipes used were 6 in. in diameter, enlarged to 9 in. in diameter near the sewer or manhole. The column of the lamp contained a [illegible] diameter [illegible] tube connected at its lower end with a pipe leading to the [illegible] and at the upper end to three incandescent gas burners in the lantern. The lantern was air-tight, with the exception of the outlet fitted immediately over the burners; the sewer air [illegible] by the lamp passed through and round the burners, and was discharged into the street air through the lantern at the top.

The amount of air passing from the manhole through the pipe was generally so small that no [illegible] sufficiently [illegible] when placed in the end of the pipe, [illegible] therefore, the end of the pipe was closed with the exception of the space occupied by the recording instrument, in order to set up a sufficient velocity to enable the instrument to register. A small current of air was thus produced in the 6-in. drain attached to the base of the column, but its effect on the air in even the smaller sewers was practically nil, and quite worthless in the case of large sewers. The average quantity of air extracted per lamp was 723.9 cu. ft. per hour.

The amount of coal gas per lamp consumed from June 20th to September 21st was 33,000 cu. ft., at a cost of £3 14s. 3d. At another site the average amount of air drawn from the sewer by this apparatus was about 1,100 cu. ft. per hour.

Prof. Delepine found no evidence of any material dilution of the air in the sewer even close to the ventilating column. When the lamp was not lighted there was an escape of bad-smelling air, but the number of bacteria reaching the lamp outlet was very small. When the gas was lighted, the smell was not noticeable. The temperature of the air at the outlet was so high (exceeding 250 deg. Cent.), that even during a rapid transit it is believed that the bacteria suspended in the air would be destroyed, and this was proved to be so in the case under investigation. The system appeared to be capable of reducing a local smell nuisance without affecting the state of the air in the sewers, and the action of each lamp appeared to be very limited.

Method C consisted of forcing the sewer air, after admixture with fresh air, by a jet pump through clean water, which was supposed to wash it and free it from all impurities. Complaints were received of smells from one of these washing installations, which it was ascertained did not come from defective covers or any points outside the apparatus. Each ejector installation required about 254,000 gallons of water per quarter if worked continuously. The cost for water at Manchester amounted to about £13 13s. per ventilator per quarter.

The proprietors claimed that the sewers would be kept entirely free from sewer air, but this was not justified by the results obtained. Prof. Delepine found that this apparatus did not materially affect the composition of the air contained in the sewer to which it was applied. The air escaping from the outlets at the level of the pavement usually contained about twice as much carbonic acid as the air collected about 5 ft. above the pavement, and distinctly more carbonic acid than air collected at the level of the pavement; the air also had an unpleasant smell.

Method D consisted of a cylindrical casting containing a cotton-wool filter and disinfectants, and fitted into the manhole shaft, and the inventor claimed that by this method the heat of the sewer air could be made use of to prevent the cotton wool becoming saturated by the condensation of warm, damp sewer air, but the results of the tests would not warrant the general application of the system.

Shortly stated, the investigation of the subject at Manchester showed that the air within the Manchester sewers, situated at a depth exceeding 10 ft. below the surface, generally contained more carbonic acid than the worst street air, and that the proportion of carbonic acid in sewers increases with the depth below the surface, and becomes considerable when all openings are closed, a condition necessary to mechanical ventilation. Although a large quantity of of carbonic acid can be extracted by mechanical ventilation, a greater proportion was found in the air of sewers that were so ventilated, which may be accounted for by the restriction of free ventilation, a condition indispensable under Methods A, B, C, and D.

Prof. Delepine found that the bacteria in the air of the street sewers ventilated in the ordinary way were subject to variations which appear to be due to sudden disturbances of the air, such as steps in sewers, the fall of sewage from inlets above the level of the flow, and condensation on the sewer surfaces exposed to the air.

In order to estimate the influence of sewer air upon health, an elaborate system of experiments has been commenced by Prof. Delepine at the Public Health Laboratory, Manchester, and has not yet been concluded; the results obtained up to the present are, however, extremely interesting and instructive.

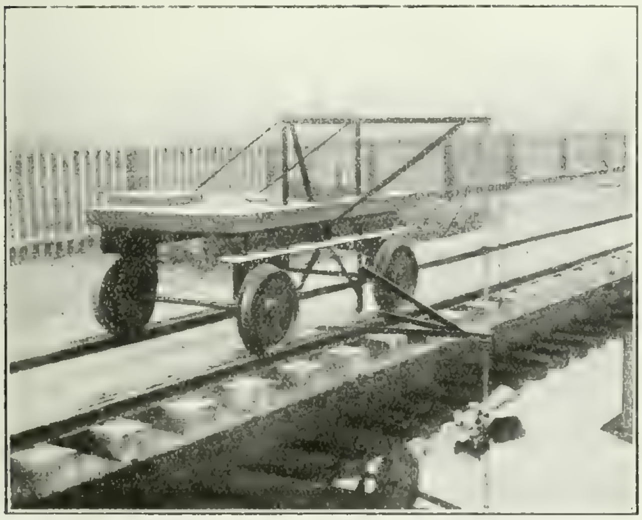
◆

A CURRENT METER RATING STATION.

The current meter rating station at the Irrigation Office, Department of the Interior, Alberta, was described in a paper read by Mr F. H. Peters, Chief Engineer, to the Canadian Society of Civil Engineers, on October 10th. An abstract of the paper follows:—

The work of stream measurements has been carried on by the Irrigation Office, Department of the Interior, for a long period of years in the two Provinces of Alberta and Saskatchewan, but it was not until the early part of 1909 that the great importance of this work was recognized by the Department, and at that time a special Hydrographic Surveys branch was organized under Mr. P. M. Sauder, C.E., from which time the work of stream measurements has been carried on systematically and extensively.

Prior to this time a current meter rating station had been established on a slack water mill pond on Bow River at Calgary, but its equipment was never very satisfactory, and it finally fell into bad repair and its use was discontinued. Along with the formation of the Hydrographic Surveys branch was considered the matter of establishing an up-to-date and efficient current meter rating station, because it was realized that without this equipment, by which means all current meters used could be frequently rated, the current meter records would be liable to serious errors.

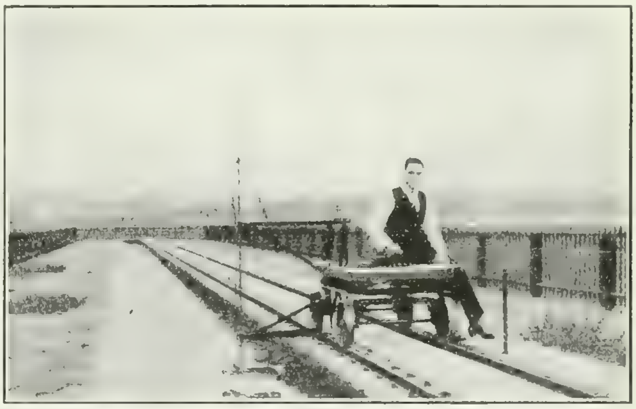


View Showing Meter Suspension Irons.

No active steps were, however, taken in the matter until the winter of 1910, when the plans, speifications and estimate of cost for the station and equipment were prepared by the writer. The contract for the work was let to the firm of Jones, Blackshire & Lyttle, of Calgary, on May 29th, 1911, and was completed by them on July 21st, 1911. In carrying out the construction the steel reinforcing, the steel rails, the cement, and the car were supplied by the Department, and the city of Calgary laid the water supply pipe to the edge of the rating station property. Everything else was included in the contract except some small electrical fittings, which were installed after the work was completed under the writer's supervision. The total cost of the station and equipment was $4,475.39. The total estimated cost for the station was $4,690.24.

In designing the work the aim was to gain the most perfect apparatus possible for rating the current meters and to create a permanent structure, so that it was early decided to use concrete in the construction of the necessary tank.

As no stretch of still water having a suitable length and depth was available, it was necessary to create a tank, and in studying its design two points had to be principally considered. First, as the water supply had to be taken from the city mains the tank had to be made proof against any leakage, as the city authorities were not willing to guarantee any large supply of water such as might be required if any serious leakage from cracks developed in the tank. Secondly, the cross-sectional water area was required as small as possible, and yet of sufficient dimensions to guard against any following-on movement of the water, in running the meters through the tank. To overcome the first difficulty a heavily reinforced structure was designed, such that being emptied and exposed to the weather in winter no temperature cracks could develop, and the inside faces of the tank were waterproofed by Sylvester's process. In deciding on the proper cross-section of the tank to overcome the second difficulty no data were obtainable, but with the tank as constructed no following-on movement or undue disturbance of the water has been observed, even with the largest meters tested at velocities as high as 10 feet per second. The length of the tank (250 feet) was adopted in order to bring the cost of the structure within the limits of the amount of money available, but provision has been made in locating the tank for its future extension to a length of 500 feet, which is desirable in order to attain the highest degree of accuracy.



Meter Rating Car at Rest; Note the Switch Operating Rod Upright at Right and the "Time" Push Switch Opposite, near the Left Wheel.

A description of the station will be given, the various points of which will be made clear by referring to the several plates.

The main feature of the station is a car to which the current meter is attached and carried through the water in the tank at different uniform rates of speed. The three elements, the distance, the time, and the number of revolutions of the meter, are mechanically measured, and from these the velocity of travel of the current meter through the water is related to the revolution per second of the meter, which relation of revolutions to velocity constitutes the rating of the meter.

The concrete tank is 250 feet long with an inside width and depth of 6 feet by 5 feet 6 inches, and the depth of water to be maintained is 5 feet. The floor and walls are

8 inches thick, and are reinforced heavily, longitudinally and transversely, with ½-inch round mild steel rods, in order to absolutely preclude any temperature cracks in the concrete. The concrete was specified a mixture of one part Portland cement to seven parts clean river gravel, to have at least 15 turns in a good machine, and to be placed wet and thoroughly tamped. All the interior faces were thoroughly spaded in order to create a smooth, close-grained surface, to which to apply the Sylvester's wash. All steel rods at joints were overlapped 16 inches, and it was specified that they were to be wired so as to have contact throughout the whole of this length. The tank floor was laid on an 8-inch foundation of large stones overlaid with smaller stones and gravel, in order to provide thorough drainage for any water which might leak through the tank, so that when the tank is emptied in winter and exposed to the weather no heaving might result from any water being lodged under the tank bottom. The soil beneath is of sandy character, which is permeable to water. The water supply is from a 2-inch iron pipe laid from the city mains, and a 6-inch tile drain 224 feet long, fitted with an iron gate-valve at the tank, allows the tank to be emptied at any time into the Bow River. After the tank was completed all the inside faces were treated with two coats of Sylvester's wash. At the time of writing, the tank has been exposed empty to two cold snaps with the thermometer at 30°, and no cracking of the concrete whatsoever has resulted, except a few hair-line cracks near the top of the walls. As regards the waterproofing, two observation shafts were left along the tank sides running down to the foundation, and no leakage whatever was observed during the summer when the tank was full except a slight dampness at the bottom of the side walls. It should be noted that another reason why it was desired to make the tank leak-proof is that it is intended to obtain evaporation records at the tank in future seasons.

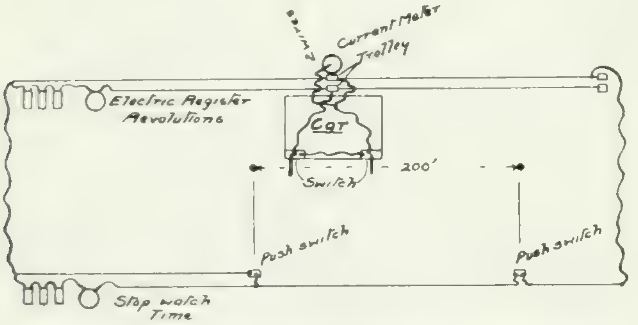


Diagram of Electric Connections

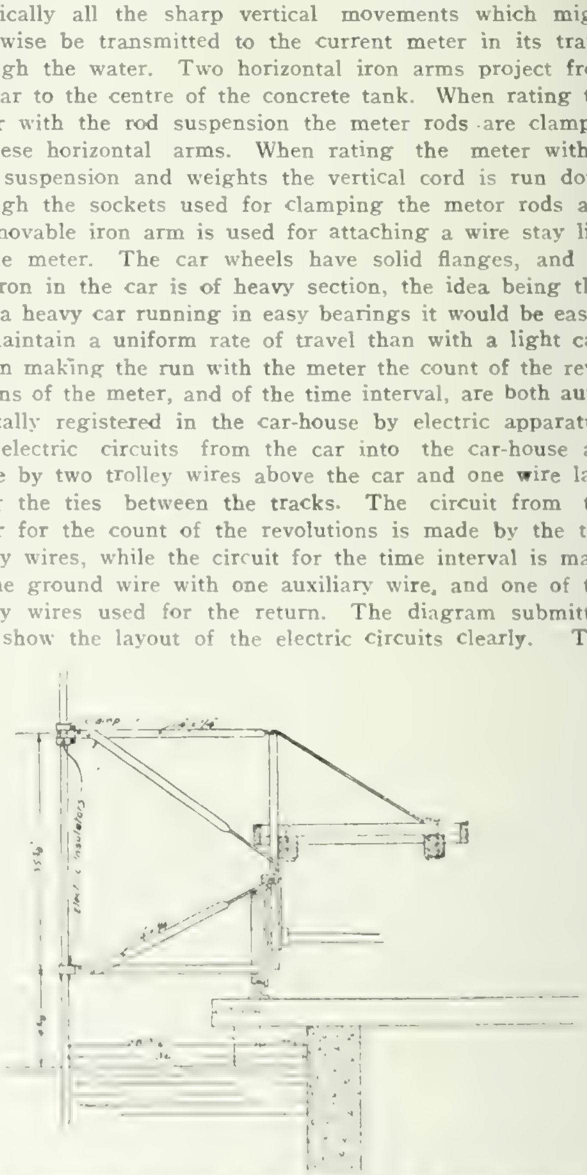
The track laid along side of the tank for the car is of [illegible] rails and laid to a gauge of [illegible] inches on 4 x 6-inch ties, fishplates and bolts being used at every joint. In laying the track, the greatest care was exercised to get it laid solid and as level as possible with close rail joints, in order that the car would run on the track as smoothly as possible. The measured run of the car is 200 feet, [illegible] feet being left at each end of the track in which to speed up the car, and the track passes at one end into the car-house, where the car is kept under lock and key when not in use.

The original idea was that the car should be mechanically driven by an electric motor working on one of the axles of the car. It is [illegible] that the rate of travel of the car over its measured course should be uniform, but after much consideration the writer was not able to devise any method of control by which the rate of travel of the car could be kept uniform (without acceleration) throughout its run, if driven by an electric motor or other mechanical means. The car is, therefore, propelled by hand, but its design is such that an electric motor can be easily attached at any future date if any means can be devised of overcoming the difficulty mentioned above.

The main features in the design of the car have been copied from the car used by the Bureau of Standards, United States Government, at their current meter rating station at Washington, D.C., blue prints of the design of which were very kindly lent by an officer of the Bureau of Standards.

The main features of the car are that the axles run in roller bearings, and the platform is attached to the front axle by a pinion joint, which makes the level of the platform entirely dependent on the rear axle, and thus any tendency of the platform to be twisted due to uneven tracks is overcome. It is thought that this arrangement eliminates practically all the sharp vertical movements which might otherwise be transmitted to the current meter in its travel through the water. Two horizontal iron arms project from the car to the centre of the concrete tank. When rating the meter with the rod suspension the meter rods are clamped in these horizontal arms. When rating the meter with a cord suspension and weights the vertical cord is run down through the sockets used for clamping the metor rods and a removable iron arm is used for attaching a wire stay line to the meter. The car wheels have solid flanges, and all the iron in the car is of heavy section, the idea being that with a heavy car running in easy bearings it would be easier to maintain a uniform rate of travel than with a light car.

In making the run with the meter the count of the revolutions of the meter, and of the time interval, are both automatically registered in the car-house by electric apparatus. The electric circuits from the car into the car-house are made by two trolley wires above the car and one wire laid along the ties between the tracks. The circuit from the meter for the count of the revolutions is made by the two trolley wires, while the circuit for the time interval is made by the ground wire with one auxiliary wire, and one of the trolley wires used for the return. The diagram submitted will show the layout of the electric circuits clearly. The distance over which each run is made is 200 feet, and this distance is marked by two rods set up vertically on the ties at the side of the car. On the car platform are two electric switches with long arms projecting over the edge of the car platform, and these, engaging with the two rods at 200 feet interval, close the electric circuit for this interval, running through the commutator box on the meter, and thus the revolutions of the meter over the interval of 200 feet are transmitted to the car-house, where they are registered by two electric registers set in series in order to check each other on the count. Some difficulty was experienced at first in getting the electric registers to count accurately when

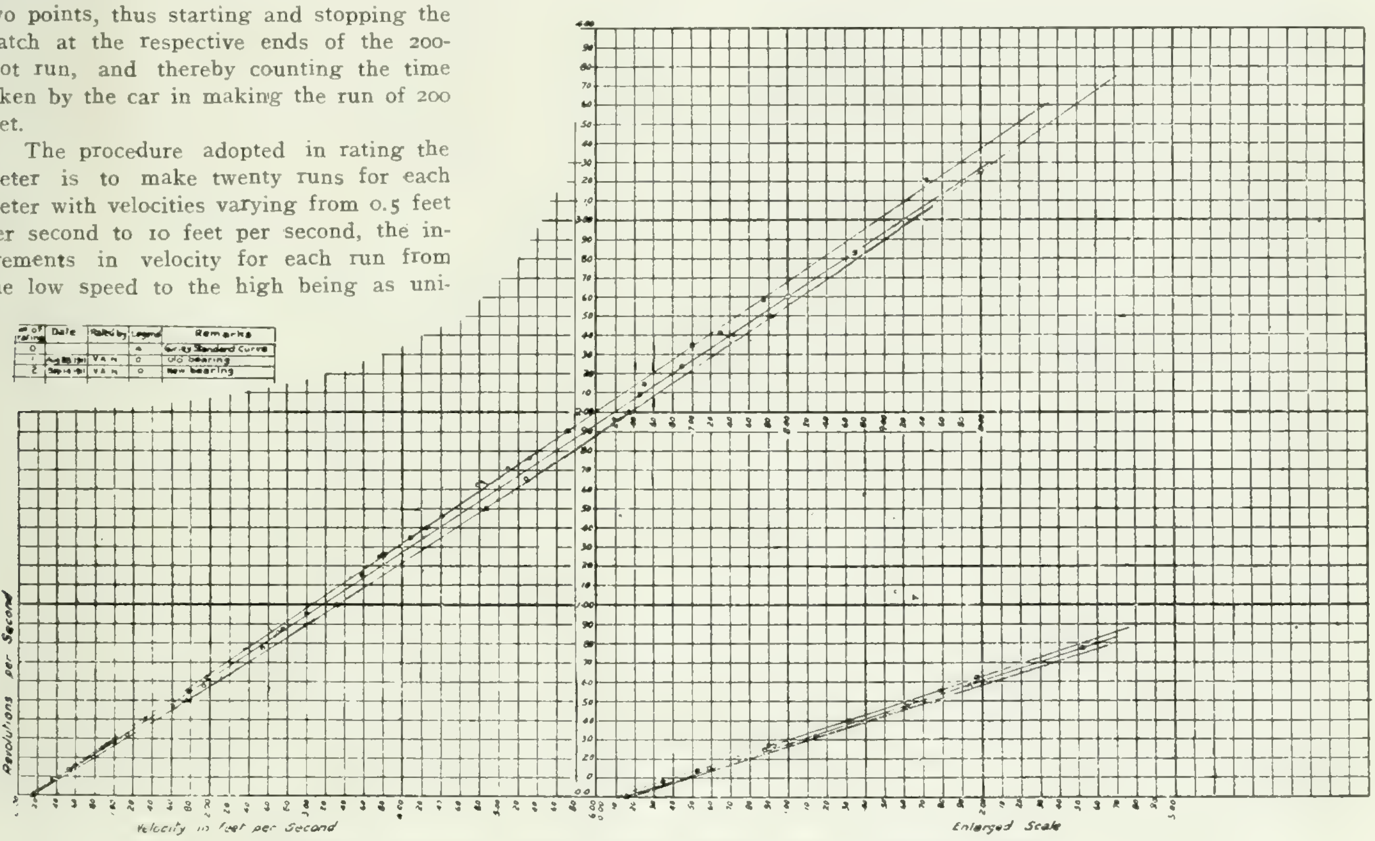


Sketch Showing Method of Suspension of Meter from Car.

running the meters at high velocities, but this difficulty was overcome by always overhauling the commutator box on the meters and making a fine adjustment of the make-and-break apparatus therein. It will be seen that this method of counting the revolutions is liable to be slightly in error, owing to the fact that the registers do not take any count of the fractional revolution of the meter at either end of the run. This error, however, would be reduced to a minimum by increasing the length of the run.

The time interval is counted by a stop watch, which is operated by a simple electro magnet, with a padded lever attachment, designed by the writer, in exactly the same manner that a stop watch is operated by hand. At each rod, marking the 200 foot interval, the circuit running through the stop watch via the two ground wires has inset a one-nipple push switch, and lugs, underneath the car, make and break the circuit as the car passes these two points, thus starting and stopping the watch at the respective ends of the 200-foot run, and thereby counting the time taken by the car in making the run of 200 feet.

The procedure adopted in rating the meter is to make twenty runs for each meter with velocities varying from 0.5 feet per second to 10 feet per second, the increments in velocity for each run from the low speed to the high being as uniformly distributed between the limits as possible. From the data thus gained the revolutions per second with their corresponding velocities per second are computed, the points plotted, and among them the most probable curve is drawn. From the rating curve thus constructed the rating table is prepared for use in the field and office, showing in convenient tabular form the velocities corresponding to the various revolutions per second of the meter, from zero velocity up to 10 feet per second. It should here be noted that the rule in the service is not to measure any stream at a section where the average velocity falls below 0.5 feet per second, and a velocity of 10 feet per second is about the highest met with in practice.



Rating Curve for Gurley's Large Electric Meter, Pattern No. 600.

Showing revolutions per second and velocity in feet per second. NOTE.—This meter was in hard use for two seasons and shows a typical condition of the variance of rating curves. Note that with the old bearing the meter ran fastest, and that the introducing of a new bearing brought the rating curves closer to the standard.

Mathematically, the most probable curve is that drawn from values found from normal equations by the method of least squares. It is considered, however, that the method adopted of taking the values off a curve carefully plotted as noted above is quite accurate enough to meet all practical requirements, and the saving of time and labor by using this method is very great.

For purposes of keeping a graphical office record of the succeeding ratings of the meters a separate sheet is prepared for each meter. On this is first plotted, for purposes of comparison, the standard curve for the meter (Gurley's standard curve for all Price electric meters), and all succeeding ratings of the meter will be plotted on the sheet in different colored inks, with notes as to the date of ratings, conditions of the meter, etc., until the confusion of many curves will require the preparation of a new curve sheet. Revolutions per second are plotted as ordinates to a scale of 4 inches to one revolution per second, and velocities in feet per second are plotted as abscissae to a scale of 4 inches to 2 feet per second. For velocities up to 3 feet per second, an auxiliary curve is drawn with the velocity scale increased to 4 inches to 1 foot per second, to allow for greater precision in taking the quantities off the curve.

It is the intention to carry on extensive experimental work in order to determine the various conditions that affect the rating of the current meter. Especially is it desirable to rate every large meter using the two methods of suspension, that is by meter rods and by cable with stay line. With the limited time available during the past season it was possible to rate the meters only with the rod suspension. Some of the results obtained, however, are surprising and worthy of note. The writer has had a lengthy experience with the use of the Gurley No. 600, large electric meter, and his idea has always been (and he knows that it was shared by other men of experience) that with continued use on account of the pivot bearings constantly wearing, the friction was increased, and the revolution of the meter was thereby retarded. The experience of the past summer in rating nine of these meters has indicated that after considerable use the meters run fast instead of slow. The evidence proves, that with considerable use the bearing points in the meter wear themselves smoother than when received from the makers, and hence have less friction than when they are new. The experiments, however, have not been exhaustive enough to prove anything conclusively beyond the fact that, except when they are perfectly new, no current meter can be relied upon unless it is carefully and frequently rated. The new medium size type of electric meter (Gurley's No. 623) has beeen adopted by this office for the first time this year, and, therefore, no experiments could be made on worn meters of this type. Five meters of this type were tested, of which two had been in light use for one season and three were perfectly new. All of these gave a rating curve practicaly the same as the standard curve issued by Gurley's, but in every case showing the meter running a little faster than Gurley's standard.

Of the small electric meters, Gurley's No. 618, nine were tested, and all showed nearly the same results, although four of them had been in use for two seasons and five of them were new. At low velocities the new curve coincided with Gurley's standard curve, but as the velocities increased the new curve dipped below the standard, which means that the meter was running slower than the standard. This may have been due to the bending at high velocities of the small meter rods by which the meter was suspended from the car. This bending from the vertical of the meter rods was actually noticed to take place, but there was no opportunity to use a stay line to keep the rods vertical, and thereby test the effect of the bending on the rating of the meter. As indicated above, it is the intention to carry on extensive experiments in the future to determine the effect of the method of suspension of the meter on the rating. In practice, all of the large streams are measured by suspending the meter in the stream with a cord and employing a stay line to hold the meter up against the current. Under these conditions, especially with high velocities, there is a tendency for the meter to sway continually from side to side at right angles to the current, and it will be interesting and important to determine what effect this has on the revolutions of the meter. Identical conditions will not be obtainable at the rating station, as the length of the cord suspension will of necessity be much shorter than that used either from a cable car station or from a highway bridge station, and this factor will no doubt enter largely into the [illegible] that the meter will have. Four rating curves are submitted with this paper in order to show graphically actual results obtained in rating meters of different types during the past summer. Explanatory notes have been added (which do not appear on the original office copies), and the curves were selected to show typical cases.

Mr. V. A. Newhall had charge of all the meter ratings during the past season, and under his direction the working parts of the station were put into order and the electric registers and recording apparatus were finally adjusted and improved to overcome difficulties met with in operation. To him, also, the writer is indebted for the notes on the behaviour of the several types of meters on being rated.

In conclusion, the writer would note for the information of members of the Society that the Irrigation Office is prepared to rate any meters that may be sent in by any engineers or others desirous of having their current meters tested and a certified rating table will be prepared and returned with the meters. A small fee, based on the salaries paid to the men by the Department, will be charged to cover only the actual time of the engineer and his assistant employed in making the rating and preparing the table.

◆

[illegible]

CONSTRUCTION OF SURFACES WITH BITUMINOUS MATERIALS.*

By Arthur H. Blanchard, M.Am.Soc.C.E.†

Various kinds of bituminous materials have been used in the United States in the construction of roads and pavements for over fifty years. The introduction of the use of bituminous surfaces and bituminous pavements in the construction of highways outside of built-up districts is af comparatively recent origin in this country, dating practically from 1906. Since that period the growth of the use of asphalts, asphaltic oils and tars has been exceedingly rapid. For example may be cited the increase in the yardage of bituminous surfaces and bituminous pavements constructed with bituminous materials, not including light oils, under the jurisdiction of eight state highway departments of the east. In 1908 the total yardage was 416,700, while in 1911, 17,749,000 yards were constructed. The discussion of this subject will be presented in the form of a brief resumé of typical current practice and a review of some of the causes of failure of the different types of bituminous surfaces and bituminous pavements.

In order to avoid misunderstandings, the various methods of using bituminous materials referred to in this paper will be explained by the following definitions:

Bituminous surfaces are those consisting of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous macadam pavements are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous gravel pavements are those consisting of gravel and bituminous materials incorporated together by penetration methods.

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, etc., or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous surfaces are usually constructed on macadam or gravel roads, or on bituminous pavements or cement concrete pavements. A notable innovation is the use of bituminous surfaces on brick and wood block pavements. In the case of roads, the mode of procedure is to thoroughly clean the surface by sweeping with hand brooms or horse sweepers or combination of these methods. The bituminous material, which is generally heated, is applied to the surface with the aid of pouring cans, hose attached to gravity tanks, hand-drawn gravity distributors, horse-drawn or power-driven gravity distributors and pressure distributors. After a varying interval, some kind of mineral coating is generally applied to cover the bituminous material.

The causes of failure of bituminous surfaces are numerous. They may be considered from the standpoint of the condition and character of the original surface, the material used, the method of construction or local conditions.

The failure of bituminous surfaces from the standpoint of the character of the original surface is many times due to failure on the part of those in charge to place the surface in satisfactory condition before the application of the bituminous material. Many cases are noted where bituminous materials are applied over a surface in which are found many pot holes and ruts, or which is dirty, due either to

---

[*] Presented before the American Road Congress at Atlantic City on October 4th, 1912.

[†] Professor of Highway Engineering, Columbia University, New York City.

accumulated dust and dirt or to the original method of construction. With certain kinds of materials a damp condition of the surface has resulted in failure.

From the standpoint of the physical and chemical properties of the material, many instances may be cited in which failure is due to materials not having the proper characteristics for the conditions under which they are employed. As an example might be cited the case of a prominent thoroughfare in one of our large cities which is subjected to motor 'bus traffic and a large amount of motor car and horse-drawn vehicle traffic. This road is constructed of gravel upon which has been applied an asphaltic oil and gravel top dressing. The surface at the present time in many sections is full of ruts caused by the traffic pushing the material from side to side. Again, the large percentage of volatile constituents contained in certain asphaltic oils has rendered surfaces constructed with them unsatisfactory because of the long period required for these surfaces to "set up" so that the bituminous material will not track or the carpet thus formed will not creep and form waves and humps. In certain cases the use of light oils on tar or asphalt surfaces has softened the original bituminous surface to such an extent as to render the road or pavement unsatisfactory for use.

From the standpoint of construction, we find failures due both to the use of too small an amount of the bituminous material and an excess of material. Improper application, resulting in uneven distribution, is accountable for many failures of bituminous surfaces, while in other cases a lack of sufficient covering of stone chips or material of a similar character has rendered the surface sticky, mushy, sometimes in the first season, but sometimes not until the second summer.

There are numerous instances where bituminous surfaces have been adopted under conditions which call for the construction of bituminous concrete pavements or even some type of block pavements. A mat type of construction, which has been employed to a considerable extent, has proved inefficacious in cases where horse-drawn vehicle traffic has been more than a certain amount in combination with a motor car traffic which in amount was not sufficient to satisfactorily iron out the calk holes caused by the horse-drawn vehicle traffic. There are cases where esthetics should govern the selection of the type of surface, and generally in such cases the black or brown surface resulting from the use of bituminous material does not harmonize well with the environments.

Bituminous macadam and bituminous gravel pavements are of many types, one of the primary differences in construction being the use of one or two applications of the bituminous material. The efficacy of many of the types depends upon the combinations of sizes of broken stone or gravel and the combinations of bituminous materials used when two applications are employed. Variations in types also exist dependent upon the manner in which the different courses may be filled and the treatment of the filled course prior to the application of the bituminous material. The one application method is very similar in its simplest form to the construction of a bituminous surface except that the bituminous material is applied upon a much more open surface. In the case of the two-application method in certain instances an attempt is made to build up a two-course pavement, while in others the second application is in reality used as a seal coat.

Unfortunately many are the instances where improper bituminous materials have been employed. In some cases the materials were satisfactory in themselves, but were used improperly. Many engineers having charge of bituminous work do not appreciate the cold fact that different types of bituminous materials have entirely different physical properties and require entirely different treatment in use, although they may have been purchased under one and the same specification covering chemical and physical properties. In some cases entirely unjustifiable combinations of materials are employed. For instance, one case is in mind where an asphalt of excellent characteristics was used for the first application, while for the second application an asphaltic oil having decidedly solvent and fluxing properties was employed. Overheating of the material has likewise proved the cause of many failures, as thus the properties of the materials are sometimes changed and in many cases the materials are ruined.

Under the heading construction, we find failures due to the uneven distribution resulting especially from the improper use of hand pouring pots and hand-drawn distributors, and also in many cases when horse-drawn or power-driven distributors are employed. Many unsatisfactory bituminous macadam pavements result from the use of the wrong sizes of broken stone. One instance will be cited where a hard broken stone ranging from 2 to 3½ inches was used for the wearing surface. After rolling, 1½ gallons of bituminous material was applied and the road finished with a layer of chips. The rapid formation of fine cracks, due to the rocking movement of the individual stones under traffic, finally resulting in raveling and general disintegration, is of common occurrence. Segregation of sizes of stone preventing uniform penetration results in weak spots in some cases and "fat" spots in others. In certain cases after a rain the construction has been carried on before the broken stone immediately below the surface has dried out. Many of the causes attributed to the failures of bituminous surfaces may likewise apply to bituminous macadam and bituminous gravel pavements.

Bituminous concrete pavements other than sheet asphalt and pavements laid by companies as proprietary articles have received more attention during the past season than at any time since the days of Abbot, Leverich, Scrimshaw, and Van Camp. Less fear of litigation proceedings and the introduction of economical mixing machines equipped with heating attachments have exerted a marked influence. But, furthermore, the rapidly growing recognition of the inherent advantages of bituminous pavements constructed by the mixing method has been largely instrumental in its adoption for traffic conditions for which it is believed to be economical and suitable.

This type of bituminous pavement is constructed usually by one of three methods. These methods, although overlapping to a certain extent, may be described as follows when broken stone is used as an integral part of the mineral aggregate.

Type A consists of so-called one size crusher run broken stone mixed with bituminous material. It should not be considered that the designation "one size crusher run stone" means an aggregate composed of broken stone of uniform size. This term, as used here, refers to the product obtained at a crushing plant which passes over one size of screen holes and through the next larger, or passes through a screen of one size of holes and is retained upon a screen having smaller holes. It is evident to those familiar with the operation of crushers that the product thus obtained does not usually consist of stone of uniform size. For example, broken stone commercially designated as "three-quarter inch," used in the vicinity of New York City, is obtained in some cases by passing over ½-in. and through 1¼-in. openings. The size of the stone varies from one inch to one-eighth of an inch. It is self evident that this variation in size produces a more stable pavement than if the aggregate consisted of broken stone of uniform size. Type A has been constructed by both hand mixing and machine mixing and by using both unheated and heated stone. Many kinds of bituminous materials have been used, while in some cases one kind of bituminous material has been used in the mix and another kind for the seal coat; one of the most common combinations being the use of tar in the mix and asphalt for the seal coat.

Type B consists of one size crusher run broken stone and sand or other fine mineral matter mixed together with bituminous material. The wearing surface of this mix is sometimes finished by rolling in fine stone chips, but generally a seal coat is used together with fine mineral matter for a top dressing. When constructed on a commercial scale, the mineral aggregate is always heated and mixed in a specially constructed machine. Usually the same grade and type of bituminous material is used for the mix and the seal coat.

Type C consists of a wearing course composed of a graded aggregate of broken stone and sand with or without other mineral matter, which aggregate is mixed after being heated with a bituminous cement in a specially designed machine. As with Type B, this pavement is finished with and without seal coats of bituminous material. The Topeka and the Bitulithic pavements may be cited as examples of Type C.

Having reviewed the fundamentals of the various types, consideration will now be given to causes of failure of some bituminous concrete pavements. It should be noted that the percentage of failures of bituminous concrete pavements is much smaller than in the case of bituminous macadam and bituminous gravel pavements.

Poor and unsuitable materials have been accountable for certain failures. Attachment for a material of a certain type has led to a blind adoption of any material belonging to a given class. For instance, in one case coming under the writer's observation, crude coal tar from one gas works had given good results on the average. Based on this fact, any crude coal tar was finally used, although those in authority had had an object lesson in a failure due to the haphazard purchase of crude coal tar. Experiments in Rhode Island and in the Borough of Queens seem to have demonstrated that high carbon tar of a certain consistency is not as satisfactory or advisable for a seal coat as some types of asphalts, when the percentage and volume of horse-drawn vehicle traffic is large. In some cases an apparent cause of failure has been an excess of flux or of the volatile constituents in asphalt cements. Pavements constructed with such materials many times are wavy, due to the movement of the surface under heavy traffic. Many cases are reported where materials have been overheated at the construction [illegible] may be, and even should be, heated to the same temperature before using and that it is impossible to injure bituminous materials by heating to high temperatures.

During construction there are various details which demand careful supervision. Either too large broken stone or [illegible] this the case with very hard and tough broken stone. The [illegible] which eventually lead to disintegration. Naturally, the amount and character of the traffic is intimately connected [illegible]

unsatisfactory results. In many instances the seal coat has been applied ununiformly. The result is either uneconomical, due to the necessity of a second application before seventy-five per cent. of the surface requires treatment, or the disintegration of the pavement wherever bare spots occur in pavements where a coarse aggregate was used and where there is considerable horse-drawn vehicle traffic. Although of minor import to-day, some failures have been caused by using with unheated stone bituminous cements which will not adhere satisfactorily or which only mix with great difficulty under such conditions.

Many failures are due in both the case of bituminous macadam and bituminous concrete pavements to poor foundations. Sufficient attention has not been paid to this important part of the pavement.

Many of the above causes of failure would be eliminated if engineers would devote more time to a consideration of the physical and chemical properties of the materials which they employ. Records should be at hand covering this data and details of the success or failure of every road noted. If a bituminous material laboratory is not connected with the department, it should not be either expensive or difficult to secure certified analyses made by reputable chemical engineers.

In closing, the writer wishes to emphasize the fact that a careful consideration of the causes of failure of bituminous surfaces and bituminous pavements constructed during the past five years will result in material benefit, inasmuch as a comprehensive knowledge of the various causes of failure is one of the most valuable assets of engineers having in charge the construction and maintenance of bituminous surfaces and bituminous pavements.

◆

AMONG BRITISH COLUMBIA'S MINES.

With a production of 26,683 tons for the third week in September the Granby Company at Grand Forks, B.C., set a new record for smelter treatment in one week and brought the company's total output for the year to 905,782 tons.

Blister copper shipments were also heavy, a total of 523,000 pounds being sent to the refineries. Another Boundary property, the Mother Lode mine of the British Columbia Copper Company, made an unusually heavy shipment, sending 8,201 tons to the smelter at Greenwood, B.C.

Among the silver-lead properties which continued to make the heavy shipments which are one of the striking features of this year's Kootenay and Boundary mining, a new shipper was the Panama near Kaslo which is being operated by Mr. Henry Giegerich and associates.

Work on the tramway at the Rambler-Cariboo mine is making rapid progress and when completed will result in a heavy increase in ore shipments from the property.

Ore production totalled 52,666 tons for the week and 1,764,904 tons for the year to date. Smelter receipts for the week were 47,451 tons and for the year to date, 1,607,190 tons.

Ore production in detail is as follows:—Slocan and Ainsworth production, week 2,472 tons, year 77,373 tons; Boundary production, week 42,332 tons, year 1,445,334 tons; Rossland production, week 5,519 tons, year 174,335 tons; East Kootenay production, week 1,069 tons, year 31,309 tons; Nelson production, week 1,[illegible] tons, year [illegible] tons. Consolidated Company's smelter receipts, Trail, B.C., week 6,755 tons, year 224,918 tons.

British Columbia Copper Company's receipts, Greenwood, B.C., week, 14,013 tons, year 476,490 tons.

Granby smelter receipts, Grand Forks, B.C., week 26,683 tons; year 905,782 tons.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404, 7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 2[illegible]. TORONTO, CANADA, OCTOBER 24, 1912. No. 17

CONTENTS OF THIS ISSUE.

Editorial:

The Proposed Works of the Long Sault Development Company and the St. Lawrence Power Company 645
Experiments in Roadmaking in Saskatchewan ..... [illegible]
Utilization of Peat Fuel ..... [illegible]

Leading Articles:

Brick Roads—Materials, Construction and Maintenance ..... [illegible]
An Electric Fountain of Unique Design ..... [illegible]
The Ventilation of Sewers ..... [illegible]
A Current Meter Rating Station 639
Construction of Surfaces with Bituminous Materials 642
Designing Brick and Steel Chimneys ..... [illegible]
Systematizing Form Work ..... [illegible]
Collection and Disposal of Municipal Wastes 651
Economics of Power Transmission Lines ..... [illegible]
The Plant of Thor Iron Works, Limited ..... [illegible]
Coast to Coast ..... [illegible]
Personals ..... [illegible]
Coming Meetings ..... [illegible]
Engineering Societies 662
Market Conditions ..... [illegible]
Construction News ..... [illegible]
Railway Orders 72

THE PROPOSED WORKS OF THE LONG SAULT DEVELOPMENT COMPANY AND THE ST. LAWRENCE POWER COMPANY.

Our readers will remember that about two years ago there was considerable discussion over the proposed power development at the Long Sault Rapids on the St. Lawrence River. The company who are promoting this development have so far failed to secure a charter on account of the vigorous protests of different Canadian bodies, among them the Commission of Conservation. They have also failed to secure sanction of their project by the Federal authorities of the United States. The St. Lawrence Power Company, Limited, owns the power development at the foot of Sheek Island, near Mill Roches, Ontario. It takes water from the Cornwall Canal, on the north side of Sheek Island, and furnished electric power and light for the Cornwall Canal. The fall in the St. Lawrence River adjacent to the plant of the St. Lawrence Power Company, Limited, would furnish a substantial amount of power. Investigation has shown that without the co-operation of the riparian owners on the opposite American shore, the company can develop this power only to a very slight extent.

The Long Sault Development Company, a New York State corporation, is empowered by its charter to construct dams, power-houses, locks, and other works in the St. Lawrence River, so far as these works will be in American territory. By co-operation and developing the work of the Long Sault rapids, these two companies expect to realize the full potentiality of the river.

Although the project has received two years of strong opposition, still the company continues its campaign to acquire a charter from the Canadian and the United States governments. It is rather expected that the United States charter will be granted this coming session.

The company claims, among other things, that the construction of the works will afford abundant reliable and cheap power to all districts within the radius of transmission of electricity from the power-house; that the furnishing of cheap power will create many new industries, and will be of great advantage to those already established; that the construction of the proposed dams and power-houses will require the expenditure of many millions of dollars, which will be distributed among the transportation companies, manufacturers, tradesmen and workmen, and that the power from the entire development will be used almost exclusively for manufacturing purposes, which will mean increased revenue to the transportation companies, who will distribute these products by boat and rail. It is also stated that navigation will be very much improved; that the South Sault lock will duplicate the means now afforded by the Cornwall Canal for navigation past the Long Sault Rapids, and thus prevent delay due to failure or accident; that the construction of these works will enable boats passing the Long Sault to make a round trip in approximately four and a half hours less time than at present. It might be added that the charter would also allow them to develop a half million horse-power at a very low rate per horse-power.

The above claims of benefits accruing to the country as the result of this proposed development are very interesting, and on their face value, very fine. It must be remembered, however, that at the point where this development is suggested on the Canadian side there are very few industries at the time who would use electric power. How easy it would be for the company, after obtaining their charters, to locate the power-houses on the American side of the river. In fact, the location of the dams, canals and power-houses leads one to believe that practically all of the development will be on the American side of the line; therefore, the expenditure of many millions of dollars on the development will not mean a great deal to Canadian manufacturers. Under present conditions the development of this vast amount of power would not find a ready market for many years in Canada. The outcome of the matter would be this: from power-houses erected on the American side of the line, and developing 500,000 horse-power, the largest available market must be secured. In all probability a great portion of this power would be transmitted to New York city, which is, roughly, 400 miles. This is quite within reason with the present status of electric power transmission.

So far as we can see at the present time there are many reasons why the proposal of this company should be viewed with suspicion from the Canadian standpoint. There are two many chances against an equal division of the results of the development. It is understood that the Commission of Conservation are preparing a report containing a large amount of data dealing with the whole proposition. No doubt no action will be taken by the Dominion government until the whole matter has been carefully investigated. Certainly no such charter should be granted until the government are absolutely sure that Canadian interests are adequately safeguarded.

◆

EXPERIMENTS IN ROAD-MAKING IN SASKATCHEWAN.

One of the elements of most vital importance in the development of any country is its transportation facilities, and the public road is probably the most important of the different means of communication. That we are beginning to appreciate this, more and more, is evidenced by the fact that the Dominion government and the several provincial governments are now lending assistance in the form of grants of money and by the establishment of highway boards to further the good roads movement. A recent communication from Mr. A. J. McPherson, chairman of the Board of Highway Commissioners of Saskatchewan, gives some interesting facts concerning the work being done in that province. Saskatchewan has gone about it in the right way in its initiation of a system of good roads. The provincial government has appointed a highway commission under the chairmanship of a technically trained man with a great deal of practical experience. As a result, they are proceeding along right lines in finding out, first; the type of construction which will be most economical and efficient for the province. To illustrate their methods some of the work of the commission may be instanced. Dr. W. W. Andrews, of the Highway Board, has been engaged for some time past in investigating the practicability of treating the gumbo clays, which are spread so abundantly throughout the province. Quite a large section of the province lying from Weyburn north-west to the Elbow, on the South Saskatchewan River, and north of the South Saskatchewan to the Alberta line, consist of a gumbo clay which does not lend itself to making satisfactory roads. Even an application of gravel or crushed stone is not a success, as the clay is of such a nature that when dry, it is exceedingly hard, and it is practically impossible to prevent [illegible] or [illegible] forming on the road. When wet it turns into a liquid, and in a very short time any coarse material that is put on the road becomes impregnated with this liquid and is lost. Experiments have been made with tannic acid, which, when applied to this clay, will take away some of these qualities, the tannic acid being obtained from ordinary straw or hay by means of a certain process. It is understood that this method has not proved itself up to the present to have a likelihood of success. Dr. Andrews has also devised a method of calcining the clay by means of burning lignite or straw in the form of a kiln on the road. The results from this method seem to show that there is some hope of success. When the clay is calcined in this way it does not form a mud, as it will in its natural state. An experimental piece of road is now being tried on a practical scale with the object of seeing how the resulting products from the calcination process will stand the test. It will also give the Commission an idea of the cost of a unit length of road by this method. The Highway Commission of Saskatchewan are to be congratulated on their enterprise. This Commission is an example of what may be secured when technically trained men are appointed to positions calling for technical knowledge.

◆

UTILIZATION OF PEAT FUEL.

A report on the utilization of peat fuel for the production of power has just been published by the Department of Mines. It is a record of the experiments conducted at the fuel-testing station at Ottawa during 1910 and 1911 by Mr. B. F. Haanel, B.Sc. This report is enthusiastic regarding the result of these experiments. Describing certain alterations made to the peat gas producer and cleaning system, Mr. Haanel says: "The main difficulty, however, still exists, as in the old form of the producer, namely, the formation of a variety of tar; as a thin liquid when condensed, and as finely divided particles carried in a state of suspension after passing through the cleaning system. This objectionable by-product cannot be obviated in the producer itself, but must be separated out mechanically.

In estimating fuel costs Mr. Haanel assumes that peat with a moisture content of 25 per cent. can be delivered to the producer for $2 per ton. "In order, however, to take advantage of this, or a lower cost for fuel, the power plant will have to be situated at or near the bog where the peat fuel is manufactured. For small plants this might not prove feasible in many cases; but will prove entirely feasible and practicable when the plants are of large capacity and when the energy developed is transmitted, in the form of electricity, to neighboring towns and villages, for lighting, power and other purposes.

"Since the fuel burned in the producer does not require to be of the best quality," he continues, "the fuel cost may be considerably reduced, since the broken peat bricks and considerable fines—which always occur in the manufacture of peat, and otherwise represent a loss—can be efficiently utilized in the producer. Assuming, however, that peat can be delivered to the plant for $2 per ton, and that the plant is run with a power factor of 75 per cent. for 3,000 hours, the fuel costs would be $8.30 per B.H.P. year, including standby losses."

No doubt this report is made only after most careful thought and investigation. There have been so many reports during the past fifty years regarding the successful utilization of peat, that reports to-day are received with some measure of reserve. We sincerely hope that Mr. Haanel's predictions will be justified, for the utilization of our peat fields will mean a great deal for the industries of Canada.

DESIGNING BRICK AND STEEL CHIMNEYS.

In designing chimneys the height is generally decided upon first. This involves consideration of the height of surrounding buildings or hills, the length of all horizontal flues necessary, the character of fuel to be used, etc., as well as any local laws or ordinances that may apply. The chimney diameter may then be calculated, based upon the selected height and the boiler horsepower or the amount of fuel to be consumed. In the October 8th issue of Power, Mr. Everard Brown discusses the designing of chimneys and we herewith reproduce the article.

The minimum height necessary, however, will be governed to a great extent by the fuel—wood usually requiring the least and fine anthracite coal the greatest—the character of the installation and the number of furnaces served. Obviously the smaller and more round-about the flues, the higher must be the stack; likewise, a single furnace will require less height than several discharging into a common flue. On account of these variables, it is practically impossible to evolve a general formula applicable to all cases. Except in rare instances, extremely tall chimneys are not necessary and any increased efficiency gained by them hardly ever justifies their greater cost. The tendency is to build two or more smaller ones rather than one high one, which can very often be done at less cost.

A chimney should be proportioned to give sufficient draft for the boiler to develop much more than its commercially rated power, or, according to Kent, to bring about the combustion of 5 lb. of fuel per rated boiler horsepower per hour. By assuming such a liberal rate of combustion, the stack will certainly be large enough. Based on this assumption Kent gives the following equation:

$$E = \frac{0.3\ Hp.}{\sqrt{H}} = A - 0.6\sqrt{A}.$$

where:

E = Effective sectional flue area of stack in square feet;
Hp. = Horsepower of boilers;
H = Height of chimney;
A = Actual sectional flue area of stack in square feet.

The actual is not the effective sectional area because friction retards the ascending gases. The annular stratum of gas retarded by the wall in reality diminishes the flue area.

Molesworth gives:

$$A = \frac{Hp.}{1.28\sqrt{H}} = \frac{C}{12\sqrt{H}}$$

where

C = Pounds of coal consumed per hour.

From this equation, H may be found if the sectional area is known or assumed, or by the same process the horsepower may be found for which an existing stack is sufficient. Sometimes wind-caps are used to increase the stack capacity, but this is only rarely advisable because of their dangerous position.

Stability and wind resistence are next to be considered. Wind pressure is usually assumed to be horizontal and uniformly intense at all levels. Where a chimney is shielded by buildings, only the part actually exposed need be considered. Generally a maximum pressure is assumed of 50 lb. per square foot, although this would require a wind velocity seldom reached. A simple rule for calculating wind pressure is:

The square of the velocity in miles per hour divided by 200 equals the pressure in pounds per square foot.

The total pressure against a round chimney is about one-half that against the diametral plane of that chimney. It is therefore the product of the pressure per square foot by one-half the total projected area of the exposed part. Similarly the total pressure may be calculated for chimneys of almost any form.

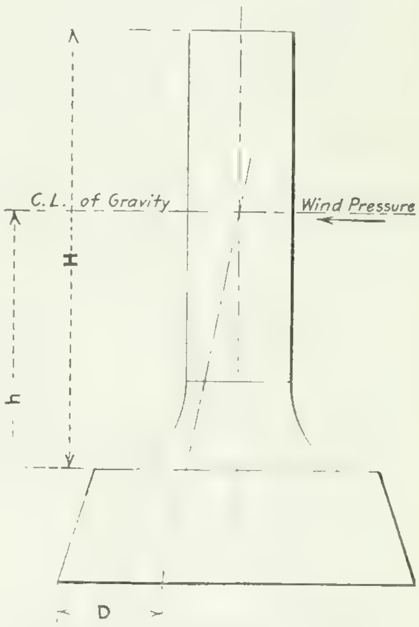
The resultant of this pressure may be assumed to act horizontally through the centre of gravity of the exposed part. The stability of a wholly exposed chimney, therefore, is determined by finding the moment of this pressure acting through the centre of gravity. From the accompanying illustration this moment is

$$h \times P_1 = H \times P \times \frac{A}{2}$$

where

h = Height of the centre of gravity above the top of the foundation;
P_1 = Total pressure exerted;
H = Total height of the stack;
P = Pressure in pounds per square foot;
A = Total vertical sectional area.

For chimneys with vertical axes, the moment of stability is the same in every direction, but few chimneys have exactly vertical axes; therefore, the least moment of stability must be considered as that which opposes the lateral pressure in the direction in which it leans. The stability at any height of a chimney, for example at a certain bed-joint of a brick structure, may be established in the same way by simply considering that part of the chimney above the point at which the stability is to be determined. Opinions differ regarding the strength of brickwork, which, together with the varying qualities of materials and workmanship, makes it exceedingly difficult to accurately calculate the power of resistance. Consequently a large factor of safety is always advisable.



Determining Stability of Chimney.

Fundamentally, a chimney's stability depends upon the weight of its outer shell and the diameter or width of its base, and, while the cohesion of the mortar in a brick stack may add something to its strength it is too uncertain to be relied upon. The effect of the two forces—the weight of the chimney and the pressure of the wind—is to shift the centre of pressure at the base from the axis toward one side, extent depending upon the relative magnitude of the two forces. A comparatively safe rule to follow is to make the base diameter not less than one-tenth of the height. This rule has been approved by many years of actual practice

Steel Chimneys.—Probably the cheapest chimney is a straight steel shell guyed with rods or wires. These are secured to the shell, usually by an encircling band, and should be anchored to incline at an angle of not more than 45 deg. with the ground. Where other structures are convenient the guys may be fastened to them. This type of stack is rapidly being supplanted by the so-called self-sustaining stack. It can be lined or not. Ordinarily when working to full capacity, the high velocity of the ascending gases allows little heat to be lost by radiation even through [illegible] If the gas temperature is [illegible] lining is desirable at least part way up. Firebrick is sometimes used, but probably more often hard-burned red brick that can withstand temperatures up to 750 deg. without injury. This lining should never be less than 4½ in. thick at the top, whether it goes up only part of the full height of the stack and should be thicker toward the bottom by 4½ in. for about every 35 or 40 ft. Not less than 1 in. should be allowed between the shell and the lining with no rigid bond between them, thus making both self-sustaining and allowing for expansion and contraction.

For ease of construction and economy, uniform diameter of the shell for all sections is preferable; the bottom of each section should lap outside the top of the next section below, except for brick-lined structures, when the reverse is often preferred. The rivets in horizontal joints should be double staggered, thus giving more lap for the sheets and, consequently, more stiffness to the shell. Single-riveted joints usually answer for vertical seams. If possible, each section should be made of a single plate, to avoid the extra riveting. In the flaring base both the vertical and the horizontal seams should be double staggered. The cone-shaped base is naturally the strongest, but bases curved like a bell are quite common, and may be equally strong if thicker material is used. Better appearance is the only advantage of the curved base.

Occasionally instead of either cone- or bell-shaped bases, the shell is made perfectly straight down to the foundation and anchored to it by steel braces or cables with turnbuckles. The latter are usually fastened to the stack at a height of about three diameters of the flue and have approximately the same slope as the conical base. This type of construction [illegible]

Caps or other ornaments at or near the top of a steel chimney are no use and a poor investment, but if desired should be of copper to be quite light and rust-proof, and firmly attached to prevent risk of being blown down, causing damage or human injury.

The chief advantages of the self-sustaining steel chimney over all others are less space occupied above the ground, and easier and more rapid construction and erection; and over brick chimneys in particular, lighter weight often saving pile driving in low load-sustaining soils; less area presented to the wind; elimination of air infiltration and consequent checking of the draft; greater strength and safety, and smaller cost. Places and conditions where steel shell construction would not be at all practicable nor economical are, for example, along the sea coast or where acid fumes [illegible]

Brick Chimneys.—The most common brick chimney is [illegible]

[illegible]

ordinary red brick the lengths may be from 25 to 30 ft. with an outside batter of 1 to 30 or 35, or they may increase gradually from the lowest division to the highest. Using bricks of greater crushing strength, these divisions may be made longer. The wall thickness and the batter must conform to the various lengths to insure stability. The former, giving weight to the structure, and the latter, presenting a sort of lever arm, combine to resist wind pressure. Since a swaying motion is usually set up by the wind, it is never desirable to connect the chimney rigidly with any other structure.

[illegible], much depends upon the workmanship and material; both should be of the best. Important, also, is not to erect too rapidly for the mortar to properly set and the foundation should have plenty of time to harden and settle. In several ways the brickwork may be bonded satisfactorily. The most common bond is probably one row of headers for every five rows of stretchers, although alternate rows of headers and stretchers, or two of the latter for one of the former are also used. Often in large chimneys an iron or steel hoop or tee iron is laid within the brick wall every few feet. This is good, especially where the wall thickness exceeds, say, 10 to 12 in.

Concrete Chimneys.—Reinforced-concrete chimneys are least common and were introduced only about 10 years ago. Information regarding them is meagre and they have hardly had time to demonstrate their durability. Ordinarily, they have inner and outer shells with an annular air space between. The shell thickness depends upon height, diameter, etc. The steel reinforcement is usually vertical bars with ends overlapping, spaced according to the size of the chimney. These bars are encircled by steel rings and are extended down into the foundation to insure a good anchorage. They are calculated to resist all pressure by the wind and any tensile strength in the concrete is usually considered an addition to the safety factor.

Foundations.—Logically, the first detail is the foundation and in its design must be considered any local building laws that apply. These laws usually specify the loads allowed in tons per square foot of area for ground of various kinds. Where the soil is very loose or sandy, piling is often necessary, but, regardless of expense, a solid, amply large foundation is imperative. Brick, stone or concrete may be used either individually or collectively. Concrete is commonly used for the subfoundation with brick or large stone above. The area of the foundation should be sufficient to prevent unequal steeling. It will receive greater pressure from above on the leeward side to the prevailing wind, resulting in a canting of the chimney if the foundation is not broad and substantial. The foundation should be such that wind pressure against the chimney will not unduly increase the load on it at any point.

To determine the stability of the chimney in relation to its foundation: first, find the greatest total wind pressure to which the chimney might be subjected and its moment about [illegible] the base of the foundation; second, the total weight of the chimney, including its lining and [illegible] the foundation itself. The former divided by the [illegible] will give the distance from the outer edge of the foundation, or the lever arm of the combined weight of the [illegible]

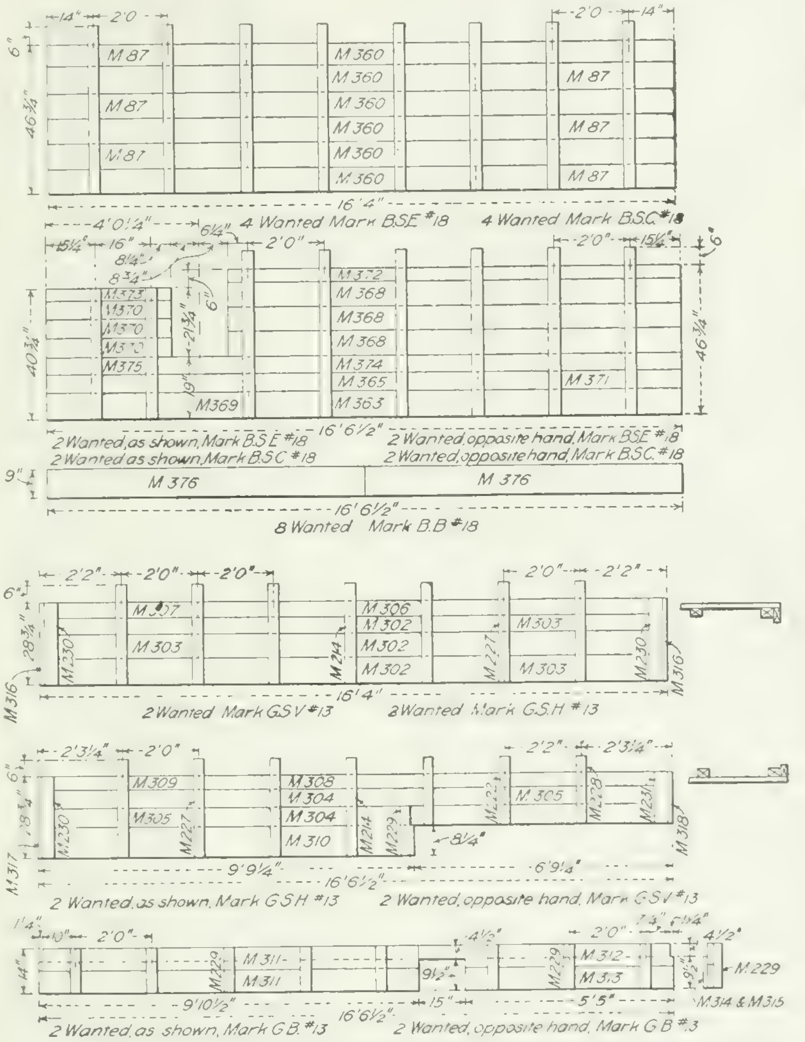
[illegible] struction and anchorage. In addition some strength will [illegible] Evidently the greater the combined weight of the foundation and chimney [illegible]

SYSTEMATIZING FORM WORK.

Reinforced concrete contractors recognize that the cost of form work is one of the dominant factors in determining whether a given job is executed at a profit or a loss. During the last few years a number of construction companies have been investigating methods of form work with an endeavor to devise some system whereby the cost could be reduced. One of the most successful efforts in this direction has been that of the Aberthaw Construction Company, Boston, who, by detailing the forms in the drafting-room of their home office and by a careful routing of the material, have reduced the cost of their form work 20 per cent. in the last three years. Those who have been in contact with this work have called it "scientific management," but a prominent construction engineer calls it "systematizing," and very aptly puts it: "We pay thinking men to think, and carpenters to saw boards."

Perhaps the very best way to illustrate the system is to consider the question of form work at the ten-story Larkin Terminal at Buffalo, N.Y. This building was erected by the Aberthaw Construction Co., while the consulting engineers were Lockwood, Greene & Co., of Boston. The total quantity of form lumber used was nearly 1,000,000 board feet. In order to understand that which follows it should be noted that this structure is 580 ft. long by 109 ft. wide, the floor space being over fourteen acres, and is bounded by Van Rensselaer, Carrol, Exchange and Hydraulic Streets.

First of all, at the home office a location plan of all beams was made. In this, similar beams were given identical numbers irrespective of location in the building itself. From this location plan form drawings in detail were made, a detail drawing being required for each different sized form, both for sides and bottoms, and the beams of different varieties of column forms were also detailed.



M 87
M 360
4 Wanted Mark B.S.E. #18
4 Wanted Mark B.S.C. #18
16'4"
16'6½"
2 Wanted, as shown, Mark B.S.E. #18
2 Wanted as shown, Mark B.S.C. #18
2 Wanted, opposite hand, Mark B.S.E. #18
2 Wanted, opposite hand, Mark B.S.C. #18
M 376
8 Wanted Mark B.B. #18
2 Wanted Mark G.S.V. #13
2 Wanted Mark G.S.H. #13
2 Wanted, as shown, Mark G.S.H. #13
2 Wanted, opposite hand, Mark G.S.V. #13
2 Wanted, as shown, Mark G.B. #13
2 Wanted, opposite hand, Mark G.B. #13
M314 & M315
M 229

Lumber Schedule 1st & 2nd Stories Wall Beam #18			
No Pcs	Size	Length	Mark
48	1¼"x7¾"	11'2"	M360
48	1¼"x7¾"	5'2"	M87
24	1¼"x7¾"	11'9½"	M368
8	1¼"x7¾"	11'3¼"	M363
8	1¼"x7¾"	5'3¼"	M369
24	1¼x5¾	3'3½"	M370
8	1¼x5¾	[illegible]	M365
8	1¼x5¾	5'3¼"	M371
8	1¼x4½	11'9½"	M372
8	1¼x4½	3'3½	M373
8	[illegible]	[illegible]	M374
8	1¼x5½	[illegible]	M375
16	1¾x9"	8'3¼"	M376
80	2"x3"	4'4¾	[illegible]
16	2"x3"	3'4¾	[illegible]
32	2"x4"	4'4¾"	[illegible]

Lumber Schedule 1st & 2nd Stories Wall Beam #13			
No Pcs	Size	Length	Mark
12	[illegible]	12'2"	M302
12	[illegible]	4'2"	M303
8	[illegible]	12'3¼"	M304
8	[illegible]	[illegible]	M305
4	[illegible]	12'2"	M306
4	[illegible]	4'2"	M307
4	1¼x5	12'3¼	M308
4	1¼x5	4'3¼"	M309
4	[illegible]	[illegible]	M310
8	[illegible]	[illegible]	M311
4	[illegible]	6'8"	[illegible]
4	[illegible]	5'5"	[illegible]
4	[illegible]	[illegible]	[illegible]
4	[illegible]	5'5"	[illegible]
8	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
32	[illegible]	[illegible]	[illegible]
8	2"x3"	[illegible]	[illegible]
36	[illegible]	[illegible]	[illegible]
[illegible]	3"x4"	[illegible]	[illegible]
4	3"x4"	[illegible]	[illegible]
12	2"x4"	2'10¾"	M227
4	[illegible]	[illegible]	[illegible]

Typical Detail Sheet and Timber Schedule.

The system of lettering used on this work is of particular note. In order to show the exact location of each form in the building, letters were suffixed to the beam numbers. For instance, a form marked BSE18 would mean that it was for the beam side of beam No. 18 on Exchange Street. The bottom form for this same beam would have the symbol BBE18.

An additional number had to be added to the symbol in the case of the column forms, as there is a variation in the height of the floors. The figures prefixed to the ordinary column symbol designated that the particular form was for the second story columns. To illustrate, a column form with symbol 2CSE19 would mean second story form column side Exchange Street, while 19 is the number of column proper as specified by the original location plan.

Form details were designed complete for two stories, and to each form detail was given a symbol to be stenciled on this form when made up, together with the number or quantity required in the first two stories of the structure. On this same form detail the width of the form was divided into an exact number of boards, which were to make up this total width of the dimensions written on the drawing. Therefore, having given the exact length of form and the width of the different boards going to make up this form and the total number of forms required for the job, it is quite readily seen how the sum total of boards, with the exact dimensions, was easily summed up.

Aside from these form details, it was, of course, necessary to draw plans showing assembling of forms, the chief object of this being to specify the spacing of posts and jacks, amount of bracing, and location. From this assembly plan, together with a layout plan of the building, the exact number of pieces and size of lumber constituting the centering could be scheduled. On this completed schedule bids were obtained from the various lumber dealers before ordering the material for the job.

It was very vital that a systematic plan of piling and laying out the lumber should be adopted, inasmuch as 1,000,000 board feet were used. Particular attention was given the dressed stock going to make up the forms proper, since this was taken to and from the mill to the benches. The lumber was so piled that when the laborer wanted a certain number of boards of a particular size he could find them quickly, for a plan was drawn showing the lumber layout and the relative location of different piles of lumber according to widths and lengths. Signs were placed in front of each individual pile, stating the dimensions. On the Larkin job the Aberthaw Company found it best to build two distinct saw mills, since 90 per cent. of the dressed stock had to be cut to exact length. Both mills had practically identical equipment, but were laid out slightly different. The most used piece of machinery in those mills was a cut-off saw, on either side of which was a table, where the stock was placed before being cut. The other equipment consisted of a rip-saw, boring machine, planer, and emery wheel.

To illustrate the methods employed in making up a complete form from the blue print as received from the central office it may be desirable to follow in detail a single operation.

The form details, as previously mentioned, stated exactly the boards which would constitute a particular form and the number of forms required. Cards were made out at the route clerk's office stating for the labor foreman the number of pieces of stock and sizes to be taken to one of the mills. The mill men in return received orders from the route clerk stating the length to cut off the stock, and, if ripping was required, to what width to rip. It was the duty of the labor foreman to tag this stock according to the M number indicated on his order card. When all the stock required for a certain form had been cut and delivered to the proper bench, orders were issued by the route clerk to the two carpenters, who worked at the same bench, to make the number of forms required as indicated on the blue print.

In order that the forms were made up in time to erect as planned by the office, eight benches were used, with two carpenters at each bench. The carpenter having been given his orders by the route clerk, telling him what lumber would be tagged to make up a certain specific form, and having been given blue print of the same form, he merely laid his stock on the bench and nailed it together. When the forms were completed a laborer oiled the same and stenciled them according to the symbols printed on the forms by the carpenters. If not required for immediate use the forms were piled systematically back of the bench at which they were made. When needed, teams carried the forms to that part of the building for which they were designed. Since it was previously determined at which point of the building the erection was to be started, a clerk was given the duty of listing forms as required for erection, and seeing that labor foreman received orders to have these forms delivered to the exact part of the building where and when needed.

◆

TORONTO STREET RAILWAY AND THE CITY OF TORONTO.

[illegible] the terms of the franchise granted to the directors of the Toronto Street Railway a certain percentage of the cash receipts must revert to the citizens under the care of the corporation financial department. The amount received [illegible] percentages are as follows:

[illegible]	[illegible]	Total receipts.	City's share.
$[illegible]	$[illegible]	$[illegible]	$[illegible]
[illegible]	50,000.00	500,000.00	50,000.00
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1,000,000.00	150,000.00
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
	$[illegible]		$[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

CONSTRUCTION OF A WOOD STAVE PIPE.

In discussing a recent paper given before the American Society of Engineering Contractors on the construction of a 48-inch continuous wood stave pipe, Mr. Willard D. Lockwood gave some interesting facts regarding the laying of a 24-inch machine made wooden pipe, five miles in length.

The pipe was made by the A. Wyckoff & Son Company, of Elmira, N.Y., of selected Canadian pine, cut into lengths of 8 to 12 feet. The speaker found it advantageous to use the shorter length, as it permitted piling the pipes crosswise in a box car.

On good ground a foreman and eight men could easily lay 1,000 feet of 24-inch pipe per day. With the cost of $5.50 for the foreman and $1.75 for the men for 9 hours, the cost of laying the 24-inch pipe for four miles across wet meadows was about 4½ cents per lineal foot for labor alone.

The manner in which the pipe was made at the mills is described by the manufacturers as follows:

"The wood from which our wood-stave pipe is made is selected Canadian pine. As the staves are run through the finishing machine, which cuts the double groove and tongue and planes the faces to circular and radial lines, a competent inspector of many years' experience handles every stave just at the time when its defects can best be detected. This inspector culls out about fifteen per cent. of the timber which comes to our factory and these culls are used for other purposes foreign to wood-pipe. The winding machine used for banding the wood staves together is so arranged that the band can be wound at any desired tension, according to the set of the machine, which is regulated for each class of pipe according to diameter and pressure specified. The tension can be made great enough to crush the wood in the large size pipe. During the manufacture of one standard a uniform tension and spacing is absolutely assured.

"The pipes are made in maximum lengths of 12 feet. We have found that sections of 12 feet require a minimum expense in handling at factory, loading and unloading in and from box cars, by which means they are always shipped, hauled to work and placed along the conduit line. The shorter sections permit of the pipes being laid in a curve with perfect satisfaction. As each stave is made, two grooves are cut into one edge ⅛ inch deep and ⅛ inch wide at the base of groove. On the opposite edge two tongues or heads are cut 3/16 inch high and 3/16 inch wide at base of head. Each of these is cut ⅜ inch from the outer and inner face of the stave. When the staves are banded together the head, being a little larger than the groove, is squeezed into it and thus makes a thoroughly water-tight joint. The shorter sections of pipes are always used to make up the curves.

"The coating is heated in tanks by steam to a temperature of between 250 degrees and 300 degrees Fahrenheit and applied to the steel bands as they are being wound around the wood by running them through the tank which stands upon the winding machine; this method insures a full and complete coating between the steel and the surface of the wood, thus preventing the moisture, which may sweep through the outside of the wood, from coming into direct contact with the steel bands.

"After winding, the chambers and tenons are cut on the pipe, each being four inches in depth by one-half the total thickness of the shell of the pipe, which is usually [illegible] inches thick. After leaving the banding machine the pipe is placed on the top of the two grooved rollers, set parallel and horizontal, with one-half their diameters submerged in a tank of the hot Hydrolene. As these rollers revolve, the pipe revolves and its coating which adheres to the rollers is evenly applied to the outside surface of the pipe, covering the bands and wood. After all is applied that the surface will hold, the pipe is rolled on to a table filled with saw dust, the sawdust adheres to the hot coating and protects it from being scraped off or abraded in handling or laying."

COLLECTION AND DISPOSAL OF MUNICIPAL WASTES.

In the monthly bulletin of the Ohio State Board of Health Mr. Irvin S. Osborn, consulting expert in charge of garbage disposal for Columbus, Ohio, makes some comment on the above question. He states that the collection and disposal of municipal waste is one of the most serious problems that confronts nearly every municipality. In the smaller communities it receives little attention without serious results, but as the municipality grows it becomes necessary to adopt some definite plan, by means of which the work can be carried on in a systematic manner.

The experience of the majority of cities has been unsatisfactory. An investigation of the methods employed in cities will show that desired results have not been obtained except in a few cases, indicating that the methods employed are radically wrong in regard to the way the work has been handled. Many cities have expended large amounts trying to obtain better results, both as to the sanitary conditions and also as to cost, but have failed, because as a rule they have either acted on the recommendation of manufacturers of equipment, who make impossible guarantees, or they have copied the method used in some other city where the conditions are radically different.

The work has not been taken up as a problem to be solved, but has been considered as a condition to be overcome in the easiest manner. In other words, sufficient study has not been made of the conditions that affect the problems, and the result has been the adoption of methods that were not suited to the conditions as they really existed. These conditions must be known in advance and the work planned in accordance with them. Many municipalities have adopted some plan, only to find that after all they are no better off than they were before, except that they have gained considerable experience at a large cost.

The engineering and municipal publications have published many articles giving results obtained in various cities and detail descriptions of the various plants for the disposition of wastes. The data and descriptions are of great aid from an educational standpoint for officials who are obtaining enlightenment on the subject, but on comparison they will be found of little value in determining what will apply to the local conditions. The articles are oftentimes written by men who are interested in some special method of disposal or for advertising purposes, so that the opinions expressed are oftentimes biased. The reports or data given on the operation of various plants are oftentimes misleading in regard to the cost for conducting the work, since many items are omitted. This also applies to the estimated value of the returns from the sale of by-products of a reduction plant, or the value of the power that can be developed if disposal is made by burning. The problem must be considered from the standpoint of actual values that can be obtained under the conditions to be met, and not on theoretical values based on what would be the results with ideal conditions. To determine what results can be obtained information should be such that the official can show what the actual results would be.

The collection and disposal of municipal waste is an engineering problem, and only when the municipalities take it up as such, will the advance be made and a desirable solution obtained. At the present time there is no branch of municipal service where the need of study and expert advice is as great as in connection with the collection and disposal of municipal waste. Other branches of municipal service have received the study required and definite information concerning them collected from long experience, but it is only during the past few years that this branch of the service is being recognized as important. Modern methods for disposing of municipal wastes involve problems in civil and mechanical engineering which must be solved in a sanitary and economical manner. If the waste is to be burned, the engineer must understand the combustion of the material to be disposed of and the results that can be obtained in the development of power. Experience shows that all furnaces will not dispose of various classes of waste in either a sanitary or economical manner. If garbage is to be utilized or disposed of by the reduction method, the need of engineering advice is still more essential in order to obtain results that will be satisfactory.

The following will outline briefly a few items that must be considered in studying the problem to arrive at a conclusion that will warrant the adoption of any particular method or a combination of the different methods:—

1. The topography of the city studied to determine the type of wagons and location of central stations or disposal plants, to determine what bearing it will have on the collection of the material from the standpoint of economy and efficient service.

2. The character of the population studied in regard to classes and nationalities to determine the quantity and quality of the various classes of waste as produced in different sections of the city.

3. The plan of the city and character of the residences should be studied with reference to the number of houses to be served and the access to the same in making collections.

4. The production of each class of waste should be studied with reference to the average daily quantities. The monthly variation of each class to determine the maximum and minimum quantities to be disposed of. This is one of the most important determinations to be made. Estimates are often made, taking the average for monthly collections from the total yearly amounts without reference to seasonal fluctuation. Garbage during the maximum months will increase more than 100 per cent. over the average collection during the minimum months, and the combustible waste will often decrease 75 per cent. during the same period, with the result that there is not a sufficient material of combustible nature to destroy the garbage without using additional fuel.

5. Records of the quantities of each class of waste should be obtained over as long a period as possible to determine the relative increase and provide for future growth.

6. What service is to be rendered to residences and places of business.

7. Analysis of all classes of waste from a mechanical standpoint, as well as chemical analysis to determine the value of the various classes in respect to calorific value, water, ash, volatile matter, etc., and when utilized determination as to available grease and tankage and value of the same.

8. The past practice should be studied to determine the work that will be required to systematize the future developments.

9. Estimates of the first cost that would be necessary to adopt each method of disposal. Estimated annual cost for operation, maintenance and fixed charges for each method to determine the most economical method that can be adopted. The estimates will vary with local conditions, quantity and quality of the wastes to be handled.

After making a complete study the question is to determine what method is best suited for the conditions to be met from a sanitary standpoint with proper allowance made for the annual charge for maintaining and conducting the work. It is not a theoretical, but a practical problem to be solved, and can only be solved by obtaining the proper knowledge and experience necessary to decide what is suitable. The correct solution cannot be obtained by trying to copy what some other city has or by what is claimed for various methods. It must be studied with all the information possible obtained, and then applied to the problem to be solved in a practical manner from a sanitary and economical standpoint.

ECONOMICS OF POWER TRANSMISSION LINES.

The following is an article by Mr. Alfred Still, engineer at the Magpie mine, Michipicoten District, Ontario, which was printed in a recent issue of Western Egnineering. It will be remembered that we published an article by Mr. Still entitled "Steel Towers for Overhead Transmission Lines" in our issue of October 10th, 1912.

"True engineering is based on economics." These are the words of R. D. Mershon; and every engineer does or should realize the truth of the statement. On the other hand, there are many engineering undertakings, or portions of such undertakings, in which this fundamental principle has been disregarded. In the case of transmission lines a certain system, or an exceptionally high pressure may have been adopted because of its peculiar interest as an engineering problem; or duplicate lines, spare generating plant, and costly automatic gear may have been installed to ensure continuity of supply, apart from the economic value of such increased protection against possible interruption. This, however, is not engineering in the commercial sense. The determination of the economical size of conductors for the transmission of any particular amount of current. in accordance with the principle generally known as Kelvin's law, is now well understood; but this is a very small part of the problem to be solved by the transmission line engineer. An attempt will be made in this article to deal with the economics of the overhead power transmission line from a broad practical standpoint. Some approximate figures for use in getting out preliminary estimates will be given, and in the working out of any numerical examples it will be assumed that the principles governing the selection of the most economic size of conductor require no explanation. When considering any scheme of power transmission from a generating plant of limited output, it is important to bear in mind that it does not pay to cover distance greater than that within which there are reasonable prospects of supplying all the power available at the generating station. The importance of this principle should be fairly obvious; yet there are instances which prove that it has been disregarded.

Choice of System.—On this continent it is usual to trans- [illegible] not meet with equal success on this continent; but it is [illegible]

Type of Transmission Line [illegible]

used on any particular transmission scheme. In some cases a composite line including two or more types of support may be found advantageous. Among the factors influencing the choice of the supporting structures may be mentioned the character of the country, the means and facilities of transport, climatic conditions, the nature of the soil, and the scarcity or otherwise of suitable timber in the district through which the line will pass. In undulating or hilly country, advantage may frequently be taken of the heights, by erecting upon them comparatively low and cheap structures and spanning the depressions or valleys without any intermediate supports. The engineering features must, however, be very carefully studied in all such exceptional cases.

Length of Span.—Even when the type of structure has been decided upon, the height, strength, and cost of the structures will be dependeent upon the distance between them. The determination of the average length of span is indeed a very important economic question. The material of the conductor will, to some extent, influence the choice of span length, because aluminum conductors will usually have a greater summer sag than copper conductors, and this will necessitate higher supports to give the same clearance above ground at the lowest point of the span. In considering span length, the first cost of the individual support is not the only question which has to be taken into account; the cost of maintenance is almost equally important. The longer the span, the fewer will be the points of support; and if the line is well designed and constructed, there should be less trouble through faults at insulators. Again, when rent has to be paid for poles placed on private property, it is generally the rent per pole apart from the size of pole which has to be considered, and this is another factor in the determination of the best length of span. In level country, the economic span for steel tower construction is usually in the neighborhood of 550 ft. If substantial, braced, wooden towers of considerable height are used in a district where such structures can readily be constructed, the economic span would probably be greater than 600 ft. It is hardly necessary to mention that, when comparing costs of various kinds of supports, the relative life and cost of upkeep of the poles or towers must be taken into account.

Effect of Span Variations on Cost of Steel Towers.—The [illegible] country depends on (1) the minimum clearance between the lowest conductor and ground when the sag is greatest; (2) the voltage, since this has an effect on the spacing of the conductors and also to some extent on the clearance above ground level; and (3) the [illegible]. This last is determined by the lengths of span, the material and size of the conductors, the range of temperatures, and weather conditions generally. For the [illegible]

[illegible]

[illegible]

the height, but also upon the stresses which the tower has to withstand. These again will be dependent upon the size of the wires, the length of span, and the weather conditions. It is probable that, with an increase in height the cost increases less rapidly than the square of the overall length, but for approximate calculations it is convenient to assume the relation cost varies as H^2. Also, if the weight of a tower measuring 60 ft. overall is taken at 1,800 lb., and the price per pound of the finished (galvanized) tower at 5c.,* the cost per tower in dollars is

$$\frac{H^2}{40}. \qquad (2)$$

The cost of the flexible type of tower is appreciably less, being about seven-tenths of the cost of the rigid type with square base, or

$$\frac{H^2}{57}. \qquad (3)$$

It is, however, usual to provide rigid strain towers in place of the flexible type at, say, every mile, and as the cost of such structures is about double the cost of the flexible tower, the cost of supports per mile of line may be calculated by assuming $n + 1$ flexible structure per mile, when the actual spacing is n to the mile.

Duplicate Lines.—A point of great importance in connection with power transmission undertaking is the means adopted to guard against interruption of supply. If it is allowed that the least reliable part of a transmission system is the line itself, it is certainly advisable, when circumstances permit, to duplicate the lines; the two sets of conductors being connected in parallel under normal conditions. The best protection against interruption would be afforded by carrying the two sets of conductors on separate poles, preferably by different routes; but this would almost double the cost of the line, and it is usual to carry duplicate lines either on one set of poles, or on two sets of poles erected side by side on the same right-of-way. As an alternative to the duplication of the lines, the provision of reserve generating plant at the receiving end may be considered, and a comparison should be made between the relative advantages and costs of the various alternatives.

A good example of steam-driven auxiliary plant in connection with hydro-electric power stations, is the recently completed oil-burning steam-generating station of the Southern California Edison Co., situated 25 miles from the city of Los Angeles and capable of connecting in parallel with the 60,000-volt and 30,000-volt systems ordinarily supplied by the Kern River and other hydro-electric generating stations of this company.

Costs of Typical Transmission Lines.—It would be possible to give a large number of figures relating to material and labor costs of completed transmission lines; but the conditions of transport of materials and quality of labor differ widely, and without complete knowledge of these conditions, such figures are liable to be misleading. For this reason two ideal preliminary estimates, one referring to a wood pole line, and the other to a steel line, are here reproduced, in the hope that they may be useful as a basis on which somewhat similar estimates may be shaped.

Preliminary Estimate No. 1.—Wood pole transmission line, 20 miles long, carrying one three-phase line. Line pressure 22,000 volts. Span 130 ft. There is no grounded overhead guard wire; but two telephone wires are carried on the same set of poles. An allowance of 20 per cent. is made for extra insulators and fixtures to permit of doubling these on corner poles and in other selected positions.

Preliminary Estimate No. 1.

MATERIALS (EXCLUDING CONDUCTORS)		
40 creosoted cedar poles, 35 ft. long, 8 in. diam. at top	$400.00	
48 cross arms, 3½ by 4½ in. by 4 ft. long	14.50	
96 galvanized iron braces, 1¼ by ¼ by 28 in. long	9.00	
32 galvanized bolts, ⅝ by 12½ in., with washers 8 galvanized bolts, ⅝ by 16 in., with washers 16 galvanized spacing rods, ¾ by 16 in., with nuts and washers 48 galvanized lag screws, ½ by 3½ in. 96 galvanized carriage bolts, ⅜ by 4½ in.	7.50	
1500 ft. galvanized 7 strand 5/16 in. guy wire	12.00	
12 anchor rods with nuts and washers and necessary timber for anchor logs	7.00	
24 galvanized guy clamps with bolts	3.00	
8 galvanized sheet-iron bands to prevent cutting of poles by guy wire	0.50	
12 standard thimbles for guy wire	0.40	
20 galvanized-iron lightning conductors, with bolts	5.50	
20 ground plates or galvanized-iron pipes	8.00	
Staples and sundries, including allowance for breakages and contingencies	15.00	
80 telephone wire insulators (glass) 80 side brackets for same (wood); 5-in. wire nails	10.00	
144 H.T. porcelain insulators	36.00	
96 galvanized-iron insulator pins with porcelain bases	14.40	
48 special pole-top insulator pins, with bolts	19.20	
Total material cost per mile of line		$562.00
LABOR		
Clearing 50 ft. on each side of pole line @ $30 per acre	363.00	
Distributing poles and other materials along the line	30.00	
Trimming poles, cutting gains, drilling holes, setting cross-arms	30.00	
Digging holes and erecting poles, including the necessary guying	80.00	
Fixing insulators and stringing wires, including telephone line	90.00	
Supervision and sundry small labor items	30.00	
Loss and depreciation of tools	10.00	
Management and preliminary work	25.00	
Total cost per mile for charges other than materials		$658.00
Total cost per mile, excluding cost of conductor material		$1220.00
CONDUCTORS		
16,000 ft. No. 1 copper conductors (hard-drawn); 700 ft. No. 4 copper for ties (soft); 10,800 ft. No. 10 copper for telephone circuit; 4550 lb. @ $15 per 100 lb.		682.50
Total cost of finished line		$1902.50

Preliminary Estimate No. 2.—"Flexible" type steel tower line, 60 miles long, with two sets of three-phase conductors. Line pressure = 80,000 volts. Average span, 480 ft. Spacing between wires, 8½ ft. A Siemens-Martin steel cable, acting as grounded guard wire, joins the tops of all towers. Insulators of the suspension type. No telephone wires. Minimum clearance between lowest H.T. conductor and ground = 40 ft. Cost of right-of-way not included in estimate.

Preliminary Estimate No. 2.

MATERIALS (EXCLUDING CONDUCTORS)		
10 flexible type galvanized steel, A frame towers @ $85	$850.00	
1 galvanized steel strain tower	170.00	
concrete foundations where necessary	80.00	
5600 ft. 7/16 in. galvanized Siemens-Martin steel-strand cable for guard wire and head guys on half mile flexible towers	128.00	
4 anchor rods complete with clamps and thimbles for guy wire	4.00	
90 sets of suspension-type insulators, including strain insulators and small allowance for breakages, complete with clamps	338.00	
Sundry small items or special material	50.00	
Total material cost per mile of line		$1620.00
LABOR		
Clearing 60 ft. on each side of line at average cost of $25 per acre	$[illegible]	
Distributing towers and other materials along the line	100.00	
Foundations for towers	[illegible]	
Assembly of parts and erection of towers	160.00	
Fixing insulators and stringing wires	170.00	
Supervision and sundry small labor items	30.00	
Allowance for loss and depreciation of tools	[illegible]	
Allowance for management and preliminary work	[illegible]	
Total charges other than materials per mile		[illegible]
Total cost per mile not including conductor material		$[illegible]
CONDUCTORS		
No. 00, hard drawn, stranded copper conductors; small amount of No. 2 soft copper for occasional ties, special clamps, shields, jointing materials, etc., 13,350 lb. @ $15 per 100 lb.		[illegible]
Total cost per mile of finished line not including right of way		$[illegible]

The cost of insulators increases rapidly with the rise of the working voltage. The curve of Fig. 1 gives approximate average prices of insulators complete with pins or suspension links for pressures up to 100,000 volts. The prices are per insulator or per series of insulator units. The suspension type of insulator consisting of a number of units in series is almost universally used for pressures exceeding 60,000 volts. One golden rule which applies to all overhead transmissions is that it is false economy to reduce first cost by putting in cheap and possibly unreliable insulators. The curves of Fig. 2 are intended to supplement the figures of the typical estimates. They give approximate costs of transmission poles or towers, with and without in sulators fixed in position. These costs are the averages of many actual figures, and give an approximate idea of the total expenditure per mile of line for various voltages; they do not include any clearing that may be necessary in wooded country, or payments for right-of-way. It is assumed that the conductors are of average size (No. 000 B and S gauge), but the actual cost of the conductors, whatever the size, must be added to the costs indicated by the dotted curves B and D in order to arrive at the total cost of the finished line. These dotted curves, however, do include an amount to cover the labor of stringing the wires. The curves A and B refer to wood poles or rigid steel towers (for the higher voltages) carrying three conductors; while curves C and D refer to a single set of poles or towers carrying six conductors. The cost of a line with flexible steel structures for voltages above 44,000 might be about 75 per cent. of the costs given by curves A and C. It is understood that the curves of Fig. 2 give only an approximate indication of the probable capital expenditure on the line. The actual cost will depend upon the character of the country, the nature of the ground, and other local conditions such as cost of labor and facilities for transportation. These, together with the weather conditions, force of wind and possible loading of wires with sleet or ice, will determine the most economical span and the average height of pole or tower. The cost, as previously mentioned, will also depend upon the material of the conductors, as a larger or smaller sag will influence spans and height of poles. The weight and diameter of conductors, by affecting the required strength of the supports, will be factors in determining the cost of the complete line, apart from any difference in the value of the conductors themselves. The actual cost of stringing very light or very heavy conductors will also differ from the average amount allowed for the purpose of plotting the curves. The number and style of lightning conductors, if any, and whether or not one or more grounded guard wires are strung above the conductors will obviously modify the average figures. Although steel or concrete poles, or steel towers, will generally be found more economical than a wood pole

---

*This cost may be anywhere between 3c. and 6c. per pound.

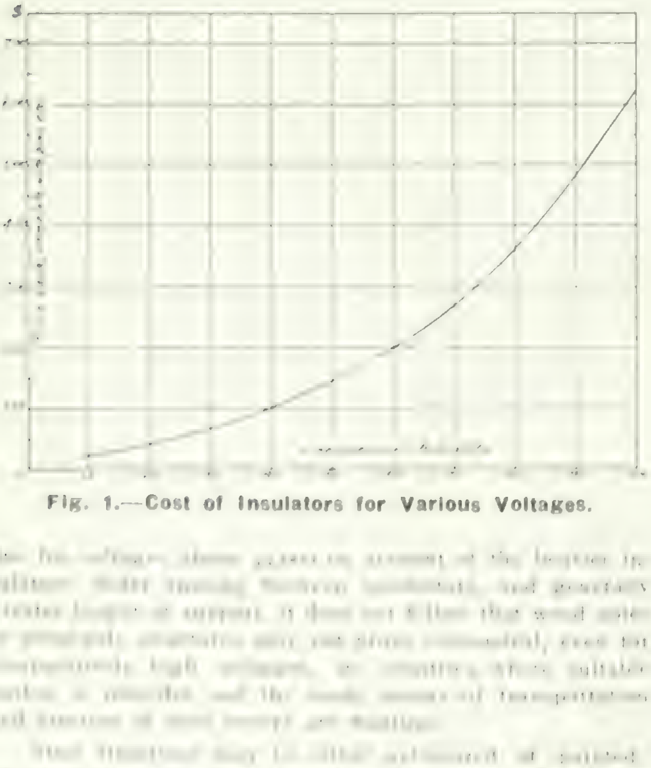


Fig. 1.—Cost of Insulators for Various Voltages.

line for voltages above [illegible] on account of the [illegible] in voltages [illegible] spacing between conductors, and greater height of support, it does not follow that wood poles [illegible] commercial, even for comparatively high voltages, in countries where suitable timber is plentiful and the [illegible] means of transportation and erection of steel towers are lacking.

Steel structures may be either galvanized or painted; [illegible] cost of galvanizing should be compared with the [illegible] cost of painting periodically [illegible]. The cost of [illegible] will usually be between [illegible] and 80c. per 100 lb. weight. A pole 35 ft. high of square section 6 by 6 in. at top and 12 by 12 in. at bottom would weigh about 2,000 pounds.

The cost of foundations for towers varies greatly. In the case of fairly high steel towers with wide square bases in soil not requiring the use of concrete, the cost of excavating, setting legs, and back filling, not including erection of towers, will generally be between $10 and $20 per tower.

Cost of Conductors.—The capital expenditure on conductors will depend upon the material and the total weight. It is not proposed to discuss, in this article, the relative merits of copper and aluminum as conductor materials, but it may be well to point out that although, at the present market values of these metals, the use of aluminum may lead to some saving on first cost, there are many engineering points to be most carefully considered before definitely adopting either metal. The weight of the conductors necessary to transmit a certain amount of power over a definite distance will obviously depend upon the voltage, but apart from the engineering difficulties encountered at the higher voltages, there are economic considerations which determine the maximum voltage suitable for any given conditions. Among these may be mentioned a possible increase in the cost of generating plant for the higher pressures, the greater cost of step-up and step-down transformers and of the control apparatus, together with the line insulators, entering bushings, etc. The transmission line poles or towers will also, as previously mentioned, cost more for the higher pressures, because of the wider spacing between conductors. Then again, with the extra high pressures, the increased losses through leakage over insulators and possible corona losses may be quite appreciable.

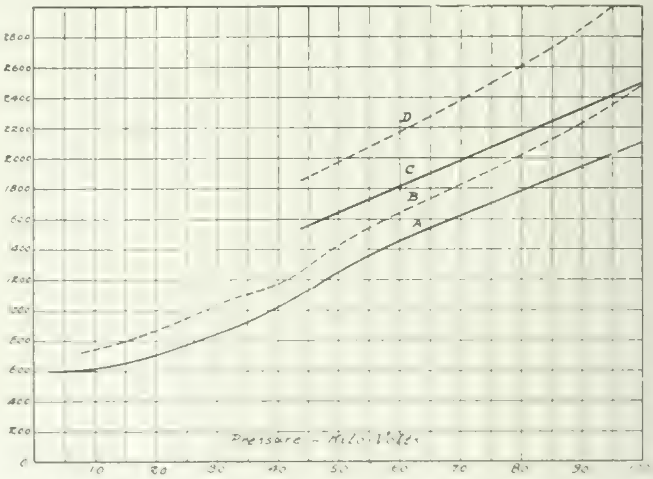


Fig. 2.—Cost in Dollars Per Mile of Transmission Line Complete, Not Including Cost of Conductors, Right-of-Way, and Clearing Ground in Wooded Country.

A—Single 3-phase line without insulators or wires.
B—Ditto, including insulators and stringing but not cost of wires.
C—Same as A, but for double 3-phase line on single set of poles or towers.
D—Ditto, but including insulators and labor stringing wires but not cost of wires.

Given a definite amount of power to be transmitted, and a definite line pressure, the current can be calculated, and the economic conductor cross-section, and therefore the weight and cost of the conductors, will be directly proportional to this current. It is only of recent years that this fact appears to have been generally recognized, and yet, so long ago as 1885, in his Cantor lectures delivered in London, George Forbes said: "The most economical section of conductor is independent of e.m.f. and distance, and is proportional to the current." The determination of the current value to be used in the calculation of conductor sections is a real difficulty. It must not be supposed that even a knowledge of the load factor is sufficient by itself. The load factor being the ratio of average load to maximum load, does not give the relation between the average I^2R loss and the I^2R loss of maximum output. The power lost in the conductors of a constant potential supply is proportional to the square of the power transmitted. On the basis of the average hydro-electric load curve, if the load factor is 50 per cent., the load on which the average transmission line losses should be based, being the square root of the mean of the square of the power, will probably be found to be more nearly 60 per cent. than 50 per cent. of the maximum load.

Economic Voltage.—Clearly, the choice of the transmission voltage is a very important matter; but as it is possible to determine the proper voltage on purely economic grounds, the use of exceptionally high pressures merely because of their interest from an engineering point of view, should be discouraged. On the other hand, it would appear that most transmission line troubles occur on lines working at pressures between 30,000 and 80,000 volts; and an important consideration to bear in mind is that more trouble may be experienced with heavy currents than with high voltages, owing to the more serious effects of interruptions or transient disturbances when the current is large, so that greater security may sometimes be obtained by increasing the voltage with a view to reducing maintenance and operating costs. A remarkable instance of high pressure being used for short-distance transmission occurs in Germany at Lauchammer. This is the first 110,000-volt installation in Europe. The line is only 35 miles long, but the power to be transmitted is considerable, being 20,000 kw. The engineers claim that, owing to large fluctuations expected through rolling-mill load, low voltages would be uneconomical. Under ordinary circumstances, the trend of modern practice would indicate something above 60,000 volts as the best pressure in this case; but when there is little difference between the cost of a 60,000-volt and an 80,000-volt scheme, it is wise to adopt the higher pressure.

When figuring on the best voltage for any particular scheme, the capital cost of all works, buildings, or apparatus which is liable to be influenced by the transmission-line pressure, together with all operating and maintenance charges which may be similarly influenced, must be taken into account. It will usually be found convenient to reduce all such costs or differences of cost to the basis of annual charges.

Costs Other Than Transmission Line, Liable to be Influenced by Voltage Variations.—The cost of a generating station complete with all plant and machinery, but not including transmission line, may be anything from $20 to $200 per horsepower installed. It will depend on total output, that is, on the size of the station, on location, and transport and labor facilities. The cost of a hydro-electric station will depend on the head of water, the amount of rock excavation, the size of dam, etc.

Approximate costs per kilowatt of medium head hydro-electric power station and sub-station (not including transmission line) for total output of about 10,000 kilowatt appear below.

The figures given in the accompanying table are approximate costs for a medium head hydro-electric development suitable for a total output in the neighborhood of 10,000 kw., to be transmitted over two outgoing 3-phase feeders. The usefulness of these figures lies mainly in the indication they give of the probable differences in cost with the variation of transmission-line pressure.

	Transmission Line Voltage		
	[illegible]	60,000	100,000
Hydraulic works outside power station buildings	$15.00	$15.00	$15.00
Power-station building, including excavations	5.00	5.06	5.10
Receiving-station building	1.00	1.03	1.05
Switch gear (both ends)	1.20	1.35	1.70
Electrolytic lightning arresters	0.34	0.66	1.20
Transformers (both ends)	2.50	2.90	3.50
Generaters and exciters	8.00	8.00	8.00
Cables in buildings, entering, bushings, etc.	0.40	0.40	0.50
Crane, sundries, and accessories, including preliminary work	2.00	2.10	2.20
Turbines and hydraulic equipment	10.00	10.00	10.00
Total cost per kilowatt	$45.44	$46.50	$48.25

Annual Charges Depending on Voltage.—These charges may be summarized as follows:

1. A percentage on all capital expenditure, whether for generating station, transmission line, or receiving stations, which is not constant irrespective of voltage.

2. The yearly cost of the power lost in the transmission line.

3. The yearly cost of power lost in generators and transformers (the efficiency of the electrical plant will not necessarily be the same for all voltages).

4. The yearly cost of maintenance and operation. This may depend upon length of spans in transmission line, and on the necessary plant, switch-gear, etc., to be attended to, and kept in working order.

The percentages referred to under item (1) must include interest on capital invested, and depreciation. The accompanying table gives the percentage to allow for depreciation for various terms of years. Depreciation, which may include what is sometimes referred to as obsolescence, is the amount to be set aside annually in order to reproduce, at the end of a term of years, the capital originally invested. This term of years in the "life" of the works or materials on which the percentage depreciation is to be calculated. It is assumed that, at the end of this term of years, the value of such works or materials is nil. It is also assumed that the amount put aside annually earns interest at the rate of 5 per cent. compound.

Depreciation Table.

(On basis of 5 per cent. compound interest earned by money put aside annually.)

Life. (yr.)	Depreciation. (%)	Life. (yr.)	Depreciation. (%)
2	48.70	28	1.710
4	23.20	30	1.505
6	14.70	32	1.325
8	10.50	34	1.175
10	7.95	36	1.045
12	6.28	38	0.928
14	5.10	40	0.828
16	4.23	42	0.740
18	3.55	44	0.662
20	3.03	46	0.593
22	2.60	48	0.532
24	2.25	50	0.477
26	1.96		

Method of Determining Most Economical Voltage.—Consider the case of a typical medium head hydro-electric power station:

Distance of transmission = 50 miles.

Duplicate three-phase line with copper conductors.

Cost of conductors = $15 per 100 pounds.

Power demanded = 15,000 h.p. or 11,200 kw. (It is assumed that this power will be required continuously day and night for industrial purposes, and that it is the probable limit of the water-power available).

Power factor = 0.8.

Selling price of power = $21 per horse-power-year.

Interest on capital invested, allow 6 per cent.

The economic drop of voltage per mile of single conductor is given by the formula:[1]

$$e_r = 8.1\sqrt{\frac{a \times p}{p_1}}$$

Where p is the price in dollars of 100 lb. weight of conductor (in this example $p = 15$), a is the percentage to cover annual depreciation and interest on cost of conductors, and p_1 is the cost per horse-power-year of the wasted power. The proper value for a may be arrived at by estimating the term of years corresponding to the life of the conductors, at the end of which they are supposed to be of no value. Taking 20 years as the life of the conductors the depreciation to be allowed according to the table herewith is 3.03, which makes $a = 6 + 3.03$, or, say, 9 per cent.

With regard to p_1, if the demand for power were equal to the available supply from the time of the power-plant being put into operation, the works cost of waste power would be the same as the selling price; but, on the assumption that the supply exceeds the demand during the first five years of operation, and that the cost of waste power during this period is only \$7 per horse-power-year.[2]

The average cost of wasted power during the 20 years life of the conductors is:

$$p_1 = \frac{5 \times 7 + 15 \times 21}{20} = \$17.50$$

The economic voltage drop is therefore:

$$e_r = 8.1\sqrt{\frac{9 \times 15}{17.5}} = 22.5 \text{ volts per mile.}$$

A first approximation to the required line voltage may be obtained by the formula

$$E = 5.5\sqrt{[illegible] + \frac{[illegible]}{100}}$$

$$= 5.5\sqrt{50 + \frac{15,000}{200}}$$

$$= 61.5, \text{ or say } 60,000 \text{ volts.}$$

In order to calculate the cost of the line losses, it will be necessary to adopt a figure for the horse-power transmitted, which, when squared, will give the average square of the power during the estimated life of the conductors.

Assuming an average figure for the output during 12 months, a table showing probable demand for power can be constructed as follows:

[illegible]

[illegible]

[illegible]

interest on first cost of conductors; and the total annual charges on active line material will therefore be:

$$2 \times \frac{I^2R \times p_1}{746} \times 3 \times l$$

where R is the resistance per mile of conductor. But

$$I = \frac{P \times 746}{\sqrt{3} \times E \times \cos\theta}$$

where P stands for the horse-power transmitted.

Also: IR = voltage loss per mile = e_r. So that the formula for the total yearly charges on conductors can be written

$$\frac{2 \times \sqrt{3} \times e_r \times P \times p_1 \times l}{E \times \cos\theta}$$

which in this example becomes:

$$\frac{2 \times \sqrt{3} \times 22.5 \times 13,600 \times 17.5 \times 50}{60,000 \times 0.8} = \$19,300$$

Closer Estimate of Economic Voltage.—In order to take into account first cost, life, annual maintenance, and operating charges of every portion of the complete undertaking which may be affected by a change in the transmission voltage, the costs, worked out on an annual basis, may be arranged in tabular form as here shown, where the total charges for the 60,000-volt scheme are compared with the estimated charges for an 80,000-volt transmission. In this particular example, the figures are favorable to the higher voltage; but the difference is small. It would be useless to repeat the process for a voltage lower than 60,000, because the cost would certainly be higher.

Comparison of Costs at Different Voltages.

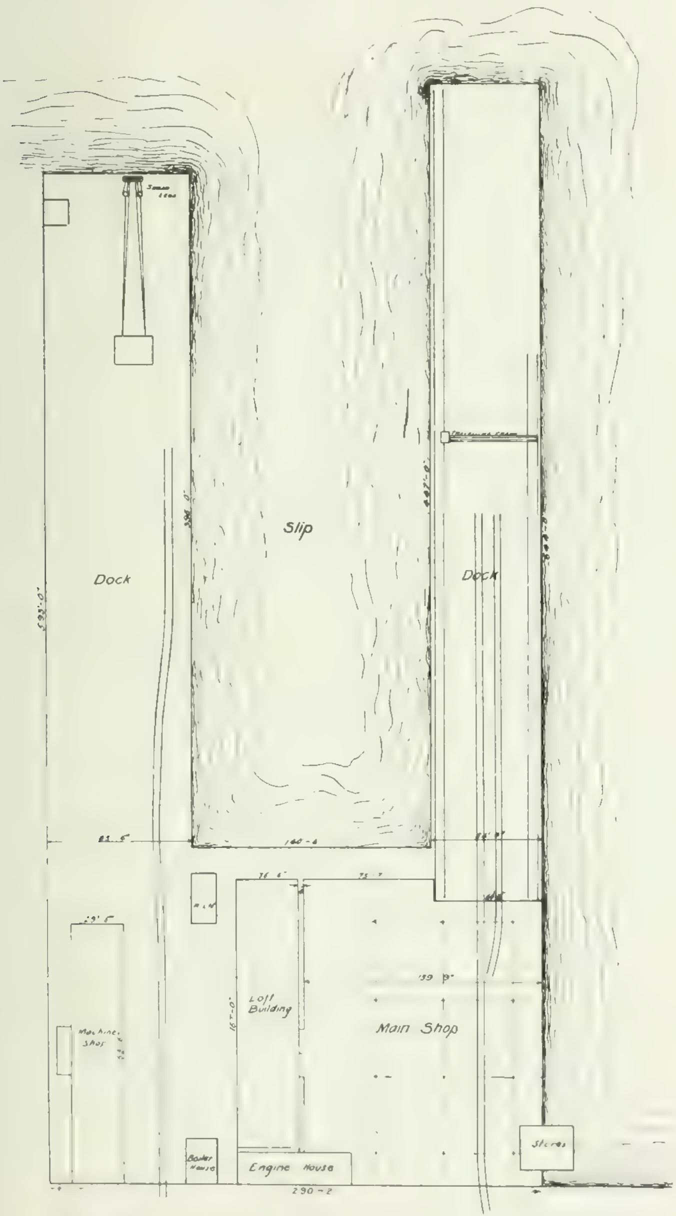
Portion of Complete Undertaking Affected by Change of Voltage	Estimated life (yr.)	Depreciation (from tables)	Depreciation plus 6 per cent.	Total Cost Voltage 60,000	Total Cost Voltage 80,000	Annual Charges Voltage 60,000	Annual Charges Voltage 80,000
Line conductors (copper) of most economic section (annual cost varies as $\frac{1}{\text{voltage}}$)	20			—	—	\$19,300	\$14,475
Steel tower transmission line, without conductors, but otherwise complete (from curves, Fig. 2)	18	3.55	9.55	\$108,000	\$130,000	10,310	12,410
Generating station buildings	40	0.828	6.828	56,000	57,000	3,870	3,895
Sub-station buildings	30	1.505	7.505	11,500	11,900	863	893
Transformers	18	3.55	9.55	32,500	35,200	3,100	3,360
Switch-gear, including lightning arresters, cables in buildings and entering bushings	14	5.10	11.10	27,000	34,000	3,000	3,775
As are unaltered:							
Yearly cost of power lost in generators and transformers							
Yearly cost of operation and maintenance							
Right of way and clearing						\$40,443	\$38,808
Difference in favor 80,000 volts = \$1,635							

It will be understood that the accompanying estimate of total annual charges of the two selected voltages does not include any items other than those that are liable to vary with changes in the line voltage. An estimate covering the complete undertaking would, in addition to the items named, have to take account of [illegible] rights for dam, reservoir, etc., preliminary legal and other expenses; cost of providing proper access for materials to site of work, dam and hydraulic works, generating station building, hydraulic electric generators, and auxiliary plant, [illegible] and contingencies.

In the case of a short distance transmission with a low pressure not exceeding 11,000 volts, and the possibility of winding the generators for the full pressure, the relative costs and efficiencies of generators wound for different voltages should be [illegible].

THE PLANT OF THOR IRON WORKS, LIMITED.

The Thor Iron Works, Limited, of Toronto, has been incorporated with an Ontario charter with the object of manufacturing steel plate work of all descriptions, structural steel for buildings and bridges, to execute marine repairs, and to conduct a general iron and steel manufacturing business. The company has bought the plant and equipment, excepting the land, which is leasehold, and the property of the Grand Trunk Railway, of the Toronto Shipyards Company, successors to the Canadian Shipbuilding Company. The experience of these companies, and of others, led the directors of the new company to the conclusion that a shipbuilding proposition can hardly be made to earn satisfactory dividends here.



General Layout of Plant of Thor Iron Works at Toronto.

The sketch shows the general layout of the plant. The shops are located at the foot of Bathurst Street, Toronto, along the waterfront, and the slips where the docks are located are, therefore, in the protected harbor of Toronto Bay.

Although the plant was originally designed for shipbuilding, and is capable of constructing as large vessels as are in use in Canadian inland waters, it is not the intention of the company to engage in this work. The old layout of the plant will be slightly altered to the conditions shown in the drawing, and the company will manufacture tanks, etc.

The machinery is modern throughout, and is operated by individual electric motors. The plant consists of two large docks, on one of which is a travelling crane, and at the extreme end of the other is a set of shear-legs of 65 tons lifting capacity. The shear-legs will be used for lifting boilers and machinery out of vessels and for raising small vessels out of the water for repairs.

As has been noted, the shops are situated at the foot of Bathurst Street, and are served by a branch of the Grand Trunk Railway. The shops consist of punch-shop, boiler, and engine-house, woodworking shop, machine shop, storehouse and general offices. In the punch-shop is a complete equipment of punches and shears, rolls, planers, steam hammers, etc., with an admirably designed system of cranes to serve them. These machines are all operated by individual electric motors. The main plate rolls have as great a capacity as any in Canada, and the punches and shears have all the attachments for making special cuts that are likely to be called for.

The machine shop contains several lathes, a large planer, a shaper, pipe-cutting and threading machines, and a complete outfit of small tools, while the storeroom is equipped with a large stock of valves, pipe fittings, bolts, etc.

The plant is well adapted to the fabrication of steel plate work for tanks, water-towers, standpipes, etc. No additional machinery or equipment is required. For marine repair work, also, the plant is well laid out. The actual capacity of the equipment now installed is estimated at about 3,000 tons per annum. The company expect that at the outset the principal business done will be in the line of steel plate work, construction of tanks, water-towers, flumes, penstocks, blast furnaces, etc.

The unusual dimensions and capacities of many of the machines have in the past brought special work from many outside plants. The new owners will maintain the policy of placing the equipment at the services of any firm requiring assistance. Plates 19 feet wide may be rolled in the plate rolls and, by means of a special device, the rolls may be used for flanging. The steam hammer and large forges combine with heating furnaces of unusual length and capacity and bending slabs of ample area to make possible the handling of blacksmith work on a large scale. Although originally planned and used as shipyard equipment, this part of the plant is easily adaptable to other work of a similar nature.

The stores contain a great variety of special as well as much stock material. This is being disposed of to a very considerable extent to make room for materials used in connection with the work to be undertaken. Much of the special wood-working machinery will also be eliminated—only sufficient being retained to equip pattern and template shops.

The company have already started work, although it will be a few weeks before they can secure delivery of steel. The plant is being overhauled and put in shape in the meantime.

The company's authorized capital stock is $100,000. The officers and directors are Messrs. J. H. Malone, J. E. Russell, W. Snaith, C. H. Cunningham and W. L. Carr, all of Toronto.

◆

KING EDWARD HIGHWAY.

A portion of the King Edward Highway is to be built of concrete, the contract having been let on September 11th, by the Honorable J. E. Caron, Minister of Agriculture and Highways of the Province of Quebec. The King Edward Highway is the Canadian section of the International Highway connecting Montreal with several large cities of the United States. Ultimately, it is expected that this road will continue as far south as Miami, Florida.

NEW RESEARCH LABORATORY IN CONNECTION WITH SCHOOL OF MINES, KINGSTON.

Under the directorship of H. T. Kalmus, S.B., Ph.D., there has been recently opened in the city of Kingston, Ont., a new research laboratory to be devoted to researches along the lines of the practical application of electrochemistry and electro-metallurgy. This laboratory is the property of the mines branch of the Canadian Department of Mines.

The first investigation, which is now well under way in this department, and which is being done for the mines branch, Department of Mines, Ottawa, has to do with the utilization of the element cobalt. (Canada has produced and is producing millions of dollars worth of cobalt, estimating it at a fair market value, of which only about one-third finds its way into the industries). Although this metal is in many respects similar to nickel, yet, no important alloys of it with other metals are in use. An exhaustive series of researches is therefore being undertaken on "The Metal Cobalt and Its Alloys," for the purpose of increasing its usefulness in the industries.

This research, among others which this new department is conducting, requires an electrical equipment of the most modern type. The laboratory is supplied with electrical power from the power plant of the School of Mining, which is being enlarged for the purpose, and has suitable transformers, bus-bars, switch-boards, etc., to operate its furnaces at any current up to 3,000 amperes, and at varying voltages up to 120 volts. This power equipment, situated as it is in the splendid new Nicol Hall, and with the most modern auxiliary apparatus is probably the most complete electro-metallurgical laboratory in the world.

◆

A 28,000 H.P. ZOELLY STEAM TURBINE.

The firm of Escher Wyss & Co., in Zurich, Switzerland, Canadian office in Montreal, has recently delivered to the Rheinisch-Westfelischen Electric Generating Station In Essen the most powerful steam turbine ever built. When running at a speed of 1,000 revolutions per minute it develops 22,500 h.p. eff. under normal continuous working, [illegible] and a steam temperature of 572 deg. Fahr. at the stop valve and a vacuum of 27.5 inch. (A higher vacuum cannot be obtained owing to the fact that only re-cooled water is available for the condenser). The turbine is also capable of developing 28,000 h.p. continuously and 30,000 h.p. for short periods.

[illegible] "Zoelly" [illegible] turned out [illegible] total [illegible] of the rotor being 26 tons. The total weight of the generator rotor (Siemens Company's make) approximates 60 tons.

[illegible] of oil for lubrication. This oil is under pressure produced [illegible]

[illegible] the turbine, the cooling water being supplied from a cooling tower. A separate turbo-pump then delivers the condensed steam into a hot well, from which the water is in turn delivered to the boiler feed pump.

The attendance of this gigantic turbine-driven alternating unit with its condensing plant is overcome with ease by only three men on each shaft.

◆

LOSSES OF EXPOSED STEAM PIPES.

In a paper read before the British Association it was stated that the effect of the density of the surrounding air greatly enhanced the loss of heat from exposed steam pipes, and that under experimetal pressures of 2,000 lbs. per square inch the heat loss became enormous. Other experiments under normal conditions demonstrated that 1-in. uncovered steam pipe lost in free air 3 b. t. u. per square foot per hour per degree of temperature difference. Out of this total only 15 per cent. was due to radiation and 4 per cent. to conduction. The remaining 81 per cent. was found to be wholly due to convection. In experiments with insulating material it was found that the best of such materials had some thirty times the conductivity of air, so that, were it not for reducing the convection, pipe covering would actually increase the loss of heat instead of diminishing it. This was borne out by the discovery that the heat loss from pipes depended very largely upon the closeness of the packing. If the insulation was very tightly packed, the efficiency was low owing to the increase in conductivity, while, on the other hand, if packed too loosely a large proportion of the convection would still continue. For this reason it appeared that for each class of insulation a certain density of packing was best. In the case of slag wool, this was found to be one-fourteenth the actual density of the individual fibres. In that case the loss by conduction through the insulation to the air would be raised from 0.1 b. t. u. to 0.4 b. t. u. per square foot per degree per hour; loss by convection would be reduced from 3.2 b. t. u. to 0.1 b. t. u. per square foot per hour, the net loss being thus one-seventh of what it would be with bare piping. With bare pipes the character of the service had a distinct influence, but this affected only the loss by radiation. With a good machined surface this loss was reduced from 15 per cent. of the total to about 7 per cent., and if the piping were polished to a mirror-like surface this loss was still further reduced to about 3 per cent. of the total. The loss by convection was not, however, affected in any way, and, as this was the main factor constituting as stated 81 per cent. of the total loss, there was very little to be gained by polishing in the case of ordinary steam pipe temperature. Another factor which was considered was the diameter of the piping. With a small radius the conduction loss was found to become more important, so that the total loss varied with the diameter of the pipe. It was, however, found that this increased loss by conduction only became important with pipes less than ½-in. in diameter, although, as had been previously shown, the loss in the case of fine wire becomes enormous. For pipes above 4 in. in diameter the loss was found to become [illegible] per square foot per degree per [illegible] of the diameter.

◆

[illegible] Rob Roy's [illegible] with Loch Katrine has just been bored through. The length of the tunnel is 3,000 ft., and the inside dimensions are 12 ft. by [illegible] commenced over two [illegible] the rock the pro- [illegible] At each end of the tunnel large [illegible] are to be built.

COAST TO COAST.

Calgary, Alta.—Mayor Mitchell was accorded the honor of turning the first sod in connection with the construction of the Canadian Northern Railway subway entrance to this city.

Province of British Columbia.—It is estimated that the cost of double tracking the lines of the Canadian Pacific Railway traversing the Rocky Mountains will be about $30,000,000.

Ottawa, Ont.—The municipal council have been named defendants in a large number of damage claims arising out of death and disablement following the recent outbreak of typhoid fever.

Vancouver, B.C.—Up to date the expenditure on the Burrard Peninsula joint sewerage has been $21,280, out of the total amount of $35,000 agreed to be spent during the year in preliminary work. To this amount Vancouver contributes $14,000, and South Vancouver, Point Grey and Burnaby, $7,000 each.

Ottawa, Ont.—Twenty-one out of the one hundred and eight joints of the river section of the new intake pipe have already been repaired by divers employed by Messrs. Laurin and Leitch, the Montreal contractors, as far as fixing the bolts or putting on clamps is concerned. To make assurance doubly sure it is the intention to encase each joint in concrete which work will take some time still.

Toronto, Ont.—The Provincial Board of Heath of Ontario contemplate in the near future the oppointment of an engineer to the staff, who will be available to give all municipalities advice as to the sort of works they should construct in connection with plans for waterworks and sewage disposal systems. This will allow the municipalities to engage any engineer they may wish to carry out the work.

London, Ont.—Mr. H. J. Glaubitz, general manager of the hydro-electric department in this city, has presented a good report showing the result of the operation of the utility for the past few months. The statement shows that for the first ten months the department has a gross surplus of $31,784.61, and a net surplus of $15,046.73. This is looked upon as exceptional in view of the fact that $7,000 for the solicitation of business has been charged against revenue.

British Columbia.—The fact that the coal deposits found along the shores of the Pacific are of pre-tertiary origin, and yield no coke, is a circumstance which so greatly hampers the development of the iron industry in British Columbia that the latter, in fact, has to fall back upon suitable imported coke. This being so, Russian enterprise is now being urged to commence the exploitation of the rich deposits of coal in the Island of Saghalien, which are supposed to be the best in the Pacific Ocean, but which hitherto for some reason have been entirely neglected. The geographical position of these deposits is favorable for the export to British Columbia of coal or, perhaps, coke.

Vancouver, B.C.—The city council passed an agreement between the municipality and the Canadian Northern Railway by which the city is prepared to deed over to the railway company 110 acres of tide flat property. The agreement will go before the ratepayers in November. The company will spend $4,000,000 in terminal facilities and $4,000,000 in a tunnel entrance to the city, four miles in length. The proposed depot will cost $1,500,000, and a first-class hotel will be built.

Marlboro, Alta.—Three rotary kilns, each 140 feet in length, eight feet in diameter, made of steel ranging from three-quarters to fifteen-sixteenths of an inch in thickness and weighing 150,000 pounds, exclusive of base and gear, arrived in the Grand Trunk Pacific Railway Company's north yards from Alliance, Ohio, consigned to the Edmonton Portland Cement Company at Marlboro, Alta., 144 miles west of Edmonton. Twelve flat cars, six of which carried the ends of the kilns on swivel blocks, were required to convey the machinery, which weighed 450,000 pounds.

Coquitlam, B.C.—An old proposal to construct a dam across the Second Narrows and thus convert the eastern end of Burrard Inlet into a fresh water lake has now been revived by the municipal council of Coquitlam. This body has forwarded a request to Hon. Frank Cochrane, minister of railways and canals, to withhold sanction to the Second Narrows bridge project until the municipality has had an opportunity to prepare plans for a causeway and locks, and forward them to the department. The application has a connection with a scheme to connect the headwaters of the Pitt River with the Inlet by means of a canal.

Victoria, B.C.—Following the recent educational campaign of the university authorities and parliamentary officials regarding forestry and lumbering methods, the management of the Victoria Lumbering and Manufacturing Company have made a practical application of these teachings and have, after installing a logging railroad, given instructions that all underbrush, snags, down logs, or whatever else might help to spread a fire must be cleared away for at least a hundred feet on each side of the track. This is probably the first time that adequate precautions of this kind have been taken by any lumbering company in this province.

Ottawa, Ont.—The Secretary of the Dominion Railway Board has sent out a circular to the railroads informing them that in all cases of bridge work over water in which there might be the slightest doubt as to it being navigable or not, the railway companies must, in addition to the papers now forwarded in support of their applications, furnish the Railway Board with evidence showing that the question of the navigability of the water has been, in the first instance, taken up with the Department of Public Works; and, secondly, that if the department deems the waters to be navigable, the structure is satisfactory to that department.

Province of Ontario.—The Great Lakes International Pure Water Association and the National Association for Preventing the Pollution of Rivers and Streams will meet in Cleveland on the 23rd and 24th of this month. Dr. Chas. E. Hodgetts of the Conservation Commission, Dr. J. W. S. McCullough of the Provincial Board of Health, Prof. Amyot, provincial bacteriologist, and Dr. Charles Hastings, Toronto, will represent the Canadian interests. The whole range of subjects dealing with water contamination will be discussed, and the conclusions of the conference will be forwarded to the International Joint Commission, which meets to deal with the question next month.

Detroit, Mich.—The Livingstone Channel in the Detroit River, one of the two most important engineering feats on the great lakes, which has cost the United States Government fully $10,000,000, has just been formally opened for navigation. The plans for the initial opening were in the hands of Lieut.-Col. M. M. Patrick, chief the of the United States engineers in charge of the Detroit district, representing the War Department; George A. Marr, Cleveland, secretary of the Lake Carriers' Association; and Homer R. Warren, president of the Detroit Board of Commerce. The length of the channel is eleven miles; its width 300 to 800 feet, and its depth 23 feet, and it has been under construction for the past four and a half years.

Midland, Ont.—At a meeting of the citizens of Midland held recently the construction of the Central Canadian Railway from Midland to Montreal was approved. This company [illegible] some years and are entitled to a very large land grant under a charter granted before confederation. The company have recently floated their bonds in England and have let a contract to a large English contracting corporation for the construction of the railway from Montreal to Midland. An offer has been made to the Dominion Government to grant running rights to the Intercolonial Railway from Montreal to Midland, thus giving the government road a much needed outlet to the lakes and providing them with the means of securing western freight.

Vancouver, B.C.—Mr. E. H. Heaps and Mr. H. Schaake, of the Heaps Engineering Co., successors to the Schaake Machine Works, met the finance committee of the city council of Vancouver and discussed the details of the agreement, whereby the engineering company will lease from the city 697 feet of land on Lulu Island at a yearly rental of $1,742.25, provision being made so that the company can purchase the land at the end of five years for $69,700, or $104,550 if purchased within seven and a half years, and the price to increase to $139,400 if purchased after that time and up to ten years. The company agrees to employ not less than 100 employees and during the term of the lease shall employ white men only. A by-law will be submitted to the ratepayers to ratify the agreement.

Toronto, Ont.—Commissioner of Works Harris states that in his opinion it will not be possible to secure the requisite equipment in sufficient time to operate the civic car lines this winter. To do so, he states, it will be necessary to erect transformer houses, design and build machinery, and erect feed wires, as well as to secure snow sweepers, etc. A gasoline motor or storage battery car might be operated, but sufficient experience has not been gained with these types of unit to justify him in recommending their use. Again, the line has been built with the overhead structure required for trolley operation. Respecting this, the Board of Control recommend that the Commissioner of Works be given full authority to establish an electric service on the above branch of the civic car line system.

Cretna, Man.—The Savoie-Guay Company, of Plessville, [illegible] auto plow of their own manufacture. The machine is of 45 [illegible] thing that a tractor can be used for, for driving all classes [illegible]

The Canadian Pacific Railway.—[illegible]

[illegible]

[illegible] not yet fully developed the local traffic which they are capable of carrying. The length of line in operation upon the system in 1902-3 was 7,748 miles; in 1911-12 the corresponding total was 10,990 miles. The receipts in 1902-3 were $43,957,000; in 1911-12 they had expanded to $123,310,000. But while the Canadian Pacific Railway has yet to develop its full carrying powers and productibility as regards local traffic, one important reason for the high ratio of its working expenses is the high cost of labor. The growth of population will probably moderate this difficulty, and it will certainly add year by year to the local business of the system.

Regina, Sask.—We are informed through Mr. A. J. McPherson, chairman of the Board of Highway Commissioners of Saskatchewan, that Dr. W. W. Andrews, of the Highway Board, has been engaged for some time past in investigating the practicability of treating the gumbo clays, which are spread so extensively over the Province of Saskatchewan, so as to make them more suitable for road purposes. Quite a large section of the Province lying from Weyburn north-west to the Elbow, on the South Saskatchewan River and north of the South Saskatchewan to the Alberta line, consists of a gumbo clay which does not lend itself to making satisfactory roads. Even an application of gravel or broken stone is not a success, as the clay is of such a nature that when dry it is exceedingly hard, and it is almost impossible to prevent hummocks or lumps forming on the road, and when wet it will turn into a liquid, and in a very short time any porous material that is put on the road will be impregnated with this liquid and lost. Dr. Andrews made experiments with tannic acid, which when applied to this clay will take away some of these qualities, the tannic acid being obtained from ordinary straw or hay by means of a certain process. This method has not proved itself up to the present to have a likelihood of success. He has also devised a method of calcining clay by means of burning lignite or straw in a form of kiln on the road. The result from this seems to show that there is some hope of success. When the clay is calcined in this way it does not form a mud, as it will in its natural state, and an experimental piece of road is now being tried on a practical scale with the object of seeing how the objects from the calcination process will stand the traffic, also to find out what it will cost to do a unit length of road by this method.

Toronto, Ont.—The local Board of Health states that [illegible] month of September, water samples have been taken all over the city, including all the pumping stations, the reservoir, and the various districts of the city, in order to detect any other possible source of contamination. The taste [illegible] the water at Exhibition time began at the same time that the filters were put in operation, and was undoubtedly due to a combination of the tar from the sand boxes in the filters, the hypochlorite, and probably to an or- [illegible] down to .1 part per million, before we could eliminate the taste, and as it was then dangerous to have from 8-10 million gallons of unfiltered water and almost unchlorinated water coming into the city, all of the water was put through the filters. Now that the filters have been washed free from the material responsible for the taste, we have been able to increase the amount of chlorine to .25 parts per million without producing taste. Tests for B. Coli while the sand is being stirred up by the pump at the John Street well will be without significance, and in general terms it may be said that Toronto water, as long as it is filtered and chlorinated, is safe drinking water. The water used at West Toronto and East Toronto, however, is not safe, because at times the water is muddy and the chlorine does not work so efficiently. When the sewage is transferred to Morley Avenue and put into the lake, it will make the West Toronto supply very much safer, and the East Toronto supply less so. At present it is only the chlorine that stands between the people and the possibility of sewage infection, and though this has proved satisfactory most of the time, it must be recognized that at the time when the water is muddy and at the worst, the chlorine is not so efficient.

◆

AMERICAN SHIPBUILDING COMPANY'S CANADIAN PLANT.

The company's plant at Port Arthur is referred to in the annual report of the American Shipbuilding Company for the year ended June 30th, 1912. That plant is stated to be in full operation, with contracts for steamers that will keep it busy for the next six to eight months, with additional negotiations pending. It is also well employed in dry dock and repair work. A considerable part of its equipment has been completed and is in operation, and its permanent machine shop, joiner shop and power plant are well under way toward completion.

The surplus of the company for the fiscal year was 0.36 per cent. on the common stock as against 1.1 per cent. in 1911. There was a balance of $580,699 as compared with $637,228 in the previous year. During the year up to the close of navigation, in 1911, marine business continued very dull and discouraging to the vessel interests; but the opening of navigation this year was more encouraging, and at the end of the company's fiscal year there was a fair revival in business.

The company has built and completed twelve vessels and has now under construction nineteen, among them a side wheel passenger steamer, larger than the one built last year, and which, when completed, will be the equal in type, construction and finish to anything afloat on inland waters.

◆

RAILROAD RATES ON PULPWOOD.

Argument was heard before the Dominion Railway Commissioners recently in the application of the International Paper Company, of New York, and a large number of Canadian firms to have the railways justify their recent increase of approximately 1½c. from Ontario, Quebec and New Brunswick points to New York State on pulpwood. The Canadian Pacific Railway, Grand Trunk and Canadian Northern were represented and urged that the new rate was a substitution for a blanket rate which had originally covered a very large territory. On account of the extra haul a line through Richmond, Quebec, had been taken as a dividing point and rates increased beyond that, the advance chiefly affecting American mills. Warning has been given shippers so as to allow them to take the increase into their contracts. The pulpwood interests, on the other hand, urged that the present rates are high enough.

BRANCH OFFICE IN WINNIPEG.

The Canadian Domestic Engineering Company, Limited, have opened a branch office in Winnipeg, to handle its Western business. This company has a very large contract in hand for the new Parliament Buildings at Winnipeg, Manitoba.

◆

PERSONAL.

MR. C. O. MAILLOUX has been appointed assistant to the president of the Granby Consolidated Mining Co., of Canada. This is a new position.

MR. A. W. DAVIS, mining engineer for the Consolidated Mining and Smelting Co., of Canada, has returned to Trail, B.C., after examining prospects in the Skeena district.

MR. WILLIAM H. NICHOLS has been chosen president of the Granby Consolidated Mining, Smelting and Power Co., in place of G. M. Luther, who retires on account of ill-health.

MR. WILLIAM R. WORTHINGTON, B.A.Sc., who has been recently appointed chief sewer engineer for the city of Toronto, was born and educated in Toronto. He is a graduate in civil engineering of the Faculty of Applied Science and Engineering of the University of Toronto, in the class of 1904, and since that time has been chief assistant in the sewers department. During this time he has had charge of the design and construction of some of the largest sewer systems in Toronto, and indeed, in the Dominion. These systems required expert technical knowledge and foresight to meet the extraordinary growth of that city.

Mr. Wm. R. Worthington.

MR. J. M. TURNBULL, mining engineer for the Consolidated Mining and Smelting Co., of Canada, has been chosen a member of the first senate of the newly organized University of British Columbia.

MR. C. N. CLARKE, of New York, president of the Minnehaha Mining Co., recently visited the mine, situated in the Manitou Lake mining district of Ontario, in connection with negotiations for its sale.

MR. F. H. SYKES, O.L.S., D.L.S., until recently Assistant Structural Engineer in the Toronto City Architect's Department, has been appointed Chief Examiner of Plans for the same Department. Mr. Sykes is an honor graduate of the School of Practical Science of the class of 1905.

MR. H. G. SALISBURY, Chief Examiner of Plans of the City Architect's Department, Toronto, has tendered his resignation to the Board of Control. In accepting the resignation, the Board have recommended that his salary be paid until the end of the year in view of his past satisfactory services.

◆

MEETINGS.

Dr. Chas. Hodgetts, of the Conservation Commission; Dr. J. W. S. McCullough, of the Ontario Health Department; Prof. Amyot, Provincial Bacteriologist, and Dr. Charles Hastings, M.O.H. for Toronto, represented Canada at the meeting of the National Association for the Prevention of the Pollution of Water, which was held in the city of Cleveland, Ohio, October 23rd and 24th last.

◆

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Monthly Meeting will be held in the Rooms of the Society, 413 Dorchester Street West, Montreal, November 7th. Chairman, Henry Holgate.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE. Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—

177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings [illegible] 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh [illegible]

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; [illegible]

[illegible] and third Friday of each month, October to April, in [illegible]

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—[illegible]

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—[illegible]

UNION OF MANITOBA MUNICIPALITIES.—[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, [illegible] P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina Secretary, J. A. [illegible] Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. [illegible] Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box [illegible], Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box [illegible], Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
10-24	Construction of about 7¾ miles of Combined Sewers, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 10,400 ft. reinforced concrete pipe, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 1,660 ft. of 48" steel pipe, bends and specials, New Westminster, B.C. ...(P. & S.)	10-10

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of	Page
Calgary, Alta., warehouse	Oct. 25.	Oct. 10.	67
Cap-a-l'Aigle, P.Q., extension to wharf	Nov. 11.	Oct. 17.	65
Grimsby, Ont., public building	Oct. 30.	Oct. 10.	67
Isle aux Coudres, P.Q., extension to wharf	Nov. 5.	Oct. 17.	65
London, Ont., bridge over Thames River	Nov. 13.	Oct. 17.	74
New Westminster, B.C., sewers	Oct. 24.	Oct. 10.	76
New Westminster, B.C., supply of reinforced concrete pipe	Oct. 24.	Oct. 10.	76
New Westminster, B.C., supply of steel pipe, etc	Oct. 24.	Oct. 10.	76
Ottawa, Ont., designs for monument	Nov. 1.	Aug. 1.	67
Point Grey, B.C., steel pipes	Dec. 2.	Oct. 17.	74
Quebec, P.Q., grain elevator	Nov. 30.	Oct. 17.	76
Regina, Sask., drain	Oct. 29.	Oct. 17.	65
Seal Cove, N.B., breakwater wharf	Oct. 30.	Oct. 10.	68
Seymour Arm, B.C., pile bent wharf	Oct. 29.	Oct. 10.	67
St. Boniface, Man., motor and pump	Nov. 8.	Oct. 17.	76
Vancouver, B.C., department store	Oct. 24.	Sept. 26.	68
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., Fire Department apparatus	Nov. 13.	Oct. 17.	66
Yorkton, Sask., Fire Department apparatus	Nov. 4.	Oct. 17.	66
Yorkton, Sask., electrical plant	Oct. 31.	Oct. 3.	76

◆

TENDERS.

Longueuil, Que.—Tenders for dredging required here will be received until October 29th, 1912. Full particulars at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Midland, Ont.—Public building: Tenders to be received until November 5th, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., at the offices of Mr. Thos. Hastings, clerk of works, Postal Station F, Yonge Street, Toronto, and at the post office, Midland, Ont.

Orillia, Ont.—The town of Orillia has deeded to the government the land for the new armory. Tenders will be asked for at once and work will commence next month. C. E. Grant, town clerk.

Ottawa, Ont.—J. D. McLean, assistant deputy and secretary, Department of Indian Affairs, will receive tenders until November 12, 1912, for the erection of a frame day school building on the Songnees Reserve on the northern shore of Constance Cove on Esquimalt Harbor. Plans, etc., may be seen at office of A. M. Tyson, inspector of Indian Agencies, Vancouver; W. E. Ditchborn, inspector of Indian Agencies, Victoria, and the post office at Nanaimo, B.C.

Ottawa, Ont.—Sealed tenders addressed to the Postmaster-General will be received at Ottawa, until noon of November 29th, 1912, for the conveyance of His Majesty's mails on a proposed contract for four years six times per week over rural mail route from Weston, Ont. Full particulars may be obtained at the post offices of Emery, Weston, and at the office of the post office inspector at Toronto. (See advt. in Canadian Engineer.)

Point Grey, B.C.—The municipality are calling for tenders for the supply of about 33 miles of steel pipe, to be received until December 2nd, 1912. Particulars may be obtained at the office of the water superintendent, Municipal Hall, Kerrisdale (Vancouver), B.C. Ben. A. Cunliffe, clerk municipal council, Kerrisdale, B.C. (See advt. in Canadian Engineer.)

Rimouski, Que.—Tenders for the construction of a line of wharves and dredging tidal basin at Rimouski, County of Rimouski, Que., will be received until November 21, 1912, addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., may be obtained at the offices of this department; J. A. Tremble, Esq., district engineer, Montmagny, Que.; A. R. Decary, Esq., district engineer, Post Office Building, Quebec; J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal; and on application to the Postmaster at Rimouski, Que.

Regina, Sask.—Separate tenders for the erection of a Normal school building; and the heating and plumbing, and electrical work in connection with the above, will be received until October 26th, 1912. Plans, etc., may be obtained on application to the Builders' Exchange, Winnipeg; or to Messrs. Storey and Van Egmond, architects, Regina; or to H. S. Carpenter, acting deputy minister of public works, Department of Public Works, Regina.

St. John, N.B.—Tenders for the construction of a cribwork and concrete wharf at St. John, will be received until November 1st, 1912, at the office of Alex. Johnston, deputy minister of marine and fisheries, Department of Marine and Fisheries, Ottawa. Plans, etc., at the office of the Department of Marine and Fisheries, Ottawa, and at the office of the agents of the department at St. John, N.B., Halifax, N.S., and Sydney, N.S.

St. Victoire, Que.—Construction of wharf: Tenders to be received until November 11, 1912, by R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., to be had at the offices of J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal, P.Q.; A. R. Decary, Esq., district engineer, P.O. Building, Quebec, P.Q., and on application to the postmaster at St. Victoire, Que.

Toronto, Ont.—Tenders for the construction of additional targets at Long Branch rifle range, will be received at the office of Eugene Fiset, Col., deputy minister, Department of Militia and Defence, Ottawa, until noon of 4th November, 1912. Specifications, etc., at the office of the General Officer Commanding 2nd Division, Toronto, Ont., and the Director of Engineer Services, headquarters, Ottawa. (See advt. in Canadian Engineer.)

Victoria, B.C.—J. E. Griffith, public works engineer, Department of Public Works, Victoria, is calling for tenders to be received until the 29th day of October, 1912, for the supplying and erecting of laundry and kitchen machines and fittings at the Mental Hospital, Coquitlam.

Winnipeg, Man.—Tenders are to be received until November 15th, 1912, addressed to the Chairman, Board of Control, for the supply of all labor, material and plant required for the execution of the works in connection with the extension of the artesian well water supply system of the city of Winnipeg. Plans, etc., may be obtained at the office of the city engineer, 223 James Avenue, Winnipeg. M. Peterson, secretary. (See advt. elsewhere in Canadian Engineer.)

Winnipeg, Man.—Tenders will be received by the chairman, Board of Control, until October 30, 1912, for the supply of all labor, materials and plant, required in connection with drilling 15 wells, more or less, in accordance with specifications. Plans, etc., at the office of the city engineer, 223 James Avenue. M. Peterson, secretary, Board of Control office, Winnipeg.

Yorkton, Sask.—Tenders are to be received until noon of November 12th, 1912, for one automobile fire truck complete from 50 to 60 h.p., with combination extension ladder, hose and chemical equipment. Plans, specifications to accompany all tenders. T. F. Acheson, secretary-treasurer, Yorkton. (See advt. in Canadian Engineer.)

◆

CONTRACTS AWARDED.

Belle Ewart, Ont.—Mr. Henry Hickey, of Peterboro, Ont., has the contract for the construction of wharf with stone approach at this place.

Bassano, Alta.—The complete contract for material and constructing the water and sewer system for the corporation of the town of Bassano, has been awarded to H. C. Weir, Esq., 507 First National Bank Building, Chicago, Ill., his contract price being $105,490. Geo. B. R. Bond, secretary-treasurer.

Chattie Beach, Kootenay, B.C.—Wharf: Contract awarded to William English, for $5,400.

Chilliwack, B.C.—New armory: Contract awarded to Messrs. Campbell and Wilkie, Vancouver, for $16,350.

Holberg, B.C.—Wharf: Contract awarded to R. A. Wood, for $[illegible].

Montreal, P.Q.—Messrs. Heap and Partners (Canada), Limited, have secured a contract from the Board of Control at Ottawa, for three Rees Roturbo motor-driven pumps with total capacity of 45,000,000 gallons per day.

Orillia, Ont.—The Bell Telephone Company are constructing a new central exchange. Messrs. E. Webb and Son are the contractors.

The Dominion Government will build a new dock at the foot of Mississaga Street. Messrs. Conroy and Co., Peterboro, will be the contractors. The dock will be of concrete.

Ottawa, Ont.—A contract has been awarded to Mr. Antoine Kelly for the sum of $6,391, for the construction of an addition to the customs express warehouse in Montreal.

Stratford, Ont.—Mr. W. Bradshaw has been awarded a contract to erect an addition to the building for the filtering tanks at the pumping station. The cost of this work will be $[illegible]. The addition will be of white brick 30 x 40 feet.

Victoria, B.C.—The contract for the construction of a [illegible] has been awarded to Sir John Jackson, of [illegible] [illegible] for the work. [illegible]

◆

RAILWAYS—STEAM AND ELECTRIC.

Galt, Ont.—The Lake Erie and Northern Railroad has [illegible] of the proposed route [illegible] which it is expected will not meet with [illegible].

Medicine Hat, Alta.—[illegible]

Vancouver, B.C.—The last section of the railway connecting Vancouver with the Kootenay is contracted for. It will cost $100,000 per mile. The contract is for thirty-eight miles.

Victoria, B.C.—The contract for grading a twenty-mile section of the E. & N. railway extension on the east coast of Vancouver Island was awarded to Messrs. Moore & Pethick, by the Canadian Pacific Railway.

◆

LIGHT, HEAT AND POWER.

Brantford, Ont.—The Ontario government has appointed the Canadian Domestic Engineering Company, Limited, of Montreal, as engineers for the heating, ventilating, etc., of the new Brantford Asylum for the Blind.

Moncton, N.B.—The management of the Humphrey Unshrinkable Underwear Company are equipping their mill in such a manner as to allow full benefits to be obtained from the natural gas wells in this vicinity.

Municipality of Saanich, B.C.—The council of this point have decided that the streets must be lighted and are considering one or two propositions that have been made. This municipality is very close to the city of Victoria.

Regina, Sask.—An addition to the lighting facilities of the streets will be made in the east end of this city. The city electrician has been instructed to purchase the necessary materials.

St. Catharines, Ont.—A petition signed by one hundred citizens asking that an estimate of the cost regarding the installation of hydro-electric power into this municipality be given was presented to the council.

Vancouver, B.C.—Owners of sawmills operating in the vicinity of this city have made a proposition to the municipal authorities for permission to lay wires and offer for sale electrical energy produced from steam turbine units operating with sawdust as fuel.

Winnipeg, Man.—The Canadian Domestic Engineering Company have been appointed consulting engineers for the heating, plumbing, ventilating, electric works and central power-house equipment of the new parliament buildings, Winnipeg, Manitoba, involving an expenditure for the buildings of approximately $5,000,000, and for the engineering work of $800,000.

◆

GARBAGE, SEWAGE AND WATER.

Brantford, Ont.—The municipal council will lay a twenty-inch main to Terrace Hill at a cost of $75,000. T. H. Jones, city engineer.

Brantford, Ont.—The municipal council have given serious consideration to the request of the fire underwriters, and have discussed the installation of a ten million gallon pump and an auxiliary turbine pump to the plant now operating at the water works pumping station. The cost of this would be about $65,000. T. H. Jones, city engineer.

Montreal, P.Q.—The municipal council have considered the appropriation of $[illegible] for an investigation of the water waste by the Pitometer Company.

Medicine Hat, Alta.—The new sewerage pumping plant to be erected will be equipped with two centrifugal pumps of a capacity of 1,000 gallons per minute.

Ottawa, Ont.—Certain members of the municipal council have started an agitation to have Lake Dechenes examined and reported upon as a probable source of a pure and reliable water supply for the ratepayers of this city. Ald. Nelson is interested in the project.

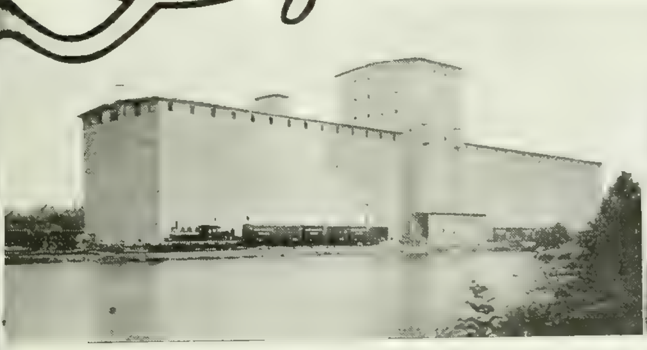
Sydney, C.B., N.S.—The daily press are urging the ratepayers to demand an improved water system of the candidates about to compete for civic election.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Berlin, Ont.—Plans are under preparation for the erection of a new opera house in this city to have a seating capacity of 1,[illegible]. Mr. C. O. Philip is in charge of the matter for the interested parties.

Barrett Specification Roofs



On Four Great Granaries

To cover the four huge granaries illustrated herewith the Canadian Pacific R. R. engineers chose Barrett Specification Roofs for good and sufficient reasons.

These practical men know that these roofs will last *20 years or more.*

They further know that they will need no painting or maintenance expense of any kind and that the net cost per year of service will be infinitely lower than could be shown by any other type of roofing.

It is for these very reasons that Barrett Specification Roofs are used on more first-class buildings in the United States and Canada than any other kind

A big roof generally means a Barrett Specification Roof, for the reason that the cost of big roofs is carefully scrutinized and ultimate economy carefully considered. Small roof areas ought also to have Barrett Specification Roofs, because they are just as economical and satisfactory there.

Copy of The Barrett Specification with tracings ready for incorporation into building plans free on request. Address nearest office.

Special Note

We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however, the following is suggested:

ROOFING Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., Limited

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Edmonton, Alta.—The management of the Edmonton Cold Storage have completed arrangements for the erection of a four story plant to cost $115,000. The building will have a storage capacity equal to 100 railroad cars.

Edmonton, Alta.—The management of the Cement, Stone and Brick Company will erect a building in this city for the manufacture of their products. Mr. Hyram Sykes, Calgary, is manager of this concern.

Fort William, Ont.—Construction work has been commenced on a new banking premises to be erected for the Merchants Bank of Canada. Mr. W. F. Bell is the local manager of this bank.

Galt, Ont.—Mr. Andrew Newlands, of the Galt Robe Works, has stated that it is the intention of the company to rebuild their burned plant at once.

Macleod, Alta.—Plans are being prepared for the erection of a $30,000 office building for the Bank of British North America. The manager is F. McRae.

Montreal, P.Q.—Messrs. Walter Baker Company, Ltd., have taken out a permit for the erection of an eight story factory to cost $50,000.

North Bay, Ont.—The management of the Bogart Refrigerator Company have requested the town council to grant a free site of two acres, exemption from taxes, and a fixed water rate preparatory to their decision to erect a plant.

Peterboro, Ont.—The management of the DeLaval Dairy Supply Company have commenced oprations on a new factory to house the manufacture of their products. The building will be 400 x 112 feet. Messrs. J. W. Ferguson Company, of Patterson, New Jersey, U.S.A., are the contractors.

Port Arthur, Ont.—Mr. J. J. Tracey, of Chicago, U.S.A., has been making an examination of this city with a view of erecting a theatre.

Prince Albert, Sask.—The Great Western Iron, Wood and Chemical Company, of Dorchester, N.Y., will establish a branch at this point. Creighton and Crowter, architects. The capital of the company is $500,000 and the directors are: D. H. Hanna, Toronto; F. H. Phippen, Toronto; Hector McInnes and Felix Frank, of Halifax.

Strathcona, Alta.—An hospital to cost $150,000, four stories high, 50 feet wide, 135 feet long, and of reinforced concrete construction, will be built by Wilson and Harrals, architects.

St. Thomas, Ont.—A $3,000 greenhouse will be erected by the municipal council and the Board of Education in Pinafore Park.

Toronto, Ont.—The management of the Northern Electric Manufacturing Company have been granted a permit to erect a new factory on Bay Street at a cost of $75,000.

Toronto, Ont.—The management of the American Abel Company will make an addition to their plant on Queen Street of this city. Mr. F. C. Rumely, of Laporte, Ind., U.S.A., will assume charge of the alterations.

Toronto, Ont.—The directors of the Creche, a local charitable organization, are to make an effort to raise the sum of [illegible] for the purpose of erecting a new building.

Toronto, Ont.—The officials of St. Paul's Roman Catholic Church, Queen and Power Streets, are [illegible] for the [illegible] of a [illegible] parish house and [illegible].

Watrous, Sask.—The management of the [illegible] Company have made arrangements for the [illegible] of a plant at this point as well as at [illegible] and [illegible]. This building will cost about [illegible].

Welland, Ont.—[illegible] Limited, will establish a plant in this city [illegible]. The direct[illegible] made public.

◆

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—[illegible]

Ottawa, Ont.—There is a probability of the council of this municipality and the officials of the Township of Gloucester and Billings' Bridge erecting a bridge over a ravine near the borders of the city. A meeting will be held on October 31st to decide the matter.

Province of Saskatchewan.—According to a report the government of this province have appropriated the sum of $5,000,000 for the construction of good roads.

◆

CURRENT NEWS.

Province of Alberta.—Mr. J. F. Smith, president of the Mormon church, has stated that there is a possibility of that denomination erecting a large temple at some point in this province.

Brantford, Ont.—The municipal council will serve a notice on the Western Counties' Company requesting them to put the banks of the river at the head gates in a safe condition at once. It is hoped by this means to avert a recurrence of the flood of last spring.

Edmonton, Alta.—The Board of Trade are interested in a proposition calling for the erection of a million bushel grain elevator in this city.

Edmonton, Alta.—Improvements planned by the municipal council for the year 1913 call for an expenditure of $25,000,000.

Kingston, Ont.—The first experiment with an oil driven vessel in the government service is to be made shortly by the Department of Marine and Fisheries. A new boat, to be christened the C. G. S. Dollard, is under construction for the department by the Kingston Shipbuilding Company. The Dollard is to be used in the St. Lawrence Lighthouse Service, under the direction of the Montreal agency. It was originally intended to have the vessel fitted with the ordinary fuel accommodation, but the department has now decided to have her completed with provision for oil. There are up to the present no vessels in the government services using oil as fuel.

Lethbridge, Alta.—The recent announcement made in these columns regarding the erection of a factory addition to the plant of the Lethbridge Brewing and Malting Company now hinges entirely on the water question. The management of the company have stated to the municipal authorities that they must have a consistent water supply. They claim that the water is not properly filtered and that the pressure cannot be relied upon varying as much as 80 pounds in a day or two. Mayor Hatch has stated that to instal a proper filtration plant would cost over $100,000, and at present the city is not in a position to undertake this expense. However, the Works and Property Committee will take the matter up with the city engineer and advise what would be done.

Ottawa, Ont.—The municipal council have not looked with favor on a proposal recently made by the local Board of health regarding the installation of sanitary conveniences in the homes of persons too poor to install them of their own accord and to allow these persons to pay for them during a period of seven years.

Ottawa, Ont.—The municipal Board of Control have recommended the purchase of a tractor for the haulage of the steam fire engine. Mr. Graham is chief of the fire department.

Peterboro, Ont.—Ald. Butler is considering the appointment of an engineer to plan and supervise the installation of a large sewer.

Winnipeg, Man.—The municipal council will [illegible] debentures to pay for the sinking of three new water wells.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending October [illegible]:—

A London firm who are the patentees of an artificial re[illegible] desire to get into touch with reliable firms in Canada in touch with [illegible] engineers, electricians and [illegible].

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

DEPT. OF RAILWAYS AND CANALS, WELLAND

Superintending Engineer's Office,
Messrs. Wettlaufer Bros., St. Catharines, Feb. 7th, 1912.
No. 178 Spadina Ave., Toronto.

Dear Sirs :—Replying to yours of the 6th, I beg to say that the two Mixers received from you last summer proved to be very handy, useful machines. They turned out excellent concrete and we had no trouble with them at all.

Yours truly, J. L. WELLER, Superintending Engineer.

CANADIAN NORTHERN RAILWAY

Belleville, Ont., Feb. 14th, 1912.
Wettlaufer Bros.,
178 Spadina Ave., Toronto, Ont.

Dear Sirs :—I think it is my duty to inform you that I am entirely satisfied with the two Concrete Mixers purchased from you last season. I have tested them in every way possible, and in every case I have found them capable of doing first-class work. Yours sincerely, J. O. GIROUX.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

Compare the thoroughness, simplicity and durability of our mixer with other makes. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing and the saving of power.

Ask for our 1913 Catalogue

WETTLAUFER BROS.
Head Office and Warerooms
178 SPADINA AVENUE,
WORKS AT MITCHELL, ONT. TORONTO DETROIT, MICH. BUFFALO, N.Y.

HOOTON & MOORE, 613 Ashdown Block, Winnipeg
LAVALLE-ROSS, Alexander Block, Edmonton, Alta.
A. R. WILLIAMS MACHINERY CO. 15 Dock St., St. John, N.B.
WETTLAUFER BROS., 316 Lagauchetiere St. W., Montreal, Que.

etc., who would be willing to take up their sole agency or their patent rights.

A London firm who are in the market for supplies of Canadian asbestos desire to hear from actual miners in the Dominion.

A Birmingham firm desires to correspond with Canadian firms open to appoint a purchasing agent in England.

A firm in the Midlands of England desire to be represented in Canada for the sale of all descriptions of Birmingham and Sheffield manufactures.

A firm of colliery agents in South Wales desire to be placed in communication with colliery proprietors in Nova Scotia able to supply them with large quantities of gas coal.

◆

CANADIAN PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout and Maybee, 59 Yonge Street, Toronto, from whom further particulars may be obtained:—H. J. Graves and C. C. Parrott, wheel rims; Wm. C. Gowdy, animal traps; Sir C. C. Wakefield, forced feed lubricator; F. G. Browne, machine for cleaning ships' hulls; George J. Money, latches for doors; Henry Stanbridge, projectiles for ordnance; C. H. Gray, process of manufacture of golf balls; P. M. Bartelmann, clamping devices; W. E. Hipkins, automatic weighing apparatus; Verity Plow Company, molding machines; Minerals Separation, Limited, concentration of copper ores; C. B. Redrup, fluid pressure engine; John Anderson, feathering wind sails for propellers; F. W. Prentice, train control systems; Cummer-Dowswell, Limited, washing machine; Dunlop Tire and Rubber Goods Co., Limited, tire treads.

◆

RECENT CRANE SALES.

Contract has been awarded by the Canadian Pacific Railway Company for a ten-ton overhead traveling crane, of about 57-ft. span, for the Angus Shops, Montreal, to Messrs. Royce Limited, Trafford Park, Manchester, England. Besides this crane, a number of other orders have been booked this year by Royce's Canadian office at Toronto, as follows:—

Two 45-ton; two 30-ton; three 20-ton; two 15-ton; one 10-ton, and three 5-ton overhead electric traveling cranes; a transfer bridge and telfer plant; and the conversion of several hand cranes to electric power.

Among the customers who have ordered these cranes are such well-known firms as Jenckes Machine Company, the Hamilton Bridge Company, the Ontario Hydro-Electric Commission, the C.P.R., the Page-Hersey Company, etc.

Messrs. Royce Limited are very well known all over the world as builders of cranes. They make a specialty of hoisting and lifting machinery, manufacturing absolutely nothing else. They manufacture every portion of their cranes, including the electrical equipment.

◆

SEWAGE PUMPS FOR MONTREAL.

[illegible] Glasgow; J. T. Farmer, Montreal, Canadian agent. The [illegible]

◆

CARBIC, LIMITED.

[illegible]

◆

[illegible]

NEW INCORPORATIONS.

Kelowna, B.C.—B. P. Construction Co., $10,000.

Redlow, Alta.—Beaver Lodge Industrial Co., $10,000.

Victoria, B.C.—Gordon River Power Company, $10,000.

Kelowna, B.C.—Kelowna Garage and Machine Works Co., $50,000.

Vonda, Sask.—Vonda Farming and Industrial Co., $20,000.

Saskatoon, Sask.—Saskatoon Trussed Wall and Building Co., $100,000.

Prince Albert, Sask.—Great West Iron, Wood & Chemical Works, $500,000.

Moose Jaw, Sask.—Polar Ice Company, $60,000. General Motors, $1[illegible].

Bowmanville, Ont.—Bowmanville Building Co., $40,000. G. C. Bonnycastle, H. Cann.

Winnipeg, Man.—Canada Floors, $500,000. M. H. Teskey, R. J. A. Prince, W. Manahan.

Fort William, Ont.—Superior Brick Co., $500,000. K. R. Ayer; J. R. Hutchison, G. R. Duncan.

Cobalt, Ont.—York Ontario Silver Mines, $1,000,000. W. H. Garvey, J. A. Rowland, N. Tytler.

Vancouver, B.C.—Vancouver Spring Doubletree Co., $50,000. Maritime Motor Car Co., $50,000.

Petrolia, Ont.—Petrolia Motor Car Co., $300,000. W. English, J. A. MacKenzie, A. M. McQueen.

Lancaster, N.B.—Cement Blocks, $10,000. J. B. M. Baxter, J. McDonald, G. E. Logan, St. John.

St. Boniface, Man.—Acme Sash and Door Co., $100,000. A. T. Wilson, J. Sutherland, E. M. Counsell.

Port Arthur, Ont.—Lakeside Lumber Co., $100,000. C. Sorensen, W. F. Langworthy, A. J. McComber.

Welland, Ont.—Empire Cotton Mills, $3,000,000. J. R. Marshall, A. B. Turner, G. A. Young, Hamilton.

Minaki, Ont.—Minaki Boat and Supply Co., $20,000. J. H. Parkhill, H. P. Blackwood, V. A. V. McMeans.

Kenogami, Que.—Saguenay Coal & Lumber Co., $40,000. O. A. Porritt, R. S. Hall, J. Porritt, Jonquierres.

Ville St. Pierre, Que.—Lumber and Construction Co., $300,000. F. Ditchfield, D. B. Swinton, J. H. Leboeuf.

Edmonton, Alta.—Dominion Lumber Co., $10,000. Builders' Supply Co., $300,000. Chown Hardware, $150,000.

St. Appolinaire, Que.—Lotbiniere Coal and Oil Co., $100,000. A. Bureau, St. Martine; A. Leclerc, P. Leclerc, St. Charles.

Calgary, Alta.—J. B. Royle Supply Co., $300,000. Rambler Motor Sales Co. of Alberta, $25,000. Calgary Taxicab Co., $100,000.

Moose Jaw, Sask.—Canadian Standard Automobile & Tractor Co., $250,000. Bouseman Lumber Co., $75,000. Acme Lumber Co., $50,000.

St. Thomas, Ont.—Noble Manufacturing Co., $100,000. G. Noble, Stratford; W. K. Cameron, C. B. Taylor. Griffin Coal and Ice Co., $40,000. F. M. Griffin, W. A. McIntyre, Mrs. T. G. Plewes.

Vancouver, B.C.—Canadian Automatic Fender Company, $200,000. International Home-Purchasing Contract Company, $100,000. Canadian Light and Power Company, $100,000. North West Canada Construction Company, [illegible]

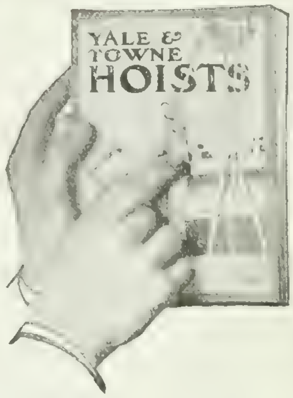
Sault Ste. Marie, Ont.—Algoma Eastern Terminals, $100,000. T. Gibson, A. Taylor, E. P. Seon, Toronto. Algoma Central Terminals, $100,000. T. Gibson, A. Taylor, E. P. Seon, [illegible] T. H. Sagle, H. A. Mitchell, Steelton.

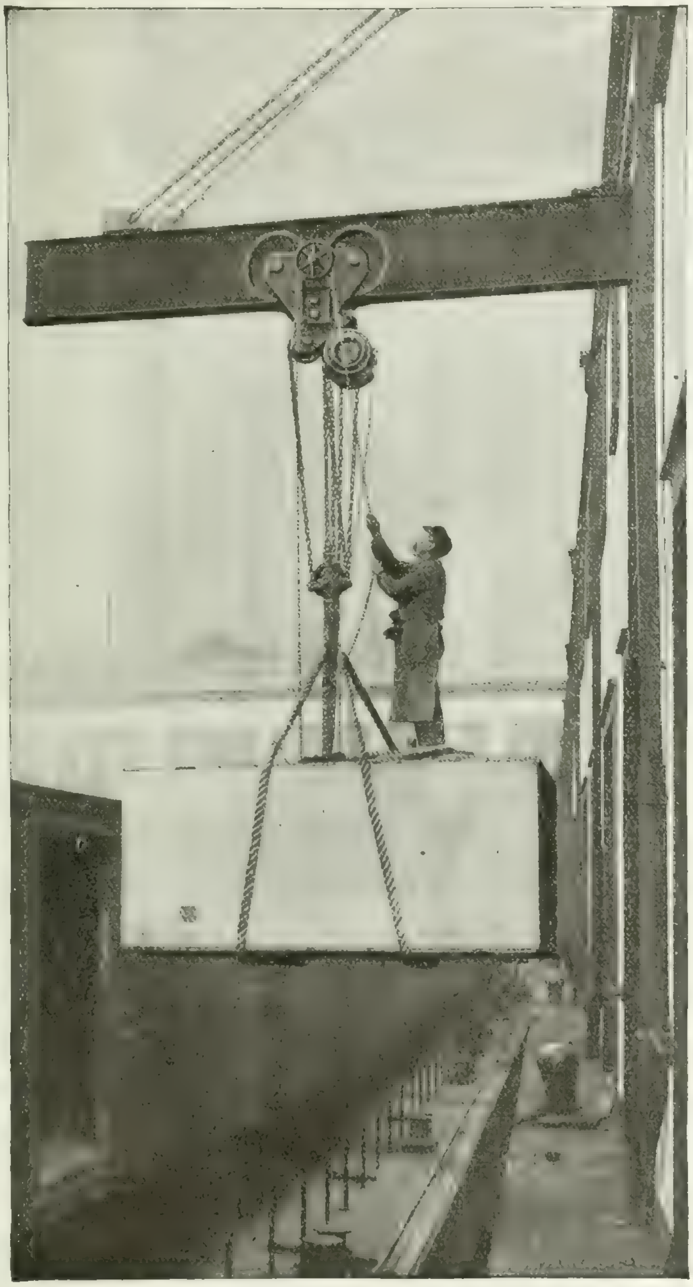
Winnipeg, Man. [illegible] Brown, W. C. Hamilton, R. Burritt. Phenix Brick, Tile and Lumber Co., $150,000. E. L. Fisher, G. D. Macvicar, S. R. [illegible] Dillabough, W. J. Moore, R. Manson. International Transit and Commercial Co., $10,000. W. L. Alexander, H. M. Beckford, [illegible]

Toronto. [illegible] ing Co., $40,000. C. H. C. Legott, C. M. Miller, Miss P. [illegible] Hugh, W. H. Furlong. York Mills Sand Co., $50,000. J. F. [illegible]

THE TRIPLEX BLOCK

REASONS FOR SENDING TODAY FOR THIS BOOK.





Triplex Block built into a 10-ton geared trolley and used for loading on floats lying alongside a pier in New York City.

A Book on the Handling of Loads, the Latest Practice Here and Abroad.

The change is coming fast. Modern plants today are equipping throughout to give each workman easy mastery over any load up to 20,000 lbs.

The new practice is to reduce all loads to one-man manageable loads, from the raw material coming in to the completed material going out. This frees the factory from an enormous waste. The primitive way of pitting time-paid muscle against stubborn weight, soon costs any manufacturer who stands for it a fortune in wages and restricts his output.

Months of research were spent by Yale and Towne engineers to make this book cover a wide range of conditions, so the man who sends for it will find it the most practical and helpful book that ever came to his desk.

Send for a free copy now, before
the thought is out of your mind.

Triplex Blocks { **16 Sizes:** One-fourth of a ton to forty tons.
9 Active Stocks all over Canada.

Every Block Tested to Fifty Per Cent. Overload.

The Canadian Fairbanks-Morse Co., Limited

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

[illegible] page may be found summaries of [illegible] Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer [illegible] fee.

[illegible]—October [illegible]—Authorizing C.L.O. & W. (C.P.R.) to construct across tracks of G.T.R., near Shannonville Station, Lot 3, Con. 1, Tp. Tyerdinage, Co. Hastings, Ont., at mileage 69.25 from Glen Tay, by means of overhead [illegible] tracks of G.T.R.

17697—October 10—Directing G.T.R. to protect Ottawa St., Hamilton, Ont., by watchman, in addition to bell already installed, between the hours of [illegible] a.m. [illegible] p.m.

[illegible]—October [illegible]—Authorizing C.N.R. to construct spur, from mileage [illegible], to connect with transfer yard west of Dawson Road, in city of St. Boniface, Man.

17699—October 9—Directing C.P.R. to make grade on south side of track crossing at Lot [illegible], Con. [illegible], Tp. Peel, [illegible] mile west of Wa[illegible] Station, [illegible], to be completed by October [illegible], 1912.

17700—October 9—Authorizing G.T.R. to construct additional track across Richmond St., in town of Strathroy, Ontario.

17701—October 8—Authorizing G.T.R. to construct siding for the proposed Hospital for the Insane, at Whitby, Ont.

17702—September 26—Authorizing C.P.R. to cross highway between Cons. 4 and 5, Tp. [illegible], by means of overhead [illegible].

17703—October 9—Granting leave to Toronto Suburban Ry. Co. to cross C.P.R. by means of under crossing, on Lot 12, Con. 3, Tp. of Toronto, Co. Peel, Ontario.

[illegible]—October 9—Authorizing Municipality of Tp. of Louth, Ont., to construct highway across tracks of G.T.R., between Lots 22 and 23, Tp. Louth.

[illegible]—October [illegible]—Directing G.T.R. to cut down trees on S.E. corner and reduce clay banks on N.E., N.W., and southwest corners, obstructing view of highway crossing 1 mile north of Burk's Falls, Ont., being Cons. [illegible] and [illegible], [illegible].

17706—October 12—Authorizing G.T.R. to carry traffic over Regina-[illegible], Man.

17707—October 11—Authorizing G.T.R. to reconstruct bridge carrying V[illegible], city of Niagara Falls, Ont., across its tracks.

[illegible]—October [illegible]—Authorizing and approving diversion of highway immediately west of G.T.R. station at Thornton, Ontario.

17709—October 9—Approving location and detail plans of G.T.R. proposed new station at Sunnyside, Toronto.

[illegible]—October [illegible]—Directing G.T.R. to reduce to [illegible] ft., the height of cedar hedge, and right-of-way fence, along N.E. side of highway just north of its station at Thornton, Ontario.

17711—October 11—Authorizing G.T.R. to reconstruct bridge No. 75, mileage 8.21, over Grand River, Brantford, Ontario.

[illegible]—October [illegible]—Amending Order No. [illegible], August 13th, 1912, by striking out clause 5 requiring Mount McKay and Kakabeka Falls Ry. Co., [illegible] cars passing over C.P.R. at Neebing Ave., between city of Fort William and Tp. of Neebing.

[illegible]—October [illegible]—Authorizing C.P.R. to construct spur, or switching [illegible] Co., Ltd., on [illegible] Lot [illegible], Con. 6, Tp. Belmont, Co. Peterborough, Ont., near Blairton.

[illegible]—October [illegible]—Authorizing C.P.R. to construct two (2) spurs for [illegible], N.E. [illegible], Tp. [illegible], at Medicine Hat, Alberta.

[illegible]—October [illegible]—Approving C.P.R. plan, dated June [illegible], 1912, showing changes to be made in electric bell protection at Main Street, Carle[illegible], Ont.

[illegible]—October 11—Authorizing C.P.R. to construct spur for [illegible] Yonge St., Tp. York, Co. York, Ontario.

[illegible]—October [illegible]—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]—October 11—Authorizing C.P.R. to construct spur for Alberta Foundry & Machine Co., Ltd., Medicine Hat, Alberta.

[illegible]—October 12—Approving revision in line and grade of portion C.P.R. Sudbury-Sault Ste. Marie Branch, as constructed, from M. 7.42 to M. 8.3[illegible] (Webbwood Section), in Lots 4, 5, and 6, Con. 5, Tp. Waters, Dist. Nipissing, Ontario.

[illegible]—October [illegible]—Authorizing city of Hamilton, Ont., to extend Birmingham St. across T.H. & B. Ry. on Lot 7, Con. 1, Twp. Barton, now in city of Hamilton.

[illegible]—October [illegible]—Authorizing city of Hamilton to extend Birmingham Street across G.T.R. on Lot 7, Con. 1, Twp. Barton.

[illegible]—October 12—Temporarily approving G.T.R. Freight Mileage Tariff, C.R.C. No. 11, between and including Prince Rupert and South Hazelton, B.C.

[illegible]—October 12—Authorizing G.T.P. Branch Lines Co. to construct for McLeod Collieries, Ltd., additional spurs and trackage turning out from [illegible], Tp. [illegible], R. [illegible], W. 5 M., Dist. North Alberta, Alberta.

[illegible]—October 11—Authorizing C.P.R. to construct spur for York [illegible], Lots 17, 18, 19, and 20, Block 74, city of Calgary, Alta.

[illegible]—October 12—Extending until November 30th, 1912, time within which C.P.R. construct spur for M. Rumely Company, in city of Saskatoon, Saskatchewan.

17737—October 11—Approving proposed location G.T.R. station on Lot 9, Con. 18, Tp. East Zorra, Co. Oxford, Ont., at Innerkip.

17738—October 8—Authorizing C.N.O.R. to take portion of Lot 15, Con. 4, Tp. Nepean, Co. Carleton, for purpose of carrying out necessary diversion as approved by Order No. [illegible].

17739—October 4—Authorizing C.N.O.R. to construct across Bridge St., village of Yarker, Twp. Camden, Ontario.

17740—October 11—Amending Order No. 17281, dated August 13th, 1912, by striking out word 'Applicants' in 11th and 12th lines of paragraph 1, and in 8th line of paragraph 2, of operative part of Order, and substituting the words, 'the owners of industries applying and interested herein.'

17741—October 11—Authorizing C.P.R. to construct spur for J. T. Hepburn Company, Toronto, Ontario.

17742—October 14—Approving location C.P.R. station at Hussar, Alta., on S.E. ¼ Sec. 14, Tp. 24, R. 20, W. 4. M.

17743—October 14—Authorizing C.P.R. to construct spurs for Tregillus Clay Products Company, N.W. ¼ Sec. 26, Tp. 24, R. 2, W. 5. M., at Shaganappi, Alta., at mileage 5.8, Laggan Subdivision.

17744—October 14—Authorizing C.P.R. to construct spur for Bishopric Wallboard Company, Limited, Sub. Div. Lots 7, 8, and 9, of Lot No. 21, Junction Gore of Tp. Gloucester, Co. Carleton, Ont., at Ottawa.

17745—October 14—Extending for six months, time within which Esquimalt and Nanaimo Ry. file Standard Tariff of maximum freight tolls for approval by the Board.

17746—October 14—Authorizing Esquimalt and Nanaimo Ry. to construct spur for Shawinigan Lake Lumber Company, Limited, Victoria, B.C.

17747—October 14—Authorizing C.N.O.R. to construct across and divert public road, Lot 4, Tp. Bristol, Co. Pontiac.

17748—October 14—Approving C.N.R. plans of its Standard No. 6 station, to be used on its Eastern lines.

17749—October 15—Approving location C.N.O.R. station grounds at Bristol Corners, Tp. Bristol, Co. Pontiac, Que.

17750—October 14—Approving by-law authorizing William McNeill to prepare and issue the tariffs of tolls to be charged by the Western Canada Power Co., Limited.

17751—October 16—Authorizing G.T.R. to reconstruct bridge No. 15, mileage 22.73, across Welland Canal, at a point 1¼ miles north of St. Catharines.

17752—October 11—Authorizing G.T.R. to reconstruct bridge No. 45, mileage 76.83, over Huron Road, between Twps. North & South Easthope, Co. Perth, Ont.

17753—October 11—Directing G.T.R. to install and maintain an electric bell at crossing just east of Jordan Station, Ontario.

17754—October 15—Extending, until June 15th, 1913, the time within which Dominion Atlantic Ry. complete bridge across the Shubenacadie River at South Maitland, Nova Scotia.

17755—October 16—Authorizing C.P.R. to construct branch line across road allowance at southerly end of Sec. 30, Tp. 16, R. 5, W. 2 M., Saskatchewan.

17756—October [illegible]—Relieving G.T.R. from providing further protection at crossing of [illegible] Street, Hamilton, Ont.

17757—October 15—Approving location C.N.O.R. through Tps. Arundel [illegible], Cos. Argenteuil & Ottawa, mileage [illegible] to mileage [illegible].

17758—October 14—Authorizing G.T.P. Branch Lines Co., to construct [illegible], Tp. [illegible], R. [illegible], [illegible], Brandon, Man.

[illegible]—October [illegible]—Authorizing C.N.O.R. [illegible] Laugh[illegible]

[illegible]—October [illegible]—Authorizing C.N.R. [illegible] Portage [illegible], Manitoba.

[illegible]—October [illegible]—Authorizing C.P.R. [illegible] city of [illegible] city of [illegible]

[illegible]—October [illegible]—Directing Hamilton Radial Electric Ry. Co. to [illegible]

[illegible]—October [illegible] Maisonneuve [illegible] St. [illegible] Montreal, Que.

[illegible]—October [illegible]—Authorizing C.P.R. to [illegible] highways [illegible]

Samson Water Wheels

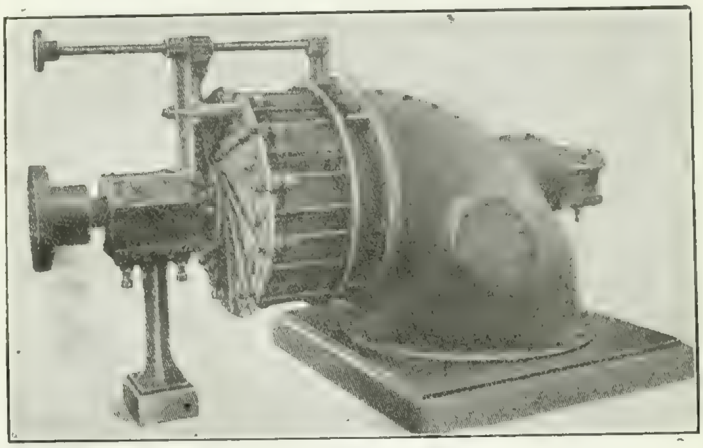
You can always judge a water wheel by the number of successfully operating wheels of that type there are in use—and besides the successful wheels show that the builders have had the right kind of experience, which is important to you.

The Samson wheels in use are developing about *Two Million Horse Power.*

And all the knowledge gained from this extensive experience is back of each new installation.

Send us your next specification.

William Hamilton Co.,
Limited
Peterborough, - Ont.



ESCHER - WYSS - ZOELLY STEAM TURBINES

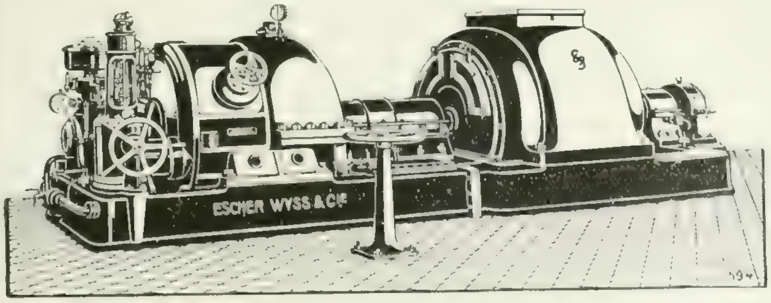
Head Office for Canada
515 Canadian Express Building
MONTREAL, QUE.

AGENTS

ONTARIO
C. J. PRINTZ
127 Delaware Ave., Toronto

MAN., SASK. & ALTA.
C. L. TRIMINGHAM
45 Canada Life Building,
Winnipeg, Man.

BRITISH COLUMBIA
FRANK DARLING & CO.
Homer St., Vancouver



PHŒNIX, B.C., IS IMPORTANT COPPER CAMP

Phoenix is the most important copper camp in Canada and the mines, up to July 1, 1910, have produced and shipped over 7,000,000 tons of ore.

The ore bodies occur in a mineralized zone which represents a portion of the Brooklyn limestone replaced by epidote, garnet, etc. The zone is separated into isolated areas which occupy trough-like basins in the jasperoids and limestones.

The ore bodies lie at different horizons in this zone though generally favoring the lower and outer portions, and may be considered simply as portions of the mineralized zone in which the copper ore has been sufficiently concentrated to form workable deposits. The ore bodies range in size from lenses about 100 feet long and 20 feet thick to extensive masses like the main ore body of the Knob Hill-Ironside mine, which is about 2,500 feet long and has a maximum thickness of 125 feet and a known width of 900 feet, is the report of Mr. O. E. Le Roy to the Department of Mines, Ottawa. The altitude of the ore bodies varies in different bodies, and at different points in the same body, from vertical to almost horizontal. There is a pronounced flattening of the dip with depth. The foot-wall is usually jasperoid, occasionally limestone, and, in one instance, the quartzose rocks of the Knob Hill group. As a rule, the commercial footwall coincides with the structural. The hanging-wall is almost invariably a commercial one, though the pay ore is usually sharply marked off from the lower grade by a gouge-filled fissure or "slip."

The ore throughout is remarkably uniform and is almost self-fluxing. It consists of finely disseminated chalcopyrite, with pyrite and hematite (specularite), in a gangue composed essentially of epidote, garnet, quartz, calcite, and chlorite. Magnetite occurs in distinct masses, or lense-like bodies, both in, and along the borders of the main ore bodies. In the case of the Monarch deposit magnetite forms one of the main ore bodies. The chalcopyrite carries all the copper, gold, and silver values, the average ore containing from 1.2 to 1.6 per cent. of copper with about $1.00 in gold and silver to the ton. The mineralized zone comprises a portion of a zone of contact metamorphism in the limestone of the Brooklyn formation. In the absence of any closely associated masses of igneous rocks, the hypothesis is advanced, that the metasomatic replacement of the limestone, and the deposition of ore have been brought about by solutions, derived from some unit of the granodiorite batholith. The solutions, given off at temperatures above the critical, and carrying silica, alumina, and ferric iron with copper and iron sulphides at a later stage, traversed the limestone in lateral and lateral descending directions, gradually replaced the limestone by epidote, garnet, etc., and deposited the ore uniformly over extensive areas, thus forming the large low grade bodies. The overlying rocks were subsequently removed, which left portions of the ore bodies outcropping at the surface.

The fact that the ore bodies are comparatively shallow, and that they give out rather sharply with depth, tends to [illegible] descending rather than ascending. The probable age of their formation is provisionally placed in the Jurassic.

In the commercial development of the ore bodies the [illegible] by diamond drilling by means of which the broad outlines of the bodies are ascertained. The ore is [illegible] underground workings.

[illegible] bodies [illegible] vantage.

[illegible]

Tenders Called For

MAIL CONTRACT.

SEALED TENDERS addressed to the Postmaster General, will be received at Ottawa until Noon, on Friday the 29th November, 1912, for the conveyance of His Majesty's Mails on a proposed Contract for four years six times per week, over Rural Mail Route from Weston, Ontario, to commence at the pleasure of the Postmaster General.

Printed notices, containing further information as to conditions of proposed Contract may be seen and blank forms of Tender may be obtained at the Post Offices of Emery, Weston, and at the office of the Post Office Inspector at Toronto.

G. C. ANDERSON,
Superintendent.

Post Office Department, Mail Service Branch,
Ottawa, 15th October, 1912.

30 M.C.B. 1,500-24-10-12.

TOWN OF YORKTON, SASK.

TENDERS FOR AUTOMOBILE FIRE TRUCK.

Sealed tenders addressed to T. F. Acheson, Secretary-Treasurer, and marked "Tenders for Automobile Fire Truck," will be received until 12 o'clock noon, November 12th, 1912, for one automobile fire truck complete from 50 to 60 horsepower, with combination extension ladder, hose and chemical equipment. Plans and specifications to accompany all tenders. The lowest tender will not necessarily be accepted, and the right is reserved to reject any or all tenders.

T. F. ACHESON,
Secretary-Treasurer.

Yorkton, Sask., October 18th, 1912.

CITY OF WINNIPEG.

Tenders for Extension of Water Works System.

Separate or bulk sealed tenders addressed to the Chairman, Board of Control, and endorsed on the envelope "Tender for extension of Water Works System," will be received at the office of the undersigned up to 11 a.m. on Friday, November 15th, 1912, for the supply of all labor, material and plant required for the execution of the following works in connection with the extension of the Artesian Well Water Supply System of the City of Winnipeg, namely:—

Section "B."—Erection of 17 Pump Houses.
Section "C."—Supply and erection of Deep Well Turbine Pumps and Motors.
Section "D."—Supply and installation of necessary voltage Transformers at the individual Pumping Stations.
Section "E."—Supply of material for Power Line Construction, and erection of same.
Section "F."—Supply, delivery and laying of approximately [illegible] feet of Steel Pipe Line with Valves and Specials.

Plans, specifications and form of tender together with conditions governing tenders as prescribed by By-law may be obtained at the office of the City Engineer, 223 James Avenue, Winnipeg. The lowest or any tender not necessarily accepted.

Board of Control Office, M. PETERSON,
Winnipeg, October [illegible]th, 1912. Secretary.

For further Tenders see page 76.

Volume 23. Toronto, Oct. 31, 1912 Contents of this issue on page 677

The Canadian Engineer

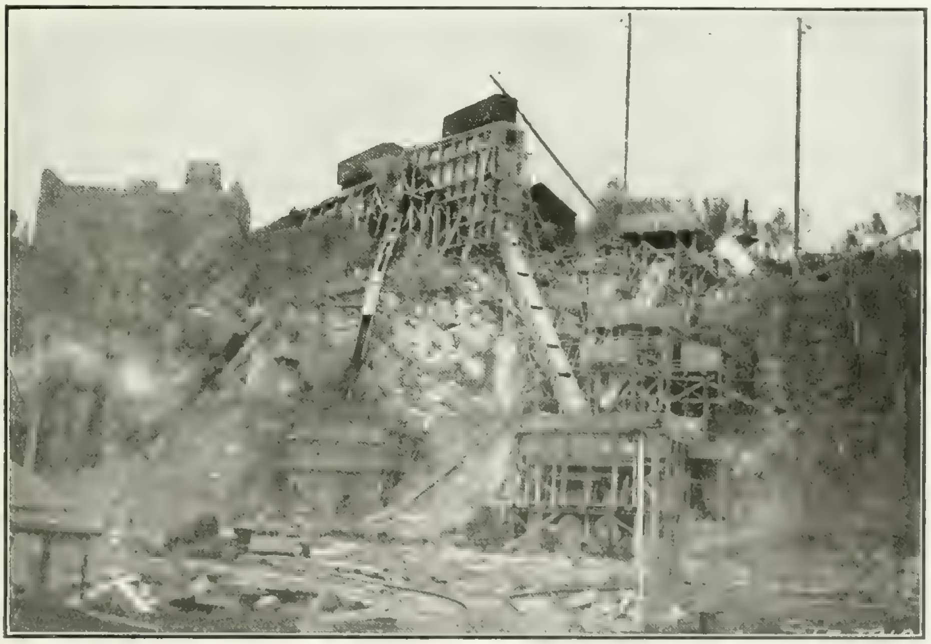
An Engineering Weekly

THE CONSTRUCTION OF THE SOUTH MAIN PIER OF THE QUEBEC BRIDGE.

By H. P. BORDEN, Assistant Engineer Quebec Bridge Commission.

Owing to the fact that the steel superstructure of the new Quebec Bridge is some 21 feet wider and nearly twice as heavy as the old bridge, it was necessary to construct entirely new piers for the new structure. This work has been going on for the past two years, and will probably require another year to finish.

The bridge has three approach spans, two on the north side and one on the south, having a total length of 409 feet, two anchor spans of 515 feet each; two cantilever spans 580 feet each, and one suspended span 640 feet in length, or a grand total of 3,239 feet face to face of abutment. The channel span is consequently 1,800 ft. centre to centre of main piers, being the same as the old bridge.



The Plant on the Side of the South Cliff.

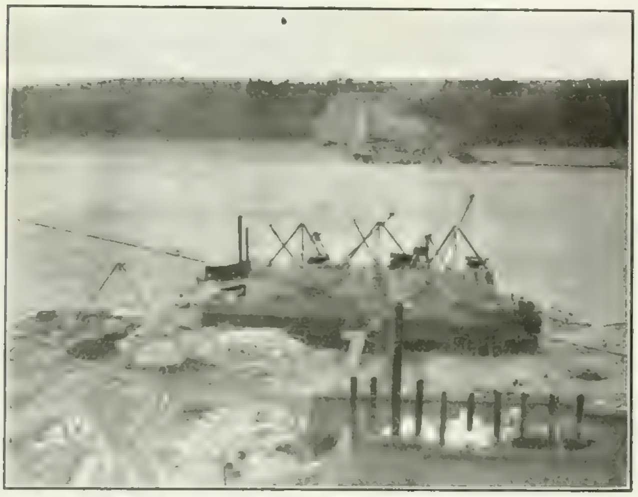
(There can be seen the quarry to the right, with crushers and stone chutes leading to the concrete mixers, also the sand and coal hoppers and chutes leading to the lower level. At the left is the south abutment). June 15th, 1912.

Last season the caissons for the north main pier were successfully sunk to a solid bottom some 80 feet below high water, or 50 feet below the bed of the river. This season the contractor has concentrated his efforts upon the sinking of the mammoth caisson for the south main pier. The caissons for the north main pier were in two sections each 60 ft. x 85 ft. with a 10-foot span between, this space being filled with concrete after the sinking was effected. On the south side one single caisson is being employed 180 ft. x 55 ft., which, taking into consideration the great depth it must go, is by far the largest caisson ever employed on a work of this kind. The caisson is being carried down to solid rock 85 feet below the level of the river bed and 100 feet below extreme high water.

The caisson was floated into position last season and grounded on a prepared bed which is exposed at low water. It remained here all winter, guard piers of rip-rap being placed along its sides to protect it from the ice. The rip-rap was mostly broken concrete taken from the old pier in course of demolition situated just outside the caisson. Weep holes were provided in the roof over the working chamber to allow free movement of water during the high tides, and thus guard against any floating of the caisson when once properly grounded. As the water rose several feet each tide above this roof it was feared that if snow were allowed to accumulate ice would form and tend to strain the structure. To guard against this contingency, the caisson was entirely housed over, and as a further precaution steam pipes were led around the walls just above the roof of the working chamber, steam being supplied by a boiler on top of the caisson. It was found, however, that the steam heating was not necessary as the interior kept sufficiently warm to prevent ice from forming.

Owing to a very late spring, actual sinking operations were not started until June 15th. Since that date the work has progressed steadily, and at the time of writing the caisson has reached bed rock, some 85 feet below the bed of the river. The material, being mostly sand, has been exceptionally easy to penetrate, the rate of progress having averaged nearly 9 inches per day for the entire time. Some weeks, however, the rate has averaged as high as 15 inches per day.

Owing to the unusual size of the caisson, extraordinary precautions were considered necessary to provide against any unequal settlement or any twisting or other movement of the caisson which might tend to open up the joints and seams and consequently allow air to escape. On this account it was decided that the ordinary method of sinking, where all the load is carried on the cutting edge, would not allow the movements of the caisson to be sufficiently controlled during the actual sinking. The rather unusual method has therefore been employed of carrying the entire load on the bulkheads and the roof and no load at all on the cutting edge.


The Plant on the South Side, Showing Caisson During Sinking.

(The plant on the north shore across the river can be distinguished.)
July 15th, 1912.

The caisson was supported on 40 sand jacks and about 25 posts 12 x 12 yellow pine and 54 sets of blocking. The jacks and posts bear directly against the roof while the blocking is piled under the bulkheads. When ready for a drop the blocking and posts are first removed by washing the sand from under them with a water jet. Then the whole caisson is lowered by operating each sand jack simultaneously. The sand jacks are of simple construction, consisting of a steel cylinder 29 inches in diameter closed in at the bottom. Near the bottom are two holes about 3 inches in diameter with a sliding cover. The plunger is a single piece of timber fitting easily into the cylinder. The cylinder is [illegible]

Floating the South Caisson into Position.

[illegible]

[illegible]

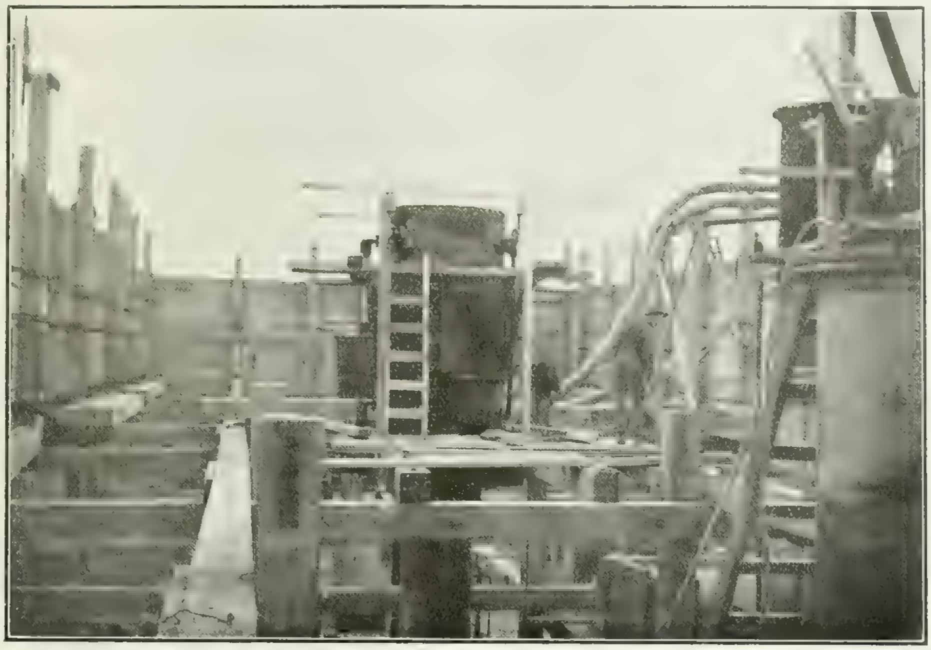
[illegible]

depth of two or three feet. This space was then filled with clay, which tended to prevent the escape of the air, and further acted as a lubricant during sinking. This scheme was followed throughout the entire sinking and seemed to materially facilitate the operation. The material encountered varied from small boulders and sand at the top to practically 95 per cent. sand towards the bottom. The sand is blown out through four-inch pipes by means of the compressed air. Ten of these pipes are in use and remove the fine material very rapidly. The larger material is removed through the material shafts in half-yard steel buckets. It has been necessary to do very little blasting.

Owing to the great depth of the caisson, special means have been employed to enable the men to enter and leave the working chamber with the least possible loss of time and labor. To this end an open shaft extends down to a horizontal steel lock placed over the roof of the working chamber. This lock is large enough to hold the entire shift. Communication with this lock and the outside air is made by means of a spiral stairway. There is an air valve at the [illegible] of this shaft and also at the top of another shaft in the [illegible] of the lock leading down to the working chamber. [illegible] there are four other 30-inch ladder shafts. The excavated material is hoisted out through three material shafts.

Contractors' Plant on South Side of River, New Quebec Bridge

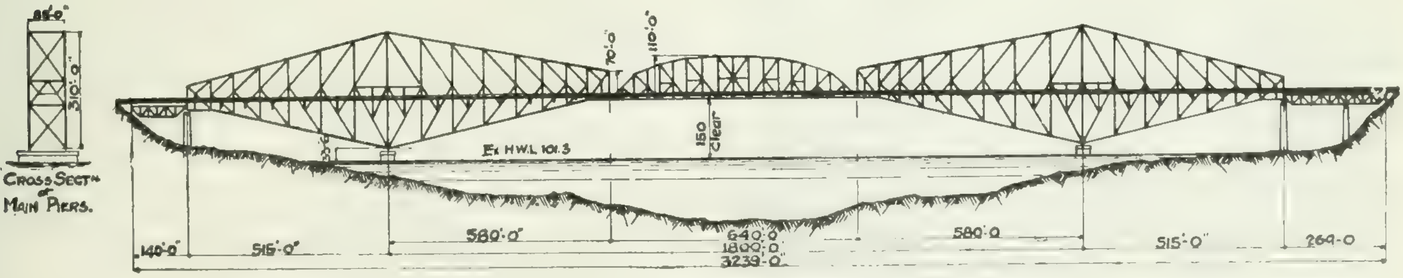
At the beginning of the work about [illegible] "sand hogs" were used in three eight-hour shifts of [illegible] men each. As the caisson was sunk and the pressure increased the length of the shift decreased. At [illegible] feet below average high water at a pressure of [illegible] lbs. per square inch, a change in working hours was made to four shifts of six hours each. At a further depth [illegible] the pressure six shifts of four hours was required. Again at 75 feet the shifts were changed to eight of three hours each. When the caisson reached its full depth of over 90 feet below average high water two one-hour shifts per day were required, this being the greatest length of time that the men could stand the very heavy pressure.



View of Interior of South Caisson.

(The large shafts are for material, while the smaller are ladder shafts for the men). June 15th, 1912.

Outside the caisson the contractor has made provision for the care of the men in many ways. In addition to a bunk-house and dining-room, there is a dressing and coffee house where "sand hogs" coming out of the caisson may change their clothes immediately and be supplied with hot coffee. Next door is an hospital with cots and a qualified doctor in constant attendance. Adjoining the hospital is a steel hospital tank connected with the compressed air pipes where men who have come out of the pressure too quickly and are attacked by the "bends" can be placed immediately under pressure again before any serious or injurious effects can develop. The caisson is surrounded on three sides by a heavy platform supported on bents. On this platform is a double line of track leading to the concrete mixers and stone yards. The skips with the loaded concrete buckets run from the mixers to the caisson by gravity, the empty skips being hauled back by horses. Three 15-ton stiff-legged derricks are placed on each side of the caisson and are used to deposit concrete, stone, or hoist the loaded buckets through the material locks. On this platform is also the pump which supplies the water to the boiler plant and for various other uses as required.



General Elevation and Cross Section of New Quebec Bridge.

(St. Lawrence Bridge Co. Ltd., contractor for superstructure).

The boiler and air compressor plant is situated near the foot of the cliff. A portion of this plant was brought over from the north shore last fall after the sinking of the north caisson was finished, but this has been increased nearly 100 per cent. in order to afford a greater reserve supply in case of break-down and also to furnish air for the increased number of blow pipes necessitated by the greater quantity of fine material encountered in the sinking.

The compressor plant consists of five Ingersoll-Sargeant direct compressors, four with a capacity of 1,250 cubic feet, and one with a capacity of 2,500 cubic feet per minute. This plant was used on the north shore last season. To this has been added, this season, two compound two-phase air compressors bringing the total capacity up to 13,100 cubic feet per minute. These two latter compressors were used only when the pressure got above 30 lbs. per square inch. The air is first compressed in the low-pressure cylinder up to 30 lbs. per square inch, then it is passed through a cooling chamber into the high-pressure cylinder where the compression is increased as desired. There is in addition a smaller high speed compressor for supplying air tools, etc. In the compressor house there is an automatic register indicating on a diagram the pressure at all stages of the tide during the whole 24 hours. Another gauge, by means of a finger operated by the tide, indicates on an adjustable scale what the pressure should be at any stage of the tide. By this means the operator can, by watching the finger, so adjust his compressors so that a pressure is intelligently maintained conforming to the height of the tide. The air is led from the compressor house into two receiving tanks, which tends to absorb the sound and shock from the compressors; thence into two 12-inch mains which are laid in a trough of cold, running water. The air, therefore, enters the caisson comparatively cool, the temperature of the working chamber rarely exceeding 80 degrees Fahr.

The boiler plant consists of one 75, six 100 and three 125 horsepower horizontal boilers, and three 250 horsepower Heine water tube boilers with a total capacity of 1,800 horsepower. A number of 50, 75 and 100 horsepower boilers are also used throughout the work, crushers, mixers, derricks and pumps.

The whole plant, as well as the working chamber of the caisson, is lighted by electricity supplied by the city.

In case of break-down on the power line the contractor has provided a complete generator plant located on the compressor house. It is equipped with a 30- kilowatt General Electric Company generator capable of operating 16 arc lights and 100 sixteen-candle-power incandescent lights.

The concrete masonry plant is situated at the foot of cliff which rises almost perpendicular for 125 feet. Half way up the cliff a No. 5 and No. 8 rock crusher is situated. The stone is quarried directly on the brow of the cliff, and is so situated that one derrick can pick up the buckets of stone from the quarry and dump it into the chute leading to the crushers. Coming from the crushers the broken stone is led through a revolving screen, thence through another chute to a hopper opening onto the mixing platform. Two Smith mixers are used, each having a capacity of 1⅓ cubic yards. The sand is brought to the brow of the cliff in cars and dumped into a large hopper. A chute leads from this hopper directly to the mixing platform. The coal is brought to the lower level in the same manner and is carried to the boiler house in side dump cars.

Sketch of New Quebec Bridge

(as it will appear when finished).

For the convenience of the "sand hogs" the contractor has erected a bunk-house adjacent to the work with sleeping accommodation for about 100 men. A dining-room is run in connection, which will accommodate about as many more.

The south main pier, when completed, will contain about 35,000 cubic yards of masonry. For a height of 75 feet [illegible] it will [illegible]

The Work of Demolishing the Old Main South Pier.

[illegible]

[illegible]

[illegible]

The concrete used for the main body of the caisson is composed of one part cement, two and one-half of sand, and five of broken stone. For sealing the working chamber a somewhat richer mixture is specified, viz., one of cement, two and one-half of sand, and four of stone. Displacer stones one-half a cubic yard and over are used in the concrete, no two stones to be closer than 9 inches vertically or 12 inches horizontally.

The work is under the supervision of a board of engineers, appointed by the government, of which Mr. C. N. Monsarrat is chairman, having associated with him Mr. Ralph Modjeski, of Chicago, and Mr. C. C. Schneider, of Philadelphia. Mr. J. D. Wilkins is resident engineer for the board at Quebec, and has charge of all inspection. Messrs. M. P. and J. T. Davis, of Quebec, have the contract for the masonry, Mr. S. H. Woodard, of Noble and Woodard, consulting engineers, New York, being superintending engineer for the contractors in charge of the entire work.

The South Caisson in Place, Behind the Old South Main Pier.

August 10th, 1911

◆

NICOL HALL, A NEW ADDITION TO QUEEN'S UNIVERSITY.

On Wednesday, October 16th last, there was formally opened for inspection an addition to the many handsome buildings of the University that will in future be known as "Nicol Hall," in recognition of the many philanthropic deeds of Prof. William Nicol.

The building will be occupied by the mining and metallurgical departments and the basement of the building is given over to the fire laboratories, gasoline furnaces, gold and silver mills, balance-room with chemical laboratories, metallurgical laboratory, equipped with roasting furnaces, blast furnaces and necessary appliances, etc.

On the main floor there is a large classroom, with accommodation for eighty students, there are research laboratories, and Prof. S. F. Kirkpatrick's room. The halls are very bright and it is the intention to use them for a museum.

The second floor contains a drafting room, lecture room, a private office and library of Prof. John Gwillim.

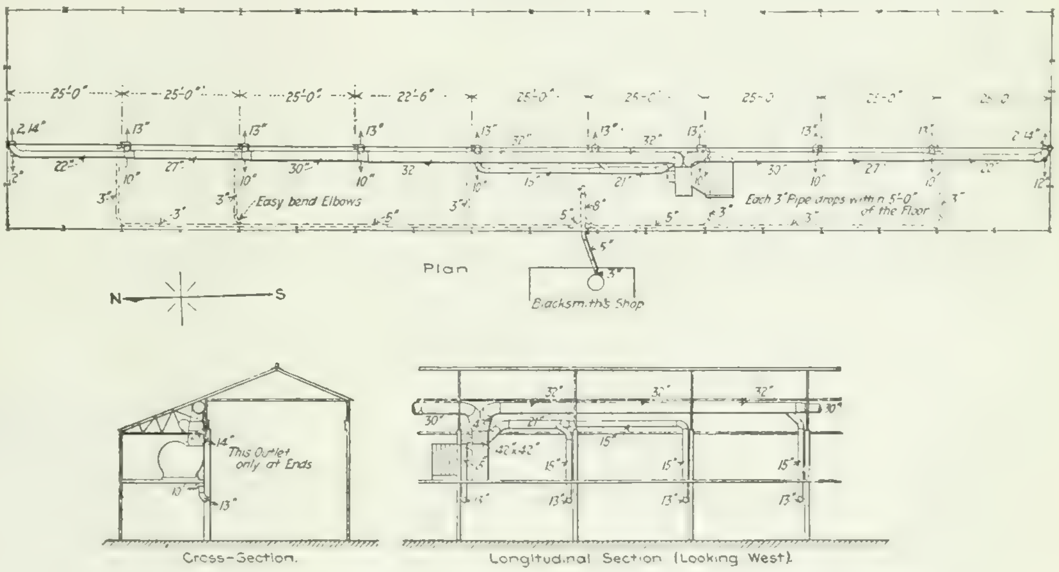
The third floor has not been fitted up as yet.

HEAT TRANSMISSION THROUGH CORRUGATED IRON.

An investigation to determine the coefficient of heat transmission through corrugated iron sheathing has recently been conducted by the Green Fuel Economizer Company, of Matteawan, N.Y., with the view of securing reliable data to be used in the calculation of the heating requirements of such buildings. Experiments were made in a shop of the company, used for the manufacture of fans and blowers.

The building is 225 ft. long by 48 ft. wide, with an average height of 32 ft. There are continuous windows on one side 15 ft. high and on the opposite side 19 ft. high. Otherwise the building is covered with corrugated iron of single thickness without lining. The crevices at the eaves are filled with asbestos and the corrugated iron is cemented in at the bottom, and other measures have been taken to make the building as air tight as possible. The exposure of the windows is east and west, the smaller windows being on the east side.

A study of the available data on the subject showed the coefficient for the rate of heat transmission through single windows with a southern exposure to be 1 b.t.u. per square foot per hour per degree difference in temperature between inside and outside, according to Prof. Homer Woodbridge. For northern exposure the same authority suggests adding 35 per cent., for eastern exposure 15 per cent. and for western exposure 25 per cent. According to Mr. Ludwig Dietz, quoting Dr. Rietschel, of Berlin, and also the specifications of the Prussian Government, the coefficient for single windows is 1.026, with an increase of 10 per cent. for northern, northeasterly or northwesterly exposures and 10 per cent. for especially strong winds. The only figure for corrugated iron without sheathing that has been found is one of 2.132 by Dr. Rietschel, but without any statement as to whether this refers to superficial wall area or to the actual surface of the iron.



Plan and sections of New Fan Building, Green Fuel Economizer Company.

The formula commonly employed for the determination of the coefficient of heat transmission from one fluid to a solid substance and from the solid to a second fluid is of the form,

$$k = \frac{1}{\frac{1}{Ai} + \frac{1}{Ao} + \frac{x}{e}}$$

wherein Ai is the transmission from the inside fluid to the wall surface and Ao is the coefficient of heat transmission from the outside wall surface to the second fluid, e is the conductivity of the material in heat units per square foot per hour per degree difference per inch of thickness, and x is the thickness in inches.

For the value of Ai and Ao Mr. Grashof gives the following equation:

$$a = c + d + \frac{(40c + 30d)}{10{,}000} T$$

in which c depends upon the velocity of the fluid. Dr. Rietschel gives for air at rest c = 0.82; in slow motion, as in contact with cold windows, c = 1.03; in rapid motion, as outside of buildings, c = 1.23. d for glass is given as 0.60 and for sheet iron as 0.57. T for single windows is given as 36, no value being given for iron.

Calculating from the above values, we find that for a single glass window Ai is 1.84 and Ao is 2.07. For sheet iron the value for Ai equals 1.81 and for Ao equals 2.04.

For e Dr. Rietschel gives 190 for iron and 6.6 for glass. It will therefore be seen that the third term in the denominator of the expression for k can be neglected for iron and is practically negligible for glass.

Using the values of Ai and Ao just found, k for a single window works out as 0.958 and for a single thickness of sheet metal as 0.955, practically the same.

This, however, is not taking account of the additional surface of the sheet metal wall due to the corrugations. The corrugated metal used in the building under discussion has one corrugation to every 2½ in., the depth of the corrugation being 1 in. The actual surface of the metal is approximately 1.35 times the superficial area. This would make the rate of heat transmission for corrugated sheet iron, figured on the basis of superficial area, approximately 1.35 times 0.955, or 1.29.

According to the engineers conducting the test the values obtained by Grashof's method for both glass and sheet iron are lower than the values used in ordinary practice. This may possibly be explained on the hypothesis that the constants used in ordinary practice have been increased to account for losses due to leakage, the opening and shutting of doors, etc. Weight is lent to this view by the results of the tests which follow, bearing in mind that the construction of the present building makes it practically air tight. At the same time the values obtained were slightly greater than Grashof's formula would call for. The sheet-metal-working machinery and shafting housed in the building were in constant operation during the test, producing heat which was not measured, while, on the other hand, doors were being opened for the passage of men and materials on an average of once every ten minutes.

The total surface of the building is made up of approximately 7,538 sq. ft. of window, including the sash, 8,247 sq. ft. of wall surface and 11,925 sq. ft. of roof, the walls and the roof being given in superficial area. The total of wall and roof areas is 20,172, which, increased by the factor 1.35 to account for the corrugations, gives 27,130 sq. ft. total metal surface. The total superficial expanse of the building is 27,710 sq. ft., and the total actual surface, counting the metal in the corrugations, is 34,658 sq. ft.

The building is heated by a Green's hot-blast heater, consisting of an engine-driven centrifugal fan drawing through a "Positivflo" heater made up of six sections of four rows of pipe each, the sections measuring 7 x 8 ft. The heater is ordinarily drained of condensate and air by a Dexter vacuum system. There are altogether 6,816 lineal feet of 1-in. pipe in the heater, or 2,272 sq. ft. of heating surface. The air is distributed throughout the shop by circular sheet iron conduits with outlets directed down into the zone occupied by the workmen.

The fan and heater had been running for about two hours when the first readings were taken at 8:30 a.m., and the temperature of the shop was maintained constant until readings were discontinued at 11:30 a.m.

During the test the fan was run at 258 r.p.m., receiving 22,416 cu. ft. of air per minute, figured to 50° Fahr., the air actually being received by the heater at 73° Fahr. and delivered from the fan at 156° Fahr. The temperature of the steam in the heater was 212° Farr. The temperature of the air delivered from the farthest outlet was found to be 141½° Fahr. Under these conditions the temperature of the building, measured 3 ft. from the floor, was 66° Fahr., and measured in the gallery 70° Fahr., the temperature out of doors being 15° Fahr.

For the determination of the total heat two methods were employed. First it was calculated from the amount and rise in the temperature of the air passed through the heater, and, secondly, from the condensation in the heater. For the latter purpose the steam pipe from which the steam was introduced to the heater was carefully drained and the condensate from the heater was weighed. Figured by the air method, the consumption of heat was 2,084,000 b.t.u. per hour, and by the condensate method 2,029,730 b.t.u. per hour.

Using the air figures, the average rate of heat transmission through the superficial area of the building, that is, not counting the corrugations, was 1.42 b.t.u. per square foot per hour per degree difference, and using the steam value 1.38 b.t.u.

According to Professor Woodbridge's figures for the rate of heat transmission through the windows, the result obtained for a window on southern exposure equals 1 b.t.u. per square foot per hour per degree difference, which, however, is to be increased 15 per cent. for eastern exposure and 25 per cent. for western exposure, or in the present case an average of approximately 20 per cent. Figuring the window surface as 1.2, the value for the corrugated iron, figuring superficial area only, is 1.5, or figuring the whole surface of the iron 1.13, that is, less than an equivalent amount of glass surface. According to the engineers the explanation in that case may be that the corrugations in the iron protect the surface to a certain extent, that is, that the rate of heat transmission per square foot of actual surface (instead corrugated area) is less than it would be if transmitted through a flat iron surface.

Using the value obtained by Grashof's method for the glass windows, namely, 0.958, the value for the actual iron surface would be [illegible], but, in the opinion of the engineers, on the basis of this formula, there would be no reason for assuming [illegible] such difference between the iron and the glass.

Allowing for the usual indeterminate conditions, it is suggested that in calculating the heat supply for buildings of this kind provision be made for a coefficient of transmission of [illegible] b.t.u. for the whole wall and roof area.

The coefficient of transmission through the surface of the heater tubes, by the way, was [illegible] b.t.u. per square foot per hour per degree mean difference in temperature between the air and the steam, figured by the ordinary arithmetical method in which the average difference in temperature between the steam and the air is assumed to be the difference between the steam temperature and the mean of the air temperature on entering and leaving.

Figured according to the logarithmic formula, which takes account of the fact that the air arises more rapidly in temperature in passing over the first rows of tubes than in passing over the later rows of tubes, the value is 10. The mean physical velocity of the air through the heater was 1,210 ft. per minute.

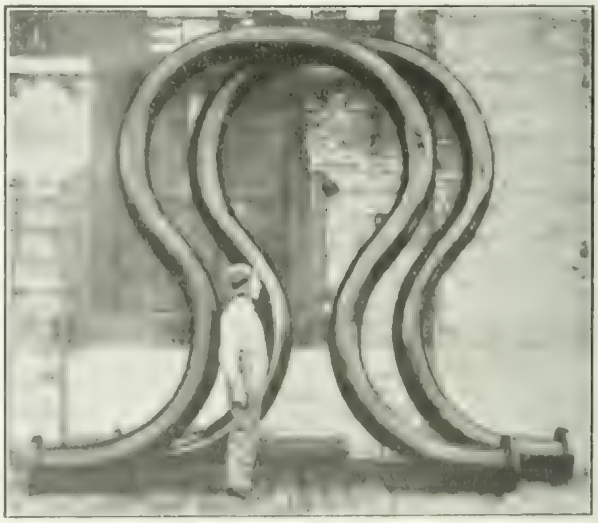
In a subsequent test, with air entering at 72° Fahr. and leaving at 166° Fahr. and steam at 213° Fahr., in which the velocity of the air was 760 ft. per minute, a coefficient of transmission of 7.5 (logarithmic) was obtained. Ten and seven and a half are in the ratio of 0.64 powers of the respective velocities, that is, the coefficient did not vary directly as the velocity, as frequently asserted. If instead of mean velocity flow in pounds of air per minute through the heater is used, which amounts to the same thing as velocities reduced to a standard temperature, the coefficients are found to be in the ratio of the 0.62 powers of the rates of flow.

◆

LARGE PIPE BENDS.

The illustration shows two "N" bends each containing 34 feet of 10-inch full weight pipe, made for the city of Lethbridge, Alberta, and ordered through the Winnipeg, Manitoba, branch of Crane Co. These bends measure 11 feet 10 inches, face to face, and 10 feet 11 inches, centre to centre in height. They have a 3-foot 2-inch radius with four 10 by 17½ extra heavy No. 295 E. welded flanges. The weight of each bend is 1,570 pounds.

The bends are part of the main steam piping in the Lethbridge power plant. One bend is in a vertical position, suspended from the roof truss, the other lies horizontally, supported from I-beams in the [illegible]. The working steam pressure of the line is 160 pounds, with superheat of 130 degrees. The engineer of the plant preferred to take care of expansion with these large "N" shaped bends rather than with sliding expansion joints. The specifications called for piping having a tensile strength of [illegible] pounds to the square inch, an elastic limit of [illegible] pounds per square inch, elongation of [illegible] per cent. in 8 inches, and a reduction in area of [illegible] per cent. Owing to the large size of the bends they had to be welded at the top of the bend, there being about [illegible] feet of straight pipe at that point.



Large Pipe Bends for Lethbridge, Alberta.

CHEMISTRY OF SEWAGE PURIFICATION.*

By Dr. Arthur Lederer.†

Sewage may be purified in part either by mechanical, chemical, or biological means, in combination or separately. Thorough knowledge of all the agencies at work in the biological purification of sewage has not been attained. The clarification of sewage by chemicals is easily explained by the reaction taking place, and the mechanical action of the floc formed. Since biological treatment is very largely used, more time will be devoted to that general process.

Unless specifically stated to the contrary, the remarks in this paper refer to dilute domestic sewage, and not to trade wastes. The treatment of sewages containing trade wastes, or of trade wastes themselves, is a problem in itself, requiring many different processes. The chemistry of the purification of trade wastes depends largely on the character of the wastes. As a rule, such wastes do not interfere with the common methods of disposal, unless they are present in in excessive quantities, or are poisonous, either to men, animals, or fish.

Physical Characteristics.—The physical characteristics of weak domestic sewage, from a large sewerage area as represented by the area draining to the 39th Street testing station, in Chicago, are subject to variations, depending, in part, on the rain-fall or snow-fall. In dry weather the sewage appears turbid, with a yellowish cast from the urine and feces; a perceptible quantity of settling suspended matter is present, in color ordinarily light gray, changing to dark gray, or even black in the storm-water sewage. The odor of the fresh sewage is slightly gaseous, but not at all repugnant as might be supposed. Other sewages might show different physical characteristics, depending upon the water consumption and other factors. As a rule, American sewages are far more dilute than foreign sewage, because of the great waste of water in the United States. A European sewage may, therefore, have not only a more repugnant appearance, but will often possess a strong putrid odor. The development of such an odor depends upon the amount of oxygen in solution.

Changes in Sewage on Decomposition.—The sewage handled at the 39th Street testing station contains some oxygen in solution, as well as nitrites and nitrates, during the greater part of the year, in particular during the winter. Such a sewage is called a fresh sewage. When the oxygen content—the dissolved oxygen as well as the oxygen in the nitrites and nitrates—becomes exhausted, the sewage turns stale, and the organic matter begins to break down, marking the first step toward the ultimate mineralization of the organic putrescible matter,—a change due mainly to the powerful activity of bacteria and enzymes. At this stage the free ammonia gradually increases, combining with the carbon dioxide to form ammonium carbonate. The organic carbon is oxidized as long as free oxygen persists in the sewage. Eventually anaerobic decomposition follows, resulting in the formation of gaseous decomposition products, of which hydrogen sulphide is very prominent. Free nitrogen is likewise released. The sewage becomes septic. The larger the proportion of putrescible matter present, and the smaller the amount of oxygen in solution, the quicker does a sewage become septic. The carbonaceous and nitrogeneous compounds present in the sewage are further attacked by anaerobic micro-organisms,—an action which frequently produces a nuisance.

The term septic has never been strictly defined, but may cover the lack of oxygen in the fluid, and the toxic or septic effect of anaerobic decomposition products upon aerobic organisms. Sometimes reference is made to an over-septic condition, which, to the writer's understanding, is one based upon the inhibition of the growth of anaerobic organisms by their own decomposition products. The term to-day is used vaguely, and requires standardization.

Physical Record.—In our laboratory we record the physical properties, as well as the quantities of settling suspended matter in the sewage, and any peculiarity in color. Sometimes the color becomes distinctly yellowish, a reddish precipitate gradually settling out. In such a sample the alkalinity is found to be low, and the sulphates high. We have traced this to the discharge of pickling liquor wastes from a wire works.

Preservation of Samples.—The odor of samples of sewage, or purified effluents, is not recorded as a routine procedure. The reason is that the samples are collected over 24 hours for crude sewage, and over, 48 hours for other effluents. To avoid change in the chemical constituents, a preservative is added,—in our case chloroform to the amount of 10 c.c. to one gallon of sewage. The chloroform effectually hides any odor present, unless hydrogen sulphide occurs in large quantities. As an additional precaution, the samples are kept in cold storage up to the time of analysis.

Exhaustive study into the question of the preservation of sewage samples has shown us that, even in a storage period as short as 6 hours, perceptible changes will occur in the nitrogeneous constituents of a fresh unpreserved sewage. At room temperature, the addition of 10 c.c. of chloroform to one gallon of sewage checks the decomposition to some extent, but even in such cases, immediate analysis is often desirable to obtain accurate results. Cold storage alone is a fair preservative. The combination of chloroform and cold storage is the best obtainable method at present. An ideal preservative is lacking for liquids, like sewage, of changing character. It should be odorless and colorless, and should not affect any of the constituents present or interfere with the analytical determinations.

Suspended Matter.—During the various stages of sewage purification, it is important to observe the physical and quantitative changes in the suspended matter, since the aim to-day is to remove as much as possible at the outset, in order to obtain a fresh effluent. In studying the efficiency of a device, frequent determinations are necessary both for the influent and effluent, extending over a considerable period, before an opinion can justly be formed of the percentage removal of suspended matter.

The settling suspended matter should be clearly distinguished from the non-settling suspended matter, in studying the efficiency of a settling device. Much of the suspended matter in sewage, particularly on large areas, occurs in a finely divided, or colloidal state, not capable of sedimentation even on prolonged storage; hence, when a settling tank is removing perhaps 35% of the total suspended matter, it may actually be taking out 100% of the suspended matter capable of settling. On prolonged storage, however, some of the colloidal matter may coagulate, and material previously in silution will also change to apparent settling matter. This is particularly true for strong sewages. From our analysis of the composition of the settling and non-settling suspended matter, it is evident that the percentage if volatile matter is greater in the non-settling portion. This may have a very important bearing upon the true character of a settled sewage from the standpoint of a prospective nuisance in a stream.

The settled suspended matter is termed sludge. The percentage of volatile and fixed matter depends upon the character of the sludge, a fresh sludge containing more volatile matter than fixed matter, a septic sludge being higher in mineral constituents. The content of moisture may run from 85% to 95%, depending upon the device.

---

*Read before the Chicago Section of the American Chemical Society.

† Chemist and Bacteriologist, The Sanitary District of Chicago

Since the determination if the settling suspended matter is of importance in the control of a sedimentation plant, the daily variations may be advantageously followed by determining the loss of suspended matter on settling gravimetrically, or else by measuring the number of c.c. of settled matter in a conical-shaped glass holding one liter. Such glasses are used in Germany, and may be of value in dealing with strong sewages containing considerable amounts of settling suspended matter, but in our weak American sewages the control is not as satisfactory, since the 39th Street sewage, for instance, contains, on an average, only 140 p.p.m. of total suspended matter, of which from 40% to 50% is capable of settling. In our case, actual gravimetrical determinations are made of the total volatile and fixed suspended matters by the Gooch crucible method.

Sprinkling filter effluents contain, as a rule, some suspended matter, but of a different character from the original floating or colloidal matter. A sprinkling filter is not built primarily as a means of removing suspended matter, but as a machine to oxidize and mineralize the organic material delivered to it. In the long run, a sprinkling filter should deliver, in its effluent, nearly as much solid as received. At times the effluent may be very clear. Some observers claim that more is delivered. The effluent, however, is greatly improved from the chemical standpoint, and also from the standpoint of putrescibility. The suspended matter, when unloaded, may give rise to putrefaction if stored in considerable quantities, and may become septic, so that shallow secondary settling basins may change a non-putrescible filter effluent into a putrescible final effluent.

Oxygen Consumed.—The time-honored oxygen-consumed test indicates the amount of oxygen absorbed by the oxidizable matter during titration in acid solution with permanganate, and in particular the amount of organic carbonaceous matter present. At present there are so many modifications of the test, that the results from various laboratories cannot be directly compared, without knowledge of the method employed. In our laboratory the 30-minute water bath boiling method is used. For comparative purposes this is a valuable test, although the figures obtained do not represent anything absolute. The result covers only a small percentage of the total carbon. The organic carbonaceous compounds vary in their resistance toward acid permanganate solution. The average of the oxygen consumed in our sewage is about 50 p.p.m.; the average of the effluent of a sedimentation tank is about [illegible] p.p.m.; and the average from the sprinkling filter is about [illegible] p.p.m.

It is important to remember that the oxygen-consumed test does not represent the oxygen which the liquid would absorb under natural conditions in a water course. From the practical standpoint, a far superior test is one which in- [illegible]

Nitrogen.—[illegible]

the ammonia was converted mainly into nitrate, but if the living organisms in the soil were paralyzed by chloroform vapor, or other antiseptics, nitrification did not take place. For the activity of these organisms the presence of oxygen is essential, as well as of a base to neutralize the nitrous and nitric acid which is formed. Moderate temperatures are most favorable, but the action may take place even at temperatures as low as 3° or 4° Cent. Species have been isolated which require very little or no organic matter for their subsistence. Such bacteria seed themselves in biological filters, and nitrify or mineralize the material coming to them. In general, the larger the bacterial surface the greater the nitrification will be for a given application of liquid. The size of the material and rates of application have to be varied for the process attained. In an intermittent sand filter, only 100,000 gallons can be applied to an acre in a day, whereas in a coarse grain sprinkling filter from 2,500,000 to 3,000,000 gallons can be applied to an acre in a day. A sand bed 5 ft deep would give a much higher nitrification than a sprinkling filter bed 5 ft. deep of stone from 1½ to 2 in. in size, at the rates mentioned. Overloading a filter will interfere with nitrification. It is interesting to note how short a period is required to establish nitrification on a large scale. The nitrates represent the last step in the oxidation of the nitrogenous matter, and serve as food for the higher developed living organisms. These organisms, in dying, form the starting point of another nitrogen cycle.

As yet our understanding of the nitrifying organisms, and the processes involved, is very meagre, so that in the future, research will be desirable to learn the exact action taking place. Possibly the nitrification process can be intensified by artificial means.

Denitrification.—It is interesting to note that certain species of bacteria have the power of reducing nitrates to nitrites, free ammonia, and free nitrogen, in contradistinction to the nitrifying group. Grayson and Dupetit made the first observations in 1882, and concluded that denitrification was essentially the result of combustion of organic matter by the oxygen of the nitrates. Frankland and Beyerinck have added to our knowledge. Many organisms have been found which do not bring about denitrification.

Because of the research into the protein molecule, I wish to speak of the nitrogenous intermediate products, which in sewage disposal are frequently productive of disagreeable odors, as for instance indol, with its putrid odor, or ammonia, with its characteristic odor. Free nitrogen, as mentioned, is produced by the denitrifying action.

Significance of Nitrogen Cycle.—The nitrogen cycle offers a good index to the efficiency of a modern sewage filter of any kind. In a settling tank we do not expect much change in the nitrogen, except the elimination of some of the organic nitrogen in the settling suspended matter. In a more extended storage period the free ammonia may increase, and the nitrates and nitrites decrease, provided the sewage originally applied was not septic. In a septic tank the free ammonia ordinarily increases, and the nitrates and nitrites decrease, or become entirely eliminated. The increase in the free ammonia in a septic tank results from the reduction of nitrates and the breaking down of the organic nitrogen. The biologic treatment on sprinkling filters and sand filters is an oxidizing process, and should result in an increase of the nitrates and nitrites. The organic nitrogen is decreased in a filter, on account of the bacterial decomposition and the escape of the volatile nitrogenous products and free nitrogen proper.

Determination of Nitrogen.—The organic nitrogen, as well as the free ammonia, the nitrates and nitrites, are determined as a routine procedure on all our samples from the sewage testing station. The method for the determination of the organic nitrogen is that introduced at the

Columbus testing station, and consists in the digestion of the sample by concentrated sulphuric acid, subsequent neutralization and direct nesslerization. The free ammonia is distilled previous to nesslerization. Very often the sample is nesslerized directly after adding a few drops of potassium hydrate and copper sulphate, the resulting precipitate being allowed to settle. The nitrates are determined by the napthylamine-sulphanilic acid method, and the nitrates by aluminum reduction in alkaline solution.

Formation of Hydrogen Sulphide.—Another interesting topic in the chemistry of sewage is the formation of hydrogen sulphide, the history of the sulphur cycle resembling that of the nitrogen cycle. Its presence in sewage indicates putrefactive changes as a rule, since sulphur is an element of the protein molecule, and as such is always present in small quantities in sewage. Plants absorbing mineral sulphates convert them into organic sulphur. On breaking down, organic sulphur yields hydrogen sulphide which becomes oxidized again to sulphates, either by chemical or biological means. Just as nitrates can be reduced to free ammonia, so are sulphates capable of reduction to hydrogen sulphide. Apparently the sulphur cycle is influenced more by purely chemical reactions than is the nitrogen cycle, but in both cases the changes are largely the result of bacterial activities.

The principal question for further study is the generation of hydrogen sulphide from inorganic sulphates, since hydrogen sulphide is one of the constituents most intimately connected with the development of a nuisance, and may also be responsible for damage to concrete work. Practically all sewage bacteria will form the gas in artificial media containing sufficient organic sulphur. Any sewage containing hydrogen sulphide may form a black sediment typical of septic conditions, the sediment consisting mainly of ferrous sulphide, since iron is almost always present in sewage in varying amounts. Other gases, however, may originate from the destruction of organic sulphur, as for instance, mercaptan. The formation of hydrogen sulphide, however, from sulphates is of more importance perhaps than its formation from organic sulphur, since sulphates are often present in large quantities. The reaction is undoubtedly due to specific types of bacteria, rather than to a wide group. Beyerinck first noted the phenomenon, and stated that the best conditions for the reduction of sulphates were the absence of oxygen, the absence of sugar in the culture media, and the presence of phosphates and other suitable solids. Only small quantities of nitrogen compounds are necessary. The optimum temperature is around 25° Cent. Beyerinck isolated an organism, the spirillum desulphuricans, a strictly anaerobic organism reducing sulphates. Other important work has been carried on by Van Delden, Letts, and recently by Dr. Buchanan.

Significance of Hydrogen Sulphide.—Hydrogen sulphide in sewage may not only be responsible for a local nuisance, since amounts as small as 3 p.p.m. can be noted under outside conditions, but on discharge into a stream it will draw upon the dissolved oxygen present, and often to such an extent that fish life will be seriously interfered with. In addition, hydrogen sulphide by itself is a poison to fish. The reduction of sulphates has been observed in many sewages in the United States and abroad, particularly when the sulphates are high from the introduction of trade wastes. In some cases the disintegration of concrete has been a serious matter, due to the oxidation of hydrogen sulphide to sulphuric acid by the atmospheric oxygen.

One of our settling tanks, a modified Dortmund tank, or, as Professor Phelps calls it, a biolytic tank, affords a typical case of active sulphate reduction. At times as much as 40 p.p.m. of hydrogen sulphide have been observed in the effluent. This can be traced directly to bacterial activity.

Before dismissing this topic, I will mention the classic work of Winogradsky, who made an exhaustive study of the oxidation of free sulphur by higher bacteria, such as beggiatoa. The beggiatoa utilize the sulphur as a source of energy, taking up from two to four times their weight without increasing in growth. Requiring but small quantities of organic matter they flourish in sulphur springs, the decomposing hydrogen sulphide liberating amorphous sulphur. The sulphur in turn is oxidized to sulphates. The effluent of our biolytic tank is quickly oxidized in a sprinkling filter. The effluent of the filter, however, contains abnormally large amounts of sulphate, and the top of the filter is covered by a silk-like growth of sulphur bacteria.

In a sewage-disposal plant there is, as a rule, no occasion to test for hydrogen sulphide as a routine procedure. The sense of smell or a simple lead acetate paper test should suffice, unless some peculiar case requires special investigation.

Chlorine.—The chlorine in a domestic sewage originates largely from the urinary chlorine, and indicates approximately the strength of a sewage. It can be easily determined by direct titration with silver nitrate solution, using potassium chromate as an indicator. Except as an index to the strength of the sewage, the chlorine determination has no further significance. The presence of industrial wastes containing chlorine, or of ground waters or sea water, may prevent us from drawing conclusions. On an average, the sewage of 39th Street contains about 40 p.p.m. of chlorine, indicating a dilute sewage.

Alkalinity.—The alkalinity has little significance in the interpretation of results, since industrial wastes may cause abnormal figures. Sewage ordinarily is slightly alkaline, considerable quantities of acid waste being required in order to turn it acid in the sewer. The average alkalinity of our sewage is 220 p.p.m., calculated as calcium carbonate. We titrate our sample with 1/50 normal sulphuric acid. Methyl orange is used as in indicator.

Fats.—In domestic sewage the fats and fatty bodies result largely from the use of soap in laundries and from household wastes containing grease. On Monday there is a slight increase in the fatty content of our sewage, but the addition is not great, since on our watershed there is a large proportion of apartment houses where washing is spread over several days of the week. No attempt is made to separate the fat from the soaps. On the addition of sulphuric acid, a certain quantity of sewage is evaporated to dryness, and the total fat extracted with ether. The average amount present in our sewage is approximately 25 p.p.m.

Total Solids.—The total solids in sewage are not now determined as a routine procedure, being largely of scientific interest. In our case the amount is about 600 p.p.m., or 0.6 of a gm. per liter. This indicates the extreme dilute character of our sewage.

Dissolved Oxygen and Stability.—Dissolved oxygen and putrescibility will be discussed together, since while both are determined separately, neither is by itself as instructive as when studied in connection with the other. The two determinations not only furnish a key to certain phenomena in biologic sewage disposal, but when their relation is better understood the solution of many problems will be attained. In a popular sense, putrescible matter is material which draws upon the oxygen in solution for its oxidation. However, inorganic compounds sometimes utilize oxygen in solution for their oxidation as well. From the standpoint of sewage disposal by dilution, or in studying the effect upon fish life, it is immaterial how the oxygen is used up. During the colder season, fresh dilute domestic sewages contain, as a rule some oxygen which in a short time becomes exhausted, and anaerobic conditions set in. The liquid then enters a stage where oxygen is quickly absorbed when supplied in any form.

In the control of a sewage-disposal plant, the determination of the putrescibility is more important than the determination of the oxygen, and in comparison with the other constituents, the knowledge of the putrescibility or stability is of the greatest importance. With this test a plant can be controlled to better advantage than by any elaborate chemical analysis. The reason for this is simple. The ultimate aim of any disposal plant is to make the putrescible matter more or less stable. The putrescibility test indicates the degree of oxidation obtained, and the determination of the dissolved oxygen gives a fixed figure of the absolute amount available for further oxidation. Both factors are important in studying a nuisance or fish life. A high oxygen content, in itself, does not indicate stability.

Determination of Dissolved Oxygen.—In our laboratory, the Winkler method has been used to determine the dissolved oxygen in the manner described in the "Standard Methods of Water Analysis" adopted by the American Public Health Association. The sample is collected carefully in order to avoid aeration. Manganous sulphate and an alkaline solution of potassium iodine are then added. The precipitate of manganous hydrate is allowed to settle; sulphuric acid is then added, and the free iodine in the solution titrated with standardized sodium thiosulphate. The equivalent of free iodine is calculated to oxygen. The results are expressed either in p.p.m., or in percentage saturation. In the latter case the temperature must be considered. Normal fresh water which has not undergone temperature changes ought to be 100% saturated, but may be sub-saturated or supersaturated, depending upon conditions, such as the season of the year, the sunlight, the presence of algae, or sudden changes of temperature.

As an alternative method, the American Public Health Association has recently recommended the Levy method for the determination of dissolved oxygen. This consists, briefly, in the conversion of a ferrous salt into a ferric salt by the oxygen in the water. The residual ferrous salt is titrated with the permanganate solution. At present the use of either method is a matter of choice.

Determinations for dissolved oxygen should be made on the spot to avoid a loss of oxygen, particularly in putrescible samples. From a study of this question in our laboratory, we have concluded that only fresh saturated and uncontaminated water like that from Lake Michigan can be kept for a number of hours without showing a reduction in oxygen. Even then the sample should be kept in a cool, dark place. The addition of a small quantity of formaldehyde allows an extension of the storage period, but it is preferable to add the first two reagents in the Winkler method in order to form the precipitate, where the determination cannot be made on the spot.

Determination of Putrescibility.—The putrescibility test has been almost universally adopted by various sewage purification plants. The one most in favor is the so-called methylene blue test devised by Spitta and Weldert in Germany. A dilute solution of methylene blue is added to a definite portion of the effluent in a sterile bottle; the mixture is then incubated at 20° Cent. and the number of hours or days required to reach the blue color is discharged. This decolorization takes place only in putrescible samples, and [illegible] the formation of [illegible] the [illegible] by [illegible] has been [illegible]. Some prefer an incubation temperature of 37° Cent. to obtain quicker results, but this temperature is not [illegible] because it does not correspond to actual conditions, as does the temperature of 20°. Furthermore, a [illegible] will [illegible] at 20°, which [illegible] at the lower temperature. Phelps has [illegible] a [illegible] stability [illegible] the [illegible] of a sample can be expressed in terms of [illegible]. [illegible] figures [illegible] the proportion of [illegible] compared with the total amount required to effect the complete oxidation of a sample in question. The sample should be kept in the incubator for twenty days before being discarded, but from a practical working standpoint this is neither necessary nor desirable. Ten days storage as a maximum is sufficient, and often four days will give results sufficiently accurate for practical purposes. Samples which show signs of decolorization after four days may be held for further observation. The exact hour of decolorization is difficult to fix, but an experienced observer can avoid material mistakes in estimating the end point.

Index of Permissible Dilution.—The putrescibility test outlined is eminently practical and valuable, but is not a quick method. Recently Phelps devised another method to give the desired information in a shorter time. The test in principle is not new, for it has long been known that organic putrescible material will absorb oxygen in solution, and the rate of absorption under certain conditions has rightly been looked upon as a good index to the putrescibility of the sample. Only recently, however, could the permissible dilution be calculated for a sewage effluent under certain assumed conditions. The procedure is to mix a small quantity of sewage carefully with fresh aerated water in definite proportions, and to incubate the mixture at 20° Cent. for a number of hours. To hasten the result, the dilution may be lowered. The dissolved oxygen is determined in the mixture at the start and again after the lapse of several hours. With these two figures in hand, the percentage of sewage permissible in a stream under assumed conditions can be calculated. In the formula are terms for the period of contact and the percentage of dissolved oxygen to be available at the desired point in the flow. With our present knowledge of this test, the same assumptions must be followed from time to time in order to get comparable results, since the formula in its present state is not as perfect as may be, owing to the lack of knowledge of the shape of the curve for this bacterial reaction. The results obtained, however, are very practical and of great value. The method requires more accurate and careful work than the methylene blue test, and at present is open only to a skilled chemist.

Bacteria.—Most of the chemical changes in biologic sewage purification are in reality the result of bacterial activity. The significance of these bacteria in general is of interest largely from the scientific standpoint. The removal of disease-producing bacteria, however, is a question of practical interest. Sewage disposal devices, in themselves, are not built, primarily, as bacterial removers, and cannot be relied upon unless sterilization of the effluent with chloride of lime be added as a sure means for removing bacteria. In a chemical precipitation process, the bacteria may be reduced partly by sedimentation and partly by the germicidal properties of the chemicals employed. In a plain settling tank the reduction of bacteria is due to sedimentation. In a sprinkling filter or in a contact bed the reduction is undoubtedly the result of mechanical detention as well as the action of higher developed organisms. The unfavorable environment may also be an influence. Secondary settling basins will reduce the number of bacteria again by simple sedimentation. The effluent of a filter may contain [illegible] of the original number of bacteria present originally. Biologic sewage purification may eliminate the putrescible matter, but if bacteria purification be desired, disinfection only will secure the result.

In our laboratory the method employed to determine the number of bacteria is to plate 1 c.c. of the sample, properly diluted, on a litmus lactose agar medium. The temperature of incubation is 37°, and the time of incubation two days for the [illegible]. It is well known, however, that no artificial medium, be it an agar or a gelatine medium, will permit the growth of all bacteria ordinarily present. Therefore, the count per c.c. indicates but a portion of the true number. More colonies will develop on gelatine than on agar.

Methods of Sewage Disposal; Dilution, and Sedimentation.—I shall not attempt to discuss here the question of sewage disposal by dilution, other than to point out that such a method is entirely legitimate within the oxidation capacity of the body of water into which the sewage is discharged. I will, therefore, turn to a consideration of the methods of preliminary treatment which may be covered by simple sedimentation, decomposition, either aerobic or anaerobic, and chemical precipitation. In the operation of a sedimentation tank, sludge is removed frequently in the early stages of decomposition. The resultant improvement of the sewage from the standpoint of dilution will, of course, vary with the composition of the sewage and the amount of suspended matter present. We have recently demonstrated the fact that the simple removal of settling suspended matter improves the physical character of the sewage and its relative stability to some extent, but not to as great an extent as might be assumed from the actual physical improvement. In other words, the removal of 50 to 60% of the suspended matter will improve the character of the sewage from the standpoint of dilution from 25 to 30%. This means that the additional removal of the pseudo-colloidal matter will improve the liquid far out of proportion to the quantity of suspended matter thus removed. A device which would remove this fine suspended matter, without resorting to biologic treatment, would undoubtedly furnish an effluent which on a large scale would be intermediate between the preliminary or partial purification effected by settlement, and the more complete purification made by a sprinkling filter. In some cases it might suffice where preliminary purification alone would not.

Septic Tank.—The anaerobic decomposition of sewage finds its widest application at present in the septic tank. This process may also be called a hydrolytic or liquefying process, and is substantially the same as that in the ordinary cesspool. The cellulose decomposes, forming hydrogen and marsh gas. Carbon dioxide and fatty acids are produced as by-products. Nitrogen is formed, probably due to nitrate reduction. Thirty-two degrees Cent. is the optimum temperature for the decomposition of cellulose; therefore a septic tank shows more violent ebullition of gas during the hot season, and frequently unloads large amounts of suspended matter. In our climate not enough gas is produced for any practical purpose, but at Matunga, in India, the gas from a septic tank has been utilized for driving an engine to pump sewage and for lighting and cooking purposes.

The ammoniacal fermentation taking place in sewage is due to the presence of urea. It starts readily and is frequently completed in the sewer itself. In septic-tank treatment the protein substances are the ones responsible for the foul odors, since hydrogen sulphide, mercaptan, indol, skatol, and various amines result from their decomposition. Fats when present in appreciable quantities may give rise to an objectionable rancid odor.

It is still a question whether the decomposition taking place in sewage under anaerobic conditions, as in a septic tank, is an advantage in the further purification. Current practice favors the treatment of a freshly settled sewage. However, treatment of what may be called a "semi-digested" liquid has, apparently, some points in its favor, since compounds which are ultimately formed by these putrefactive processes yield more readily to oxidation than do the higher complex bodies originally present. On the other hand, the anaerobic decomposition products are probably inimical to the aerobic organisms present in the body of the filter.

Biolytic Tank.—In our biolytic tank, a remarkable reduction of the organic nitrogen has taken place, accompanied by the excessive formation of hydrogen sulphide. The pseudo colloidal matter has been completely eliminated, leaving nothing save a slight amount of black sediment and the hydrogen sulphide odor. All this occurs in less than four hours. Without further oxidation the effluent from this tank would be a nuisance, and a detriment from the dilution standpoint.

The chief objection to-day to the use of septic tanks is that they may produce a nuisance, and may discharge sludge in hot weather when the ebullition is a maximum. For these reasons the separate digestion of the settled suspended matter is recommended, particularly in double-deck tanks of the Emscher type.

The septicity of the sewage is a point worthy of comment. If we assume that hydrogen sulphide is the proper index of the increase in septicity, the formation of insoluble ferrous sulphide might be accepted as a measure, provided enough iron were present in solution to combine with all of the hydrogen sulphide. The key to the question probably lies in the bacterial control of the septic tank process, but a far deeper knowledge of the species involved is required than we possess at present.

Sludge.—Whether sludge be fresh or old, its ultimate disposal has been and still is a problem for sewage experts. In order to fully appreciate the difficulties encountered in the commercial utilization of the product, it is necessary to consider its physical as well as its chemical composition. Fresh sludge is a black semi-liquid substance with an odor varying from that of burnt rubber to an acrid putrid stink. The specific gravity varies 0.01 to 1.06. In our case the grit chamber sludge frequently contains considerable quantities of heavier material, and its specific gravity may be as high as 1.35. The average quantity of moisture is from 85 to 95%, the percentage of organic matter 60, and of fixed matter 40 when calculated on a dry basis, in fresh sludge. The nitrogen on a dry basis amounts approximately to 2%, the fat varying from 1% to 5%.

Many schemes have been suggested for the utilization of sludge as fuel, as filling for fertilizer and as material for gas, or even the manufacture of alcohol. Only in isolated cases under peculiar conditions has any process for the recovery of any by-products been successful. For instance in Bradford, England, where the sewage contains a deal of wash water from wool pulleries, fat has been successfully extracted from the sludge. The difficulty of the quick removal of the moisture from the sludge makes its use as a fuel doubtful. For the same reason drying the sludge for fertilizer purposes is uneconomical. Old sludge thoroughly digested contains much less volatile matter than the fresh sludge, the amount decreasing frequently from 60% to 40% of the total dry matter. In Germany and England, sewage sludge has been sold or given away to neighboring farmers, but the general experience has hitherto demonstrated the difficulty of disposing of sludge continuously in any such manner.

Partial purification of sewage can be accomplished under semi-aerobic conditions, as in a Dibdin slate-bed, which is akin to a contact bed. In this device nematode worms, infusoria, and bacteria accumulate and work over the sludge. Experience in this country with the slate beds has not been favorable.

Chemical Precipitation.—The colloidal matter in crude sewage may be eliminated by the use of chemicals as a precipitant. Ferric sulphate, aluminum sulphate, lime and ferrous sulphate have been frequently used in various combinations. The chemical to be employed and its quantity is largely governed by the composition of the sewage, and the cost of obtaining the chemicals. The quantity of sludge resulting is larger than from any other method of clarification. The effluent is low in suspended matter and is susceptible of treatment on filter beds at a high rate. Beyond a certain point, however, the application of chemicals does not reduce the amount of suspended matter appreciably. A concentrated sewage is better adapted to chemical clarification than a weak sewage.

Comparison of Methods.—More complete purification may be accomplished, either on intermediate sand filters, contact beds, percolating or trickling filters. The suspended and colloidal matter is mechanically retained by the filter material to be worked over by the biological life in the filter, which quickly forms in a new bed as a slimy coating on the surface of the particles of the filter material. The chemical change in the liquid is called nitrification or mineralization. When the bed becomes clogged, nitrification gradually ceases. In a sprinkling filter it is favored by the spraying of the liquid, which undoubtedly aids the oxidation process following. As a rule, more nitrates are formed in a sprinkling filter than in a contact bed, but less than in a sand filter.

The deeper the writer progresses into the field of sewage disposal, the more he realizes the amount of work that is still required to make it an exact science or art. The co-operation of biologists, entomologists, chemists, and sanitary engineers is required. The sanitary chemist is mostly concerned with the investigations of the biologic features, a thorough knowledge of which will materially aid in bringing about a better understanding of the facts already accumulated, as well as the solution of new problems. For the industrial chemist, the most fertile field for investigation is the ultimate solution of the sludge question. At present we are able to reduce the quantity of the sludge to a minimum, and to prevent offense, but we realize that certain constituents, even though small in quantity, may some day prove of commercial service. The economies to be obtained, however, will be available only in large plants where careful operation is possible.

◆

PURIFICATION OF WATER BY STORAGE.

In a paper read before the International Congress on Hygiene and Demography, held in Washington, September 24th, Dr. A. C. Houston gave a discussion on the purification of water by storage. He stated that the purification of water by storage is discussed under three main heads: (1) Sedimentation; (2) Equalization; (3) Devitalization. The following comprise the chief conclusions so far arrived at:

(1) Storage reduces: (a) the number of bacteria of all sorts; (b) the number of bacteria capable of growing on agar at blood-heat; (c) the number of bacteria, chiefly excremental bacteria, capable of growing in a bile-salt medium at blood-heat; (d) the number of coli-like microbes; (e) the number of typical B. coli; (f) the amount of suspended matter, color, ammonical nitrogen and oxygen absorbed from [illegible]

(2) Storage alters certain initial ratios, for example (h), [illegible] the number of typical B. coli to a disproportionately greater extent than it does the number of bacteria of all sorts; [illegible] to a greater extent than those yielded by the permanganate test.

(3) Storage, if sufficiently prolonged, devitalizes the [illegible] and the cholera vibrio.

(4) [illegible] "equalizing" effect.

[illegible]

[illegible]

[illegible] polluted sources.

[illegible]

NATURAL GAS BELT IN WESTERN CANADA.

Some important finds of natural gas have recently been made in the Canadian West, within the limits of what seems to be a long, but narrow gas belt, running north and south, in the neighborhood of the 112th meridian. Mr. Aubrey Fullerton, in a recent issue of the "Mining and Engineering World," states that the latest strike was made in June at Tofield, near Edmonton, the capital of Alberta. At that point, after several borings had been made, a flow of gas was struck at a depth of 1,054 ft. The well was at once capped and the flow tested. It has since been gaining in volume, and gives every indication of being permanent, while the quality of the gas, for both lighting and heating purposes, is excellent.

Other towns in the surrounding district are arranging for borings of their own, in the belief that a great gas vein underlies the whole country. Indications of gas have been found at various times during recent years.

A great gas-tapping project is now under way at the southern end of this same belt, where the wells at Bow Island have been piped for a supply to the city of Calgary, 180 miles to the west. The pipe line, which was constructed by Corcoran & Co., of Pittsburg, has just been completed, and when the system is in full working order gas will be sold in Calgary at rates varying from 15 cents per thousand for the larger power consumers, to 35 cents for domestic use. The project represents a $3,000,000 investment.

The Bow Island wells are in the immediate neighborhood of Medicine Hat, whose natural gas system, now in use for some years, has made the town prominent. The town uses natural gas almost entirely for lighting and fuel, and an average householder's bill for both runs at from $20 to $30 a year.

In the northern section of the belt is the biggest gas well. The Athabasca River, for at least a good part of its course, runs through a country that seems to be underlain with gas, and a tract of 100,000 square miles is saturated with petroleum. At Pelican Rapids, at a point on the Athabasca River, 200 miles north of Edmonton, is a gas well that has been burning for fourteen years, and gives no sign of lessening in flow. A photograph taken last winter shows an immense gas jet whose flame is nearly 50 feet high, and of very substantial circumference.

The Pelican well was found in 1898, when the Geological Survey of Canada sent a party of oil-diggers into the north to see if the reported existence of petroleum was a fact. They got their outfit in over the wilderness trail, and set to work. When the drill reached a depth of 820 feet it struck gas. The flow was so great that it drove back the drill, and the noise of the escaping gas could be heard two or three miles away. After the survey party went away some one came along and lighted the jet, and it has been burning more or less continuously ever since.

The report to the Geological Survey in regard to the Pelican well recommended that a new bore at the depth of 820 feet, where the first large gas vein was encountered, "should be at least 10 inches in diameter; then it would be possible to reduce the casing four or five times, giving that many different lines of pipe to be used in getting by these gas veins." Meanwhile the search for oil was of necessity abandoned, and until the railroads get into the country there is little chance of the great natural resource being developed. The big gas jet is still blazing high and fiercely but wastefully, and a great coal area further north is similarly on fire, and has been for many years, burning slowly from within. The whole region is a vast depository of natural fuel. Oil oozes out along the shores of Great Slave Lake and the Mackenzie River, and tar drips all summer long from the banks of the Lower Athabasca and Great Slave Rivers.

FIELD SURVEYS FOR ROAD CONSTRUCTION.

At the American Road Congress at Atlantic City, Mr. E. L. Griggs, Associate Professor of Civil Engineering in the University of Georgia, presented a paper, which is reprinted below practically in full, in which he describes the methods of making the actual field surveys necessarily precedent to the proper construction of highways.

Before a survey of a road is made it should be known how the construction of it is to be carried out as that determines in a large measure how much engineering work should be done.

If the road is to be constructed by contract, and especially if the consideration is based on a price per yard of material handled, then justice to both parties to the contract demands a full and most accurate survey and determination of volumes.

While to take the other extreme, if a county is building its roads with its own labor, convict for example, much less engineering work may be done. The question of exact cost in this case is not so important and the determination of volumes is for construction purposes only.

Preliminary to the final decision of the location of a new road or, what is nearly equivalent, a radical relocation of an old road, a thorough study of all the feasible routes is essential. For this purpose a most useful instrument is the Plane Table or Traverse Table. We use the simplest form for this purpose which is 14 or 15 ins. square and weighs only a few pounds. With its aid all the probable lines are gone over and plotted, the distances being obtained with sufficient accuracy by pacing, while any determining features such as residences, roads, streams, etc., are triangulated in. Property lines crossed are also noted as bearing on the question of rights of way over the individual properties. A useful adjunct to the plane table in this preliminary study is a good hand level, with which comparative elevations of ridges, etc., passed over are very conveniently estimated and then noted on the map.

This work requires only one man for its execution and equipped with only these light instruments he can cover considerable ground in a day. If he is careful to make copious notes on the map it will show when completed not only the lengths and directions of the lines but also the character of the country over which the road would pass and the number of homesteads served. This latter is, of course, one of the really governing features of the final selection. This map also furnishes facts that will aid the engineer in answering the questions of the too persistent patron who has personal ends to serve.

After this preliminary work is completed and the final selection of the location is made then we are ready to actually stake out the road. If the road is to be constructed by contract then the regular work of a railroad survey should be done. The line should be carefully measured and staked, levels run and profiles made, cross-sections taken, slope stakes set and volumes accurately determined. All these operations are essential to a just settlement of the contract but they entail heavy engineering expenses.

In the State of Georgia, as in some of the other States, most of the roads are built by convict labor and here such reasons for great accuracy do not exist and quicker and more economical engineering methods may be used. For it is of far greater importance that a road should have easy grades, perfect protection from water and a good surface than that its curves, for example, should be theoretically correct. If a road is so located and graded that the material taken from the cuts will just make the fills why should we bother about the exact number of yards of material handled? Short sharp curves and quick reverse curves are both disagreeable and dangerous with rapid automobile traffic and are to be avoided.

In making our road surveys the road is staked out by a transit party in the usual manner of staking out a railroad location. The stakes are set every 100 ft. but on one side instead of the centre of the road so that they will not be disturbed in construction. Long curves are laid out in the usual method of deflection angles. Short curves, however, can be put in much more economically in point of time by setting the stakes over on offsets from the tangents. For instance, for a two-station curve the previous tangent is prolonged straight 100 ft. to the vertex, the angle with the forward tangent measured and the degree of curve decided upon. The stake at the vertex is then moved over on the curve. The distance the stake is moved over is equal to 1.75 ft. for every degree of deflection or 2 deg. of curve. For example, if the angle between the tangents is 16 deg., then the curve will be 8 deg., and the stake at the vertex will be moved over four times 1.75 ft., or 7 ft. The effect of this is to put the stake almost exactly on the curve, but the forward tangent will be found 0.6 ft. from the position it would have occupied if it had been laid out in the regular way, the curve shortened between 1 and 2 ft. from the recorded length, and the degree of curve slightly changed.

If, however, the central angle was larger and four stations of an 8 deg. curve decided upon, then the stakes at stations one and three would be set over 7 ft., while the stake at the vertex would be set over four times seven, or 28 ft., since the offset varies directly as the squares of the distance in 100-ft. lengths. That is, at station two the distance set over would be four times that at station one, and at station three, in a six-station curve, it would be nine times that at station one. Very little time, however, is saved in using this method for curves over 400 ft. long.

In the case of the four-station 8 deg. curve mentioned above the near half of the curve is almost exactly located while the forward tangent is again found away from its theoretical position, about 5 ft. in this case, and the whole curve shortened about 10 ft. from its recorded length. This difference of about 2½ ft. in one hundred will not affect the grade and it is also to be remembered that it is not cumulative but rather balancing. For if the curve is staked out on the outside of the curve and a centre line afterwards measured it will be found that the centre line to the point of tangency is still shorter than the curve as staked out. This will tend to balance when the curve is staked on the inside

Another very convenient method of laying out a curve and especially if one happens to be without his instrument, is one derived from the method given by Searles in his Field Engineering. At the point of curvature the previous tangent is prolonged 100 ft. further and perpendicular to it at its end in the direction of the proposed curve is laid off a distance equal to 1.75 ft. times one-half the proposed degree of curve for the first station of the curve. For the second station, and all succeeding stations, the line through the two preceding stakes is prolonged 100 ft. and perpendicular to it is laid off a distance equal to twice that for the first station or 1.75 ft. for every degree of curve. In order to get on the tangent at the end of the curve the line of the last two stakes is prolonged 100 ft. and the perpendicular laid off is equal to the one laid off at station one. For example, if we propose to use an 8 deg. curve the perpendicular laid off for the first station of the curve after leaving the tangent and for the first station on the forward tangent would be 1.75 ft. times one-half of eight, or 7 ft., and for all other stations it would be 1.75 ft. times eight, or 14 ft.

The transit party also determines accurately the location of the property lines crossed, so that the exact area of the right-of-way on each separate piece of property may be found.

After the line has been staked out the level party goes over it and stakes levels, the rod being held on the ground by the stake. Levels are also taken at the opposite side of the road, the width of the road being measured by pacing. Profiles are made of each side of the road approximately paralleling each other on the same piece of profile paper. This will give sufficient information to very closely approximate the balancing of the cuts and fills without the necessity of cross-sectioning. No slope stakes are set, as the cuts are usually light. The road bed is graded down to its proper depth and the banks afterwards shaped up.

We have sometimes carried out the whole operation of surveying a road with a party of only three men: an instrument man carrying a transit equipped with level tube and stadia hairs, a rodman carrying a self-reading level rod and a stakeman.

The instrument man, after he has set up his instrument and gotten his alignment, signals the rodman forward or backward until he is the proper distance away as shown by the stadia, then lines the rod in for the exact position of the stake. After this is driven he determines the elevation of the station by using his instrument as a level. As the distances are usually in hundreds of feet and the telescope horizontal no stadia notes will have to be kept or reduced. If the ground is practically level transversely no further levels need be taken, but if not the rodman must return, after going as far as the rod can be read, and hold his rod on the opposite side of the road. This method is very laborious and subject to errors by the instrument man overlooking some of his manifold operations and is suggested only for short pieces of work or when assistants cannot be had.

The stakes are of course numbered when set and if the foreman of construction is an experienced man he is simply furnished with a profile with the cuts and fills for each station written on it, or merely a list of the stations with the amounts of the cuts and fills. If he is not so experienced he will require considerable more supervision by the engineer.

Some may infer from what has been said that since certain approximations in the surveys are to be used, the services of the engineer may be dispensed with as unnecessary and the road located by the eye alone. Such, however, is very undesirable. The knowledge, judgment and experience of an engineer are always needed for the proper location of a road, and the responsibility should be his for grading the road and so balancing the cuts and fills, yet keeping within the limits of allowed grade, that the minimum amount of earth will be handled, and for placing proper culverts that the storm water may be at all times taken care of.

Experience has shown that the cost of construction is often very materially increased by not having proper grade stakes set beforehand. As an example, on one occasion in grading a hill, 6 ins. seemed enough to take off. So it was plowed to this depth and the dirt hauled to the next fill and the road shaped up. The grade still did not look right and [illegible] tions might have been gained if the road had been located [illegible]

[illegible]

TEMPERATURE EQUIVALENTS OF WIND VELOCITIES.*

By W. H. Whitten.

A comparison of records taken at the group of buildings of the Harvard Medical School on the total heat expended and average temperatures and average wind velocities showed that one mile of wind movement per hour required substantially the same amount of heat supply as one degree change in temperature. A further study of similar records, however, has shown that there is a greater proportion of loss due to wind movement as the temperature drops.

This led the author to make investigations as to the impact effect of wind of the same velocity at different temperatures. It was found that there is a regular rate of increase in effective pressure as the temperature drops, although the wind velocity remains constant. This regular rate of increase of pressure is maintained only while the barometer readings are normal. A barometrical change caused changes in the impact pressure. The exact rate of this change was not determined, but the fact of such change was detected, the tendency being for an increase in pressure as the barometer rose and for a decrease as it fell.

It was estimated that, with the barometer and the wind constant, the increase in pressure is 0.4 per cent. per degree drop in temperature. It was also found that the non-pressure or suction on leeward sides of buildings increased in about the same proportion. The point at which heat loss from one mile of wind movement per hour and temperature were equal seemed to be between 36 and 39 degrees above zero. Above this temperature, the effect of wind became less important than the temperature changes, and below it, correspondingly more important.

For example: If, at 37 deg. plus, one mile of wind movement per hour is equal to one degree drop in temperature, at zero one mile of wind movement per hour will equal

$$1 + (37 \times 0.004) = 1.148 \text{ deg.}$$

If the temperature increases to 50 deg. plus, then one mile of wind movement equals

$$1 - (13 \times 0.004) = 0.948 \text{ deg.}$$

As a rule for personal guidance, the author has adopted the following: From 40 to 15 deg. plus, one mile of wind movement per hour is equal to one degree drop in temperature; from 15 degrees plus to 20 degrees minus, one mile of wind movement per hour is equal to 1.15 degrees drop in temperature. This is for buildings constructed in the ordinary manner, that is, without protected windows. Applied strictly to the glass surface, with leakage standardized, the loss from wind movement may be calculated as only three-sevenths of the loss under usual and ordinary conditions. This not only applies to the sides having the so-called greatest exposure, but, owing to the suction or non-pressure existing on the sheltered sides, should be applied to all sides of the building.

---

* Abstract of paper read before the American Society of Heating and Ventilating Engineers, at Detroit.

◆

The Canadian Pacific Railway Company is acquiring several independent lines in Ontario, Quebec and Alberta, which [illegible] as Canadian Pacific Railway feeders. Notice is given of the application to the railway commission next month, for a recommendation to the governor in council to sanction the lease by the Canadian Pacific Railway of the following lines: The Alberta Central Railway, the Campbellford, Lake Ontario and Western Railway, the St. Mary's and Western Ontario Railway, the Kingston and Pembroke Railway, and the Cap de la Madeleine Railway.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc. MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc. CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, OCTOBER 31, 1912. No. 18.

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Sewage Disposal and Water Pollution 677
Mathematics and the Engineer 678
Montreal Harbor Commission 678

Leading Articles:

The Construction of the South Main Pier of Quebec Bridge 663
Heat Transmission Through Corrugated Iron 667
Chemistry of Sewage Purification 669
Natural Gas Belt in Western Canada 674
Field Surveys for Road Construction 675
Temperature Equivalents of Wind Velocities 678
A New Bronze 679
Winter Troubles on Electric Railways 681
Surface Oiling and Constructing Oil Macadam 682
Operating Results of Imhoff Sewage Tank 684

Engineers' Library 686
Coast to Coast 691
Personal 693
Coming Meetings 694
Engineering Societies 694
Market Conditions 24-26
Construction News 65
Railway Orders 72

SEWAGE DISPOSAL AND WATER POLLUTION.

This question was discussed at the meetings of the Great Lakes International Pure Water Association and the National Association for the Prevention of Pollution of Rivers and Harbors, which have just closed in Cleveland, Ohio. At these meetings Dr. Allan J. MacLaughlin repeated his opinions as recently given before the International Joint Commission at Ottawa, to the effect that to compel cities along the Great Lakes so to treat their sewage that it would not contaminate the lakes into which it is dumped, would place upon these cities an unnecessary and unjustifiable expense, which would bankrupt the cities in most cases.

Dr MacLaughlin's evidence as given before these bodies does not agree very well with some of his statements as they appear in a report known as Bulletin No. 83 of the United States Hygienic Laboratory, entitled "Sewage Pollution of Interstate and International Waters." There he states that "unfortunately, the Detroit River is so grossly polluted that the city of Wyandotte has suffered terribly from typhoid fever. Undoubtedly, Wyandotte and Munroe also should filter their water supplies and protect themselves, but they should not be required to treat a raw water, which puts an unreasonable strain and responsibility on their filter plant." Many other statements similar to the above might be quoted which make it rather hard to appreciate Dr. MacLaughlin's stand in his evidence before the International Joint Commission.

It is interesting to follow the reasoning used in the above mentioned bulletin. He states that with the present rate of discharge of the St. Lawrence River Lake Ontario would require over six years to empty itself if all inflow were stopped, and then he adds that this means that the water in Lake Ontario is capable of purifying an enormous amount of organic matter, and that with the existing pollution the water should be pure outside of the zones of polluted water which surround the water-front of cities and towns and the mouths of large rivers.

The zone of pollution is a most uncertain one, as has been well demonstrated in the vicinity of Toronto. Prevailing winds may force the area of sewage-polluted water many miles from its ordinary boundary. Thus, the benefits of six years' storage of water in Lake Ontario are rather minimized. Dr. MacLaughlin states that the pollution by the Niagara River, including the sewage of Buffalo, the Tonawandas and Niagara Falls (together with the Canadian towns) is subjected to natural purifying agencies in its passage over the Falls and through the river. The results of bacteriological examinations show that the pollution at Niagara-on-the-Lake is a great deal higher than at Buffalo or Lake Erie. The effect of the Niagara River as a purifying agency is practically negligible, for it is only a matter in time of about twelve hours for water to pass from Lake Erie to Lake Ontario.

While it is true that the danger of sewage pollution of Lake Ontario is minimized by the depth of the lake and its enormous capacity for storage, at the same time it must be recognized that Lake Ontario is becoming constantly more infected. In the very near future, some experts say immediately, means must be taken to treat the sewage of the cities on the Great Lakes and the rivers flowing into them. Therefore, since this is true, the sooner the control of pollution of the Great Lakes is placed in the hands of the International Joint Commission the better it will be, in the ultimate, for both countries.

MATHEMATICS AND THE ENGINEER.

Theory and practice, in the minds of most engineers, have not a proper relationship. It is too commonly accepted by the profession to-day that a distinct line must be drawn between the purely theoretical man and the practical designer and constructor. We often hear the statement made that theory is all right, but practice and experience are the safest in the long run. As a matter of fact, there is no line to be drawn between theory and practice.

It is true that it is hard to analyze the strength of any engineering structure by means of mathematics without a practical knowledge. At the same time, it will be readily admitted that the progress made in engineering design and construction during the past few years has been due to the application of mathematics in the analysis of the stresses in their component parts.

In an address delivered by Sir William H. White, at the recent International Mathematics Congress held at Cambridge, another view of the utility of mathematics to the engineer is given. No one knows, he pointed out, any method by which the strength of a ship can be settled à priori, by deduction from the results of laboratory experiments on the physical constants of the materials used in its construction. All that is possible in getting out the scantlings of a ship, of larger size than ordinary, is to take as a model a ship which experience has proved to be of satisfactory strength. This is treated as a girder loaded in a hypothetical and purely arbitrary fashion. The stress which would result from this load is calculated, and a similar hypothetical load is then applied to the proposed vessel. Should the calculation show that this calculated, but wholly hypothetical, stress is not greater than in the model, the scantlings are considered satisfactory. The whole process, in fact, amounts to little more than an application of the rule of three, and experience shows that in this instance the procedure is legitimate. In fact, in a great number of cases we can find by mathematical methods the relative strength of two structures; but mathematical methods afford us generally no data as to the absolute strength of either. Indeed in certain cases, they fail even to indicate fairly the relative strength of similar members of different materials. Some years ago, for instance, the purchaser of a large testing-machine had considerable difficulty in persuading the builders of a well-known type to supply him with one having a steel beam. They wished to supply cast-iron, and submitted calculations which represented the latter to be not only stronger than the proposed plate-steel substitute, but stiffer. In the end, however, they gave way, but supplied their cast-iron model to another customer, with the result that it broke in seven pieces some eighteen months after being put into service. Taking a narrow view as to the field occupied by theory, it would be permissible to maintain that there was here a serious discrepancy between theory and practice; but, although it is not possible to express in mathematical form the difference in the reliability of a tough and of a brittle material, the difference cannot be neglected in any theory that claims to be in any way complete.

Mathematics to a great extent has been responsible for the benefits of our present day civilization, and it will always be the basis for engineering design. Mistakes have been made, and will continue to be made, not through the use of mathematics, but through the use of wrong assumptions on which the mathematics are based.

MONTREAL HARBOR COMMISSION

The announcement of the resignation of Major George Washington Stephens from the position of chairman of the Board of Harbor Commissioners of the port of Montreal brings to its end a Commission which has appeared to shipping and commercial circles of Montreal almost ideal. The resignation of Major G. W. Stephens came shortly after those of his two fellow-commissioners, and to some extent was no doubt occasioned thereby. Mr. Stephens makes that fairly clear in his letter of resignation, in which he refers to the manner in which the three Commissioners always worked in harmony, and expresses the view that harmony of that character is essential to the effectiveness of a commission. He considers, therefore, that it is best to retire and give the government an opportunity of electing an entirely new commission.

Part of the success of the commissioners and the cleanliness of their administration was no doubt due in large part to the fact that none of them were in financial need of the appointment. The chairman is a millionaire, and the financial remuneration attached to his position was of little consequence to him, and would be largely exceeded by the cost of maintaining the position. Messrs. Ballantyne and Geoffrion are wealthy men, and would also make more money attending to their own businesses.

The post of chairman of the Commission is one which demands the highest type of executive ability and imaginative power.

The government can only be praised for the appointments made to the chairmanships of the Transcontinental Railway Commission in Mr. R. W. Leonard, and to the International Joint Commission in Mr. C. A. McGrath. The action of the government in the selection of a new Gommission will be awaited with much interest. It is to be hoped the choice of a chairman will fall on a man of engineering training and of the requisite administrative capacity.

◆

TRINIDAD ASPHALT MINING.

The consumption of Trinidad asphalt, mainly for street construction and in a minor degree for chemical and other purposes, increases from year to year. The bulk of it is recovered from the pitch or asphalt lake on the island situated on elevated ground about fifteen miles from the sea shore. Smaller quantities are recovered by open pit mining in the close vicinity of the lake, where various deposits have accumulated from overflows in prehistoric times. The lake covers about 40 hectares, and is very deep; its surface is solid and hard enough to carry people. The asphalt is cut off with large hoes; the pieces so recovered are carried by hand into trucks attached to cable trams, and removed to the sea shore for export. A comparatively small portion of the output is, previous to being exported, freed from its water contents in a refinery on the island. The crude asphalt represents a brownish-black mass with a peculiar smell; it contains about 30 per cent water, 30 per cent mineral substances, and the rest is bitumen. The bitumen averages 82 per cent C, 10.5 per cent H, 6 per cent S, and 1 per cent N. The yearly export has now reached about 180,000 tons. Of late a liquid asphalt, or rather a highly asphaltic mineral oil, has been recovered on the island and exported, after the elimination from it of the liquid oils. It is particularly suitable for softening the hard Trinidad asphalt. The natural generating and hardening processes, which have ultimately resulted in the production of the asphalt, are of a very complicated nature; sulphur seems to have played a conspicuous part in them in conjunction with oxidation and polymerisation processes.

COST OF WATER SOFTENING BY LIME.

The members of the Metropolitan Water Board, London, England, have recently issued a pamphlet under the title of "Eighth Report on Research Work," by Dr. A. C. Houston, and a perusal of its contents would leave an impression that this board had spent considerable time since the issue of the seventh report on the financial economics of softening and sterilization of water and of the effects of time on bacteriological and pathogenic organisms when treated with germicidical agents of varying strengths.

(10,000 gallons=100,000 lbs.)

Temporary hardness of water as carbonate of lime, or its equivalent in soap destroying power, parts (or lbs.) per 100,000 parts (or lbs.) = lbs. per 10,000 gallons (100,000 lbs).	Cost of quicklime (10 lbs. 2¢.) and the amount to be added to soften the water.					
	Theoretically, that is 1 lb. of carbonate of lime requires ·56 lb. quicklime.		Practically, that is assuming that from ·75 to 1·0 may actually be required (owing to free CO_2 inert lime, &c.)			
			BASIS 1. 1 lb carbonate of lime requires ·75 lb. quicklime.		BASIS 2. 1 lb. carbonate of lime requires 1 lb. quicklime.	
	lbs. lime.	cents.	lbs. lime.	cents.	lbs. lime.	cents.
1	·56	·112	·75	·15	1	·2
2	1·12	·224	1·50	·3	2	·4
3	1·68	·336	2·25	·45	3	·6
4	2·24	·448	3·00	·6	4	·8
5	2·80	·560	3·75	·75	5	1·0
6	3·36	·672	4·50	·9	6	1·2
7	3·92	·784	5·25	1·05	7	1·4
8	4·48	·896	6·00	1·2	8	1·6
9	5·04	1·008	6·75	1·35	9	1·8
10	5·60	1·120	7·50	1·5	10	2·0
11	6·16	1·232	8·25	1·65	11	2·2
12	6·72	1·344	9·00	1·8	12	2·4
13	7·28	1·456	9·75	1·95	13	2·6
14	7·84	1·568	10·50	1·1	14	2·8
15	8·40	1·680	11·25	1·25	15	3·

The method of softening water with lime may be explained by the following equation:—

Bicarbonate of lime.		Quick lime.		Carbonate of lime.		Water.
$CaO, CO_2 H_2O, CO_2$	+	CaO	+	$2 CaO, CO_2$	+	H_2O
100 62	+	56	=	218	+	18

Fifty-six parts of quicklime (CaO) are required to combine with 62 parts of hydrated carbonic acid (H_2O, CO_2), holding the 100 parts of carbonate of lime in solution. As the hardness of a water, however, is expressed in terms of carbonate of lime, 0.56 part of quicklime is required to precipitate 1 part of carbonate of lime.

In practice considerably more quicklime is required, because the free as well as the combined carbonic acid in the water has to be acted upon and, in addition, part of the quicklime (CaO) may have become hydrated (CaO, H_2O), and therefore less active weight for weight, and part may be inert (carbonate or impurities), and, further, the mixing operations may be imperfect.

The free carbonic acid, of course, is a constant factor, for all degrees of hardness, which it is sought to remove.

The accompanying table shows the working cost of softening 10,000 gallons of water with quicklime, irrespective of interest on capital expenditure, depreciation, labor, etc., and is based on a price of $4.80 for a ton of lime. Lime in this country is somewhat higher, so that this must be allowed for.

The cost remains the same whether quicklime or slaked lime is used, but the above weights of quicklime must be multiplied by 1.32 to obtain the comparative effective weights of slaked lime.

The above results are expressed as parts (or lbs.) per 100,000 parts (or lbs.), which is the same as lbs. per 10,000 gallons. To convert into grains per gallon and "degrees" of hardness, multiply by 7 and divide by 10. No account is here taken of permanent hardness, which requires a different kind of treatment for its removal.

The wastage of lime due to free carbonic acid being a constant factor, the figures in the last two columns are only approximately correct—thus the wastage at 1 and 15 (due to CO_2) being the same, it is proportionately cheaper to soften to 15.

To take an example:—A water has a total hardness of 21, the permanent hardness being 7 and the temporary hardness 14. It is required to soften 10,000 gallons from 21 down to 11 (i.e., 10 parts). The amount of quicklime required would be, theoretically, 5.6 lbs. (costing 1.12 cents), but practically about 7.5 (costing 1.5 cents) to 10 lbs. (costing 2 cents) would be needed. Erring somewhat on the side of exaggerating the cost, it may be said that 10 lbs. of quicklime, costing 2 cents, would be needed to reduce the total hardness from 21 down to 11 (10 parts) for every 10,000 gallons of water treated.

◆

A NEW BRONZE.

The great strength necessary for bronze used in the construction of machinery, the keen competition existing between manufacturers, and the wide fluctuations in the price of tin, have induced metallurgists to study the question of substituting for the rather expensive tin bronze some special brass compositions (so-called zinc-bronzes) which not only have the advantage of being cheaper, but also surpass the tin bronze, so far as the breaking strength and elongation quality are concerned, at the same time offering the same resistance to attacks by acids.

The fact that despite the aforementioned advantages claimed for zinc bronzes, tin bronze still obstinately keeps its ground in most of the large foundries and in nearly all the minor ones, is unquestionably due to rather serious drawbacks, which even the best zinc bronzes, so far known, present along with their above-mentioned advantages.

The principal drawbacks may briefly be summarized as follows:

These zinc-bronzes generally have a very complex composition, mostly containing addition of metals not easily fusible and which unite only with great difficulty. On account of these two features the preparation of the alloy can only be carried out in a very complicated and expensive way, often even necessitating the separate preparation of distinct compositions, so-called "preparatory alloys."

The zinc-bronzes have a strong tendency toward separating when cooling down in the mould: the so-called "sweating" (liquation) takes place, which destroys the homogeneity of the smelted metal, the splitting tendency of which increases, whereas its chemical stability greatly suffers.

It is obvious that metal additions, which have to be forcibly dissolved, either by resorting to preparatory alloys or to incessant mixing before casting, take advantage of the first opportunity to separate, which opportunity presents itself during the solidification of the metal in the mould, or, in other words, during the period when a regular development of the process is of utmost importance.

	Limit of proportionality in lbs. per sq. inch	Ultimate tensile strength, lbs. per sq. inch	Elongation %	Contraction %	Deformation limit under compressive stress in lbs. per sq. inch.	Coefficients of hardness (deduced from Brinell) in lbs. per sq. inch	Resistance to shocks in lbs. per sq. inch under the test for flexure of notched bars. (Resilience)*
Universal Bronze "S," moulded in sand	28000	71000	24.2	25	47000	190000	116
Universal Bronze "W," do.	25000	67700	33.0	36	.....	......	...
Universal Bronze "H," do.	40000	77000	14.0	20	.....	215000	126
Universal Bronze "S," wrought when hot	44000	70300	23.0	36	....	......	...
Universal Bronze "S," wrought when hot; hammered when cold	65500	82700	11	30	.....	......	...
Universal Bronze "WW," 1¼" bars compressed when hot	[illegible]	65500	39.0	47	..	107000	224
The same bar stretched when cold at 30 m/m	59000	[illegible]	20.0	51		238000	155
Universal Bronze "WW" rolled in flat plate when cold, annealed, thickness 3/32"	[illegible]	74800	26.5	46	..	.....	...
The same plate rolled half-hardened at 2 m/m	48500	82500	26.0	38	..	......	...
The same plate rolled when hardened at 1 m/m 45	65500	96000	13.0	35	..	285000	...
Universal Bronze "WW" in plate 23/10 m/m; rolled when hardened at 18/10 m/m	74000	94000	14.0	33	.....	......	...
The same plate tested at 300°	60000	61000	15.0	36	.....	......	...
The same plate tested at 350°	not taken	56500	20.1	not taken	.....	......	...
Universal Bronze "WW" stretched in hammer; hardened wire of 4 m/m thickness	not taken	96000	6.6	54	....	.....	...

*In accordance with the requirements as adopted by the fifth International Congress for the testing of manufacturers products and materials, the said congress held at Copenhagen in 1909.

Furthermore, all zinc-bronzes contain iron, manganese or aluminum, and most of the time the compound of these three metals. These additions cause the formation of an oxide scale on the surface of the smelted metal; this scale or pellicle is indestructible and is continually being formed anew even if every precaution is taken in cleaning off the surface. This pellicle may also be carried in the mould, where it is constantly formed afresh; it often gives rise to troubles by intruding into the casting in the form of slag incrustation or superficial impurities.

Another and perhaps the most important drawback attached to the best zinc bronzes known to date is the fact that they shrink considerably when cooling down, bringing about a tendency to form flaws (blow-holes) in the castings.

As the result of numerous series of systematically conducted researches, the foundry laboratory of the engineering works of Escher Wyss and Company, Zurich, Switzerland, has succeeded in producing a new bronze, which, besides being one of the best [illegible] compositions, [illegible] breaking strength and tenacity, without presenting the disadvantages outlined above.

[illegible]

At the engineering works of Escher Wyss and Co., at Zurich, Switzerland, and at Ravensburg (Wurtemberg), this new bronze, "Universal Bronze," has been used on a large scale for several years in the manufacture of any kind of machinery parts exposed to heavy and sudden stresses, such as wedges, bearings bushes, valves, stuffing boxes, screws, screw heads, wings of screw propellers, runners for turbines and turbo-pumps, etc.

Particularly in the construction of turbo-pumps for raising impure water or acids, the employment of "Universal Bronze" has been a success. This bronze has proved to resist the wear and tear of these liquids in a way so far unknown. "Universal Bronze" may also be forged, rolled, stretched and bent in cold condition, whereby its qualities of resistance are being considerably increased (see table). The low price should particularly be noted as same is considerably cheaper than ordinary tin bronze (4c. per lb.)

A few co-efficients of resistance obtained at tests made with "Universal Bronze" are stated in the attached table. As to the resistance to stresses produced by shock by testing the flexure on a notched bar (the results obtained are stated in the table in the last column), it should be noted that these tests have been carried out in accordance with conditions agreed upon by the fifth congress for testing materials held at Copenhagen in 1909. The figures obtained in the annexed table, therefore, cannot be compared with those based upon testing methods by Charpy, Fremont or Guillery.

◆

INDUSTRIAL ACCIDENTS.

According to the record of industrial accidents maintained by the Department of Labor, that for the month of September shows there to have been [illegible] workmen killed and [illegible] injured, a total of [illegible]. Compared with the record for August, this is an increase of one fatal and 114 non-fatal. The trades and industries in which the greatest number of accidents occurred were: Steam railway service, in which there were [illegible] fatal and [illegible] non-fatal; metal trades, with 3 killed and [illegible] injured; mining, with 10 killed and 42 injured, and the building trades, with 10 killed and 33 injured.

WINTER TROUBLES ON ELECTRIC RAILWAYS.*

By Charles J. Jones.

The operation of electric railways in sections of the country where there is little or no snowfall, differs but little from the regular performance at other seasons. Where the winter is a rainy season of a few months the problem becomes one of railway construction, requiring waterways of sufficient number and capacity and properly located so as to avoid breaks in the roadbed due to washouts. In our northern districts, where the snowfall is of some importance, the question of maintaining the schedule in winter becomes at times a difficult one and a source of anxiety. Snow, sleet, ice and frost are the trouble makers, and the manager who contends successfully against them is the one who has made full preparation before the winter had made its appearance.

The maintenance-of-way department should see to its waterways and bridges. Where pile bridges are maintained over streams, such tools and explosives as may be necessary to protect the supports from ice should be on hand and ready for use. Heaving of track by frost is a menace to the safe operation of trains, and is a frequent cause of delay to the service. It seems almost impossible to obviate this trouble entirely, but as it is usually the result of poor drainage, it is important that all ditches in the cuts should be cleaned before the frost comes. Certain cuts cannot be drained properly by the ordinary ditch, and it then becomes necessary to lay drain tile a few feet below the ditch in order to draw away the moisture from the subsoil.

Sleet and ice coupled with high winds are serious factors to be considered in the proper maintenance of transmission lines and the assurance of a continuous supply of power. Poles and cross-arms should be carefully inspected and strengthened where necessary; new insulators should replace doubtful ones, and all wires (telephone, trolley and transmission) should be looked over and the weak places made strong. On lines where the third rail takes the place of the trolley wire, the same careful inspection should be made and proper attention given to the insulators, underground cables (with the necessary drainage thereof) and the cable terminals. The loss of power for a short time during the progress of a winter storm may mean the loss of train service for many hours.

The handling of snow may be considered under two heads: 1, Methods of preventing snow from accumulating; 2, Methods of removing snow.

Methods of the first class as applied to interurban lines include the widening of cuts and the use of snow fences. Where trouble from snow drifts occurs annually, a permanent board fence may be erected in place of the usual right-of-way wire fence. Frequently we use boards nailed to the regular fence, supporting them by nailing to the fence wire and to an intermediate post. Portable snow fences may be set out in the fall and removed in the spring. These are usually made in panels about 16 ft. long and 6 ft. high, and should be set from 50 to 100 ft. from the track.

As a rule, landowners do not object to allowing these fences on their land, but in some cases compensation is demanded. A wise forethought while securing right-of-way, has in some instances provided for the right to use portable snow fences on the adjoining property, and where possible this should always be done. These fences cost about 25c. per lin. ft., and when properly placed are extremely valuable in preventing the snow from drifting into the cuts. As the snow piles up around them, these fences can be raised on the drifts or set farther back as occasion warrants.

There seems to be no reason why the usual wire right-of-way fence should not be replaced in places subject to snow drifts by hedges of osage orange, honey locust, Japan privet, tartarian honeysuckle, or other hardy growth, which could be kept trimmed to fence height. In addition to acting as a partial protection against drifting snow they would make a permanent right-of-way fence, neat in appearance and effective in preventing cattle from passing through.

Methods of the second class, referred to as the "removal of snow" are various. They include many devices, from the man with the shovel to the light rail scraper and the powerful mechanical plow. The man with the shovel is not to be disregarded, as he is an essential factor in any snow-fighting equipment. His limitations, however, are apparent to anyone who has attempted to clean snow from track with a hundred and more men in the face of a gale of wind, the air dense with drifting snow and the temperature about zero. He no doubt has felt not only the effect of exposure to the storm, but also that of discouragement when, upon looking back, he has found that the section just cleared from snow was again full.

On city lines it is usual to equip the cars with scrapers, which are under the control of the motorman and so arranged that the blades are held on the rail under pressure. On all unpaved streets and highways it is important that the mud and dirt should be scraped aside and leveled down before it becomes frozen. If this is not done, the scraper will not be able to reach the rail and the motor and gear casings will be dragging on the high places.

The rotary broom sweeper is used especially on city lines and, being very effective, should be included in the snow-fighting equipment of all companies operating cars on streets and highways. These sweepers may also be equipped with wings which push the snow beyond the range of the brooms. As the sweeper throws a cloud of snow it is important that it should be operated by men of good judgment, as the flying snow is very likely to frighten horses. The electrical equipment to operate these sweepers varies according to the ideas of the purchaser, but the mistake of having slow-speed motors to drive the brooms should be avoided.

On lines operating on private right-of-way in the open country the high-V-shaped nose plow and centre-share plow prove to be highly efficient. These plows also are equipped with adjustable side wings to push the snow farther aside. These types of plows practically force their way through the snow and the secret of their success is weight of car and high speed. They should have the speed of the fastest passenger car on the system, in order to be able to run ahead of the regular cars and keep clear of them, and also for the purpose of clearing a large track mileage. The writer has passed through snow drifts varying from 2 to 10 ft. deep and 2,000 ft. long with a snow plow of the centre-nose type built on a flat car 34 ft. long (50 ft. over points of plows), with wings open to clear a width of 11 ft. It was weighted down with rails and old iron; equipped with four 125-h.p. motors, and geared to a speed of 72 miles per hour.

Passenger, freight and express cars are frequently equipped temporarily with a small nose-plow attachment, and are able to cut their way through snow that otherwise would stop them. In sections where the snow conditions are severe, the rotary snow plow is much to be desired. This type of plow has a large pan or hood in front, with spreading wings to collect the snow as the car is driven forward. Within the hood is a revolving wheel fitted with blades which cut the snow and carry it upward, throwing it a considerable distance to the side.

The movement of cars through snow soon forms a crust which becomes harder as the motor casings continue to drag on it. This hard centre not only checks the speed of the cars, but causes a loss of power in proportion to the extent to which the casings ride on it. This condition becomes at once apparent if a car having smaller wheels than the others is run over the line. When such a car comes to the hard centres it soon stops, and efforts to move it brings only spinning wheels. Upon examination it is found that the motor casings are riding on the crust of snow and raising the wheels from the rails, destroy the traction effort. To remove this hard centre we have the scraper and flanger, which is usually lowered and raised by compressed air. In some cases a device with steel points arranged in the form of a tooth harrow is used successfully to break down the hard centre. In congested terminals and streets where the snow can no longer be pushed aside by the wings of snow plows, etc., it becomes necessary to load it on wagons or cars and haul it to the most convenient place for unloading.

---

* Abstract of a paper read before the Illinois Electric Railways Association.

Snow storms vary in intensity and in kind, and it is hardly possible to depend upon a single type of snow plow or sweeper to overcome them all. Certain types of plows are better adapted to control certain storms. To have at command any or all of the above mentioned snow-fighting devices is not alone sufficient; there must be organization for the work. The organization should be carefully planned in advance and the men included therein fully instructed and trained, so as to avoid confusion or misunderstanding when the emergency arises. Men trained to a particular work of this kind should be kept there, if possible, as experience is a valuable asset. The men should be instructed to report for duty immediately upon the first snowfall and be ready to take charge of the work allotted to them. The superintendent or officer in charge should be where reports of progress or difficulty can reach him promptly, so that he can act in accordance therewith with precision. The work must be started with the appearance of the storm, without waiting until reports come in of the cars being stopped.

Having an organization and equipment, it is also important that the equipment be thoroughly overhauled and put in condition for immediate service at the beginning of winter. When the threatened danger has made its appearance, there is no time for repairs or the purchase of shovels and brooms or plows. A contest against the storms of winter is war, so let us follow the adage "In time of peace, prepare for war."

◆

SURFACE OILING AND CONSTRUCTING OIL MACADAM.

The city of Oakland, Cal., has been employing heavy asphaltic road oil on its macadam construction so as to make it suitable for light traffic under modern conditions. A description of the methods employed in this work and the results obtained were given by Mr. Wm. J. Baccus, commissioner of streets, of Oakland, in a paper presented at the [illegible] Munici-palities, held at Berkeley, Cal., September 23 to 28. Mr. [illegible]

Surface Oiling Methods.—Our methods of surface oiling [illegible]

square yard gives the best results. This oil is then covered with fine, clean screenings already at hand in the gutters, sufficient to prevent the oil from running into the gutters or adhering to passing vehicles. The street is then rolled with the steam roller and thrown open to traffic. It has been the custom in the past to allow the oil to stand for one or two days before screening, with the thought that the irregularities in the application will disappear, but this has several objections, and it is no longer necessary since we have adopted the use of the pressure oiler. The method described is applicable only to streets in fairly good repair. If so badly worn that half of the street must be covered with rock to produce a uniform surface, it is doubtful if the results will justify the expenditure. In such cases it is now our practice to scarify the street, harrow, reroll and reconstruct as oil-macadam, the oil having a penetration of two or three inches.

Surface Oiling Cost.—Our costs have varied between 5 and 12 cts. per square yard for ordinary surface oiling on different streets. Assuming that the street is in fair condition, and eliminating the cost of patching ruts and holes, which is not properly chargeable to oiling, a cost of 6 cts. per square yard should not often be exceeded. This does not include office expenses or general supervision. This assumes about ½ gal. of oil per square yard. More oil adds to the cost directly by the cost thereof, and indirectly by increasing the amount of screenings that must be used.

Following is a statement in detail of oiling several streets recently in Oakland, aggregating about .7 mile and having an area of 11,738 sq. yds. These streets were hard and smooth and in a hill section of the city:

	Total.	Per sq. yd.
6,000 gals. oil at 4.38 cts. (delivered)..	$263.12	$0.0224
160 yds. screenings at $1.75 (delivered)	280.00	.0238
3 days steam roller at $15.00..........	45.00	.0038
Oiling—		
District deputy 2 days at $5.00.....	10.00	.0009
Sub-foreman 5 days at $3.00......	15.00	.0012
Labor, 25 days at $2.50............	62.50	.0053
Cleaning Street—		
Deputy, ⅔ day at $5.00..........	3.33	.0003
Sub-foreman, 2 days at $3.00......	6.00	.0006
Labor, 10 days at $2.50............	25.00	.0021
Cart and driver, 2 days at $4.00 per day	8.00	.0007
Total	$717.05	$0.0611

Or about 6 1/10 cts. per sq. yd.

Results From Surface Oiling.—To make clearer the significance of these figures, apply them to a certain group of streets, comprising one sprinkler route in another part of the city. This route is also in a hill section and comprises 4.26 miles, besides a number of blocks not sprinkled because already oiled. The average daily cost for sprinkling is $3.68 for water and $5 for driver, horses and carts, a total of $8.68 per day. Allowing 250 days per year, the annual cost for sprinkling is $2,170. The estimated cost [illegible] twice per year, together with special cleaning of culverts and gutters during and after storms, is [illegible] would be [illegible] the streets were oiled. The total saving, on these two items alone, of sprinkling and cleaning, would be $2,170, plus [illegible] office expense and general supervision. The estimated cost of oiling being about 72,240 sq. yds. at 6.1 cts., is $4,407. Therefore, if the oil surface lasts on the average one year eight months over the district, the expense of oiling this sprinkler route is justi- [illegible] Other routes, on [illegible] less, would not [illegible] the oiling, while others [illegible]

Patching is done intermittently on macadam streets, at such intervals that we have no satisfactory figures on cost per mile per year. Patching on oiled streets must be done systematically and more frequently, because the public demands a smoother surface on an oiled street. Therefore, until more definite figures are obtainable, we must assume that there will be no decrease in the cost per mile per year for patching as a result of surface oiling, but that the same amount of money, or a small increase, will give better service. The saving will appear in lessened wear and tear on vehicles and greater convenience to the public.

Oil Macadam: Methods.—Our method of constructing oil macadam, summarizing briefly from our specifications, is as follows:

After the roadway has been brought to the proper subgrade . . ., and after the curbs and gutters have been constructed, a layer of broken stone, having a depth varying regularly from 8 ins. at the centre of the roadway to 6 ins. at the gutters, measured before rolling, shall be spread on said sub-grade. . . . The aforesaid layer of broken stone shall then be covered with a layer of screenings of sufficient depth to fill the voids in said layers of broken stone, and then thoroughly rolled with a 10-ton roller until the screenings have worked down into the broken stone and the roadway presents a uniform surface. All depressions occuring in said roadway during the rolling shall be brought to the required grade with broken stone and screenings of the same size and quality as is used in the aforesaid layers.

The aforesaid broken stone and screenings, after being thoroughly rolled and before the rolled surface has been disturbed, shall then be sprayed uniformly with oil at the rate of 1 gal. to the square yard of roadway surface covered, and allowed to remain in this condition for a period of not less than 48 nor more than 72 hours. A light layer of screenings shall then be spread over this oiled surface, after which the roadway shall be sprinkled with water and thoroughly rolled with a 10-ton roller.

The roadway, prepared as hereinbefore specified, shall then be allowed to become thoroughly dry, after which oil is to be sprayed uniformly over the surface at the rate of ½ gal. to the square yard of street surface covered. Screenings, to the extent of preventing the oil surface from adhering to vehicles shall then be dusted over said oiled surface and thoroughly rolled.

Oil shall be applied to the pavement under pressure of at least 30 lbs. per square inch. . . .

All of the above-mentioned oiling shall be done only while the atmospheric temperature is above 65° Fahr., and even then only during such periods as the sun is shining. No oiling will be permitted when the layer of broken stone or the screenings are in any way wet.

The oil is a residuum of an asphaltic oil and contains 85 per cent. of asphalt, having a penetration of 80. The temperature, volatility and allowable impurities are specified in detail.

Good workmanship and materials are necessary to secure results. In general, it may be said that the same precautions must be observed as for plain macadam, with several that are special to this work. Dirt, and dust in quantities, must be excluded. The greatest difficulty, and one that requiries experience and judgment to overcome, is in securing that amount of penetration that will use all of the oil (that is, take the surplus from the surface) and yet allow enough near the surface to produce finally an asphaltic appearance. The kind of rock and screenings used, the amount of screenings, the amount of rolling, the moisture present, and the weather are all conditions that must be considered. In general, it may be said that the voids should be well filled and the stone compacted before the first oil is brought on the work, but the surface should be quite porous, even open. After the first oiling should come the greater part of the rolling. In fact, before the second oiling the street should be as thoroughly compacted as can be done with a roller weighing at least 250 lbs. per lineal inch of tread. In some cases there has been a tendency to reduce the amount of rolling below the requirements of plain macadam. This should not be permitted. Oil macadam requires fully as much rolling as plain macadam.

In some places we have used and are planning to use more extensively in the future, a better class of oil macadam. This is constructed in two courses. The first consists of 4 or 5 ins. of ordinary macadam sized rock, screened, rolled and practically completed as for plain macadam. Then we spread 3 ins. of rock, not exceeding 2 ins. in size, and proceed much as already described in detail. We try to confine the penetration of the oil to the second course.

With neither type of oil macadam, nor in fact, with surface oiling, do we try to secure a uniform asphaltic appearance immediately upon completion. If we should, the material would adhere to passing vehicles and we would find it necessary to spread more screenings. It requires several weeks or months, and in some cases a year, for the surface to assume its final appearance.

Oil Macadam: Cost.—We have no figures showing the additional cost of constructing oil macadam over and above the cost of constructing plain or water-bound macadam, except such as can be deduced from our experience in surface oiling and from a comparison of contractors' bids. Roughly we figure that oil macadam, constructed as already described, costs from 1½ to 2 cts. per square foot more than plain macadam. Perhaps it would be fair to say that comparison of bidding prices shows an average increase of about 15 cts. per square yard. For oil macadam complete, as described, we are paying this season from 8¼ cts. per square foot to 9¾ cts. per square foot, or from 74 to 88 cts. per square yard. These prices, of course, include the contractors' profits, cost of collection and all overhead expenses. Where the pavement is constructed in two layers, the cost is increased again about 12 or 15 cts. per square yard. Two-layer work being better in all classes of macadam, this further increase, of course, is not chargeable to the use of oil.

Before closing this paper, it might be well to explain our reason for using oil macadam on new construction and on reconstruction instead of the cheaper process of surface oiling. As already indicated, the results are more permanent. If it be necessary to restore the asphaltic coating of oil macadam after the lapse of several years, it can be done with even less expense than original surface oiling on plain macadam. A mere surface of oil is removed within a period varying from two to five years by the action of traffic and storm water, but these agents seem to have little effect on oil macadam except at the surface. Furthermore, it is claimed, on proof of experience, that surface oiling frequently encourages raveling by preventing the renewal of the moisture that is so necessary to preserve macadam. Theoretically this should be particularly true of streets oiled soon after construction before traffic has secured final compaction. This difficulty should not be observed where the upper half or more is bound with oil. Furthermore, we have found it extremely difficult to secure a surface of oil that will adhere to the macadam and that will not "roll" or "wave." Every precaution must be observed to have the street clean and to adjust the quantity of oil to the requirements of the street. With oil macadam, however, we have more latitude within reasonable limits, for if the street finally shows a deficiency of oil at the surface, the fault can always be corrected by a light third application.

In conclusion, it may be said that it is our policy to permit the use of standard asphalt pavement on light traffic streets, but not to urge such construction excepting near the business district; to use oil macadam on all new construction in the residence districts; to surface oil, as rapidly as funds permit, all plain macadam streets that are in condition to be treated economically; and to reconstruct with oil macadam all plain macadam streets whenever such streets become worn out, unless conditions require a better pavement.

◆

AMERICAN ROAD BUILDERS' ASSOCIATION.

Arrangements for the American Good Roads Congress and ninth annual convention of the American Road Builders' Association at Cincinnati, O., December 3rd, 4th, 5th and 6th, have been practically completed. The plan adopted last year of considering certain specified subjects each day will be adhered to this year, although a somewhat greater subdivision of the main topics has been made. The first session, on Tuesday, December 3rd, will be devoted to the usual addresses of welcome and responses, and a presidential address by Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York city, and president of the American Road Builders' Association. Six of the seven remaining sessions will be devoted to the presentation of technical papers and their discussion, and one session will be used for the annual business meeting of the Association.

The tentative programme of the technical sessions includes three papers on the organization of highway departments of States, large cities and small cites, respectively. The first will be presented by Major W. W. Crosby, Consulting Engineer of the Maryland State Roads Commission; the second by Wm. H. Connell, Chief Engineer of the Bureau of Highways, Philadelphia, Pa., and the third by a speaker yet to be announced. The development of a plan for a State or county road system will be treated in a paper by an authority yet to be announced, as will also the construction of stone and brick pavements. The building of earth and gravel roads will be treated in a paper by Robert C. Terrell, State Commissioner of Public Roads of Kentucky. The subject of bituminous pavements for cities will be presented in a paper by George W. Tillson, Consulting Engineer of the Borough of Brooklyn, New York city, and Ellis R. Dutton, Assistant City Engineer of Minneapolis, Minn., will describe the construction of wood block pavements by the day labor plan now in force in that city. Three papers on questions of importance to all engaged in either road or street work will be presented by Col. Wm. D. Sohier, [illegible] of the Massachusetts Highway Commission, who [illegible] Clifford Richardson, Consulting Engineer, New York city, who will [illegible] Arthur S. Lewis, Secretary and Superintendent, Lincoln Park Commission, Chicago, Ill., who will discuss the value [illegible]

[illegible]

OPERATING RESULTS OF IMHOFF SEWAGE TANK.

The Imhoff sewage tank at Winters, California, has now been in operation for over four months and the operating results were described by Mr. Fred H. Tibbetts, designing engineer, in a recent paper before the League of California Municipalities. The design of the tank is similar to other Imhoff tanks previously described in this journal, especially those at Chambersburg, Pa., and Winchester, Ky. A brief description of the structural features of the tank at Winters is here given, however, to aid in the interpretation of the operating results later described. The information is abstracted from Mr. Tibbetts' paper.

Features of Design.—The sewage disposal works at Winters were designed to accommodate a population of 3,000, which is twice the present number, so that no enlargement of the work will be necessary in the near future. The estimated daily sewage flow is 75 gals. per capita, 225,000 gals. for the assumed population of 3,000. There are two tank units with sludge digesting chambers capable of storing six months' sludge production. The chambers are 20 ft. in diameter and have an effective depth for storing sludge of 6.5 ft.; the sludge capacity amounts to 1,950 cu. ft. for each tank or a total of 3,900 cu. ft. Estimating the amount of sludge at 0.007 cu. ft. per capita per day, the amount from 3,000 persons, therefore, would be about 3,780 cu. ft. in six months.

Communication between the upper and lower chamber of each tank unit is afforded by 10-in. slots. The trough bottoms slope toward the slots at an angle of 45 deg., which is assumed to be steep enough to allow the solids which settle on them to slide down and pass into the sludge chamber. The sewage as it enters the sedimentation tank passes under two scum boards set 1 ft. apart, with their lower edges 18 ins. below the water surface. These intercept floating matter and if the scum forms back of or between the boards it may be removed by raising the planks which cover this space. The arrangement at the outlet end of the tanks is identical with the inlet and provision is made for reversing the direction of flow periodically so as not to get a greater accumulation of sludge in one tank than in the other. The bottom of the sludge digesting chamber is an inverted cone with a height of 5 ft. and a diameter of 20 ft. The depth of sewage will be such that the sludge at the bottom will be under 19 ft. of water.

When the sludge is being removed water may be discharged into it from five points to stir it up and make it slide down to the intake of the sludge pipe. Around the base of the vertical walls of the beginning of the bottom slope is a 2-in. water pipe for flushing. There are four 1-in. openings spaced around the tank at 90 deg. intervals and a branch running to the lowest point of the tank.

Sludge is removed from each tank by an 8-in. outlet pipe of cast iron coated with coal tar to protect it from the action of the sewage. The intake end of this pipe is at the lowest point of the sludge chamber and the discharge end is in a square concrete manhole 5 ft. below the sewage level of the tank and is fitted with a shear gate. When this gate is opened the sludge will be forced into the manhole from the bottom of the sludge chamber by a 5 ft. head of water and from here will flow by gravity to the sludge drying bed.

The tanks are covered by a reinforced concrete roof [illegible] ins. thick, high enough above the sewage surface to allow the formation of a sludge mat. Manholes [illegible] ins. at the side and [illegible] ins. at the centre of each tank are provided for removing this mat if it becomes necessary to do so. All parts of the roof of the sludge chamber slope to some one of these three manholes, so that the gas bubbling from the working sludge will have free passage to the vents.

A 10-in. galvanized iron pipe connects with each of the three gas chambers and extends 10 ft. above the roof.

To give complete control of operation a 2-ft. concrete channel to carry the sewage runs entirely around the tank and is provided with stop planks, so that the sewage may run through both tanks in reverse direction, through the first tank only or by-pass both tanks. The major part of the sedimentation takes place in the first tank and it is proposed to reverse the flow through the system every week or so in order to equalize the accumulation of sludge. If it should prove that one tank is sufficient for the present population to be served, the second tank may be by-passed and held in reserve until needed. The tanks are located near the site of a proposed public park; for this reason it was considered advisable to cover them.

Operating Results at Winters.—The Imhoff tanks at Winters have not been in operation long enough to give very definite ideas of what may be expected of them, as they were first put into service about four months ago. The operation has been under the supervision of Mr. Luke Gregory, who, although without experience in sewage disposal, has given unusually careful and intelligent supervision. Three progress reports have been obtained from assistant engineers since that time, but no analyses have been attempted. The last inspection was made on September 20, by the writer, in company with Mr. Gregory. The system is completed, but all the houses have not yet been connected and the amount of domestic sewage delivered is much less than that for which the tanks were designed. The effluent from the tanks has been quite clear and comparatively free from solids, except at times some finely divided black humus matter. At first, while the flow was very small, a slight odor might be detected, but this appears to be hardly perceptible at present. During the greater part of the period of operation, only one tank has been in use. Lately a part of the sewage has been diverted so as to enter the outer end of each unit, being taken off at the centre opening. This makes the tanks operate in parallel rather than in series, as was intended.

Bacterial action is decidedly active, as evidenced by the continual rising of large quantities of gas bubbles. Most of these bubbles rise in the centre manhole, which collects gas from the largest portion of the sludge wells. Although gas was escaping in large quantities no odor of hydrogen sulphide could be detected, even close to the open manholes. The heaviest mat was found in the centre manhole of the first tank. This was about 6 ins. thick, the manhole being 3 x 4 ft. All of the other floating solids would probably be not more than six more cubic feet, making in all about 12 cu. ft. of floating solid material in the entire tank. This is a very small quantity compared to the amount of material usually found in the floating mat of a septic tank, and indicates that a large proportion of the solids do not hold enough gas to keep them continually floating.

The mat was similar to that usually found on a septic tank, and when judged by the odors given off was not nearly so offensive. Some of the material from the lower part of this mat was taken out and examined. It consisted of a black homogeneous mass containing very little fibrous material and having little odor other than that suggestive of tar or crude oil. The mat on the side manhole of the first tank was but about 2 ins. thick, similar in appearance to that in the centre. Bubbles were rising here also, but in not nearly such large quantities as appeared in the centre. This was due also in part to the fact that most of the solids fall nearer the centre of the tank, after passing through the slots from the sedimentation chamber.

The sludge deposited in the bottom of the tank has been measured by Mr. Gregory, who found it to be about 2 ft. thick. No sludge has yet been drawn out. Since the capacity of the sludge well permits of an accumulation of something over 6 ft. before this will become necessary, no observations on the character of the sludge from the bottom have yet been made.

It was found that a slight mat had formed on the sedimentation chamber longest in use. This mat was very thin, probably not over ½ in., and its origin has not been definitely ascertained. The slope of the partitions between the sedimentation chamber and the sludge wells is 45 deg., or 1 on 1. It may be that some finely divided solids have remained on this surface for a period long enough for putrification to set in and have bubbles form, causing them to float. Or it may be that, as was observed in the Philadelphia experimental tanks, some solids are contained in the sewage, which are light enough to float of themselves. Gas and scum is so small compared to the amount of sewage passing through that it cannot be a serious defect. Later designs of Imhoff tanks call for slopes of 1 on 1½ for these surfaces, and perhaps with such steeper slopes there would be less tendency for scum to form in the sedimentation chambers.

As will be noted from the description, a cover was placed on the tanks. This was done in spite of the fact that both Dr. Imhoff and Dr. Rudolph Hering of New York considered it unnecessary. In general, a cover is, undoubtedly, not required. The writer, however, believes it better to cover any sewage disposal works operated in close proximity to residences, as there is undoubtedly less odor in any type of works which is covered. At Winters, the pipes arranged for conduction of the gas from the tanks have been brought together and extended so that the point of discharge is now about 30 ft. above the ground. The operator states that previous to this there were, on quiet mornings, objectionable odors in the immediate vicinity of the tanks. This condition was relieved upon the extension of the pipes. The effluent has been concentrated in a closed iron pipe and taken down to the creek bed, where it flows through a channel in the gravel for a distance of about 100 ft. to the main stream of the creek, which is very low at this season of the year. The only odors noticeable about the entire plant were in the 100-ft. channel through the gravel. This could be readily eliminated by diverting the flow of the creek so that the point of discharge of the tank would be under water.

The cover has been found efficient in preventing the use of the tanks as a breeding place for mosquitoes, and the operator has found it desirable to make all openings as nearly tight as possible except for the gas pipes and effluent pipes.

During the summer months a large amount of cannery waste, estimated by the operator as high as 150,000 gals. in 10 hours, was discharged into the sewers, and found its way to the tanks. This material is strongly alkaline from the use of lye in the fruit canning process. It is stated by the operator that upon its arrival at the tanks, sludge decomposition as evidenced by the formation of gas bubbles, ceased. Also that the velocity of flow through the tanks was too high to admit of thorough sedimentation, and that at such times objectionable odors were given off and the effluent was dark and contained considerable suspended solids. Normal action was quickly resumed, however, when the cannery wastes were diverted from the disposal works.

◆

TO UTILIZE LUMBER REFUSE.

Vancouver sawmill owners propose to utilize lumber refuse now being consumed in huge burners at the mills to make electrical power and steam heat, and to offer the same for sale. Application is made to the civic authorities for the necessary permission to lay wires and pipes for transmission purposes. The movers in the scheme say they can offer electricity to the city at ¾ of a cent or one cent per kilowatt.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

Artistic Bridge Design.—A Systematic Treatise on the Design of Modern Bridges according to Aesthetic Principles. By Henry Grattan Tyrrell, C.E., Bridge and Structural Engineer. Chicago: The Myron C. Clark Publishing Co. Cloth; 6 x 9 in.; 294 pages; 242 figures (about 80 full-page half-tones). Price, $3.00 net.

Reviewed by C. R. Young, B.A.Sc., Consulting Engineer.

Although several comprehensive discussions of bridge æsthetics have appeared in the transactions of the great engineering societies and as chapters in general treatises on bridge design, Mr. Tyrrell's book is the first one in English, as far as the reviewer is aware, to be given over entirely to the consideration of this subject.

The author's purpose, as disclosed in the sub-title, is a commendable one, and, broadly judged, he has treated the subject well. Such criticisms as a careful reader may make are largely those of detail, and cannot be said to challenge the value of the book as a whole.

After a splendidly-written introduction by Mr. Thomas Hastings, of Carrère & Hastings, the well-known architectural firm, of New York, the author justifies his choice of subject by showing the importance of bridges, their effect on civilization and progress, and the necessity for artistic bridge construction. He then proceeds to establish "Standards of Art in Bridges," stating and discussing the following five —

1. Conformity with environment.
2. Economic use of material.
3. Exhibition of purpose and construction.
4. Pleasing outline and proportions.
5. Appropriate but limited use of ornament.

In the fourth chapter, which, it would seem, in the interests of logical arrangement, should have preceded the one just mentioned, the author effectively sets forth the "Causes for Lack of Art" in bridges. Chapter V., entitled "Special Features of Bridges," is given to the consideration of bridges carrying buildings, memorial arches, towers, etc., [illegible] it has been made to include [illegible] the [illegible] general [illegible] of the kind of bridges from the stand-point of the material employed and the selection of the [illegible] "Principles of Design" are elaborated in Chapter VI., [illegible] the "Standards of Art" [illegible] in Chapter III. In Chapters VII. to XI., inclusive, are discussed the various [illegible] illustrations, [illegible] a full page each. On the page facing each illustration is a brief description of [illegible]

[illegible] that

"there is no greater jar to æsthetic feeling than to see a bridge in which this principle (symmetry) is violated with large spans at one end and smaller spans at the other, or with the principal span noticeably out of centre" is scarcely supported by reference to an elevation of the Walnut Lane bride at Philadelphia. Lack of symmetry is, of itself, not a source of disappointment if the reason for it is distinctly apparent and does not arise from sub-aqueous conditions. Nor is disappointment occasioned if a part of the bridge is obscured from view, or if the bridge is so large that the whole structure cannot be seen in elevation at any one time. Again, the alleged necessity of indicating in some way on the surface the absence of spandrel filling where spandrel curtain walls are used (p. 22) is not defensible if the arch ring is accentuated in proportions consistent with a spandrel-filled arch. It might further be pointed out that the three designs for girder bridges by the author, shown on pages 51 and 52, are not wholly free from the defects which commonly mar such structures. In two of them the abutments lack face batter, thus giving an impression of instability; in all of them an even, rather than an odd, number of fascia panels are employed; and in one the turned balusters are large enough to effectually dwarf the girder itself.

There is a certain looseness of expression in portions of the book, indicating undue haste in writing. For example, the author speaks of certain buildings being "adorned with art" and stone bridges displaying "an amount of art . . ." Trusses are said to resist bending "by the counteracting moments in the upper and lower chords."

One regrettable feature of the book is the paucity of references to the work of those who have done most to shape and define the aesthetic principles which the author is able to re-state, possibly in improved form. Of the fourteen foot-notes, twelve refer to the work of the author and two other sources of information. The critical reader will scarcely believe that the division of honors in the references bears a proper relation to the division of labor in the development of the subject.

Apart from these and certain other criticisms which might be made, the value of the book is unquestionable and everyone who is responsible for the design of bridges should own, or have access to, a copy.

The Metallography of Iron and Steel.—By Albert Sauveur. Published by Sauveur & Boylston, Cambridge, Mass. 450 pages; size, 7½ x 10½; fully illustrated. Price, $[illegible], post-paid.

Reviewed by T. R. Loudon, B.A.Sc., Metallurgical Engineer.

Metallography has in the past few years received a great deal of attention in the literature of the day. One would not be [illegible] in saying that more attention has been devoted to the metallography of iron and steel than to any of the other metals, and, indeed, it is only to be expected that this would be so when the complexity of the composition of iron and steel is taken into account, together with the commercial importance of iron and steel. It is readily seen, however, that the very fact that a great deal has been written on the subject constitutes the main difficulty that is encountered by the student or the engineer who wishes to get authoritative opinion along these lines, and who, not being a specialist on the subject, has not very definite ideas where to look for information. The need for an up-to-date treatise on the metallography of iron and steel has long been felt.

In view of the above mentioned state of affairs, it is not surprising that such an authority as Professor Sauveur should undertake to compile a work on the metallography of iron and steel.

Professor Sauveur's book is divided into twenty-four lessons, a list of which is given at the end of this review; a chapter on the apparatus of the metallographic laboratory, and two appendices on the manipulation of apparatus and the nomenclature of microscopic constituents. The illustrations throughout are very clear; this being particularly true of the microphotographs of the various specimens. To anyone at all familiar with the photographing of metallographic specimens this will be keenly appreciated. Only too often is good subject matter spoiled by blurred microphotographs that convey no real idea of actual conditions.

It might be pointed out that the system of dividing the book up into Lessons instead of Chapters rather detracts than adds to the value of the book. There is, perhaps, rather too much of the academic suggested, whereas really the book is written with a good, practical style. Then, also, the numbering of the pages by the Lesson, i.e., beginning anew at each Lesson instead of consecutively from the beginning of the book with an ordinary index, is certainly not a time-saver.

In Lesson No. I. on Pure Metals, the author very clearly points out the difference between crystalline growth and the formation of grains. The term crystalline grains as applied to grains resulting from crystallization is a good one.

In Lesson No. 5, page 12, under the heading Micro Test for the determination of carbon in steel, the statements made are perhaps a trifle misleading. It is said that, "after a little experience and by taking the necessary precautions it will be found that, in the case of decidedly hypo-eutectoid steels at least (steels containing, say, less than .6 per cent. carbon) results are obtained fully as accurate as those of the colorimetric method, and on the whole more reliable, since the possibility of serious errors is practically eliminated." Undoubtedly the author refers to steels that are supposed to be homogenous in composition. Even admitting the value of the microscope in determining carbon content, the great trouble is that such a determination merely holds for the surface examined—the steel one-eighth of an inch below this surface may be, and often is, of a different carbon content. By chemical means, however, drilling being taken, a better average is obtained. Of course, one must admit that serious errors do often occur in colorimetric determinations, but these are mainly due to lack of skill. The same applies to the microscope. One cannot agree with the author that "after a little experience" carbon contents can be estimated. It requires a good deal of experience. As a check the microscope is invaluable, but should be used very guardedly in making determinations of carbon content.

In the investigation of the effects of mechanical and heat treatment on steels, the practical value of metallography is at once seen. This is undoubtedly the great field for metallography. In Lessons XI. to XIV., on the mechanical treatment, annealing and hardening of steel, Professor Sauveur has given a very thorough presentation of the subjects. The illustrations show very clearly the effects of the treatment to which the specimens have been subjected. These portions of the book form a valuable practical piece of scientific literature.

Lessons that should be at the end and not the beginning of the book seem a trifle strange. One can make very little real progress in the metallography of iron and steel before understanding the equilibrium diagram of iron and carbon. Be this as it may, it is pleasing to note that Professor Sauveur takes the stand that in iron carbon alloys above about 1.7 per cent. carbon, the eutectic formed is that of austenite and cementite, and that any graphite that may be found subsequently, results by the breaking up of the cementite into ferrite and graphite. This is surely the more practical way of treating the subject. The explanations of the iron-carbon diagrams are very clear, the points of historical interest being very neatly worked into the subject.

The entire book is a valuable addition to scientific literature. The book can be said to contain everything pertaining to the metallography of iron and steel written from an ardent metallographer's point of view.

The following is a detailed list of the Lessons in the book: Pure Metals, Pure Iron, Wrought Iron, Low Carbon Steel. Medium High and High Carbon Steel, Impurities in Steel, The Thermal Critical Points of Iron and Steel, Their Occurrences, Causes and Effects (three Lessons), Cast-Steel, Mechanical Treatment of Steel, The Annealing of Steel, The Hardening of Steel, The Tempering of Hardened Steel, Theories of Hardening of Steel, Cementation and Case-hardening of Steel, Special Steels (two Lessons), Cast-Iron, Impurities in Cast-Iron, Malleable Cast-Iron, Constitution of Metallic Alloys, Equilibrium Diagram of Iron-Carbon Alloys, The Phase Rule, and two Appendices mentioned before.

Theory of Structures.—By R. W. Angus, B.A.Sc., Professor of Mechanical Engineering, University of Toronto. Published by the Engineering Society, University of Toronto. Cloth; size, 6¾ x 9¼ in.; 232 pages, 147 figures. Price, $3.00.

The full title of this volume is the "Theory of Machines, Including the Principles of Mechanism and Elementary Mechanics of Machinery." The book is intended as a text-book for students in engineering in the University of Toronto. The subjects treated in the chapters are: The Nature of the Machine, Motion in Machines, Velocity Diagrams, The Motion Diagram, Toothed Gearing, Bevel and Spiral Gearing, Trains of Gearing, Cams, Forces Acting in Machines, Crank Effort and Turning Movement Diagrams, The Efficiency of Machines, Governors, Speed Fluctuations in Machinery, Proper Weight of Flywheels, Accelerations in Machinery. The method of determining the velocities of parts of machines, used in the volume, is called the phorograph method, and is here published for the first time. This gives a convenient graphical method for determining accelerations, kinetic energies of links, etc. The whole matter covered in the treatise is presented in readable form, and is very clearly written. To the student or engineer interested in the study of the theory of machines the book will be of considerable assistance.

Modern Organization.—By Charles DeLano Hine. Published by The Engineering Magazine Company, N.Y. Cloth; size, 5 x 7½ in.; 110 pages. Price, $2.00.

This volume is the latest addition to the Works Management Library, issued by The Engineering Magazine Company, and is the first complete statement of Major Hine's theory and practice of "unit organization" that has been put forth. The unit system applied on the Harriman lines has been remarkably successful in promoting efficiency without causing trouble. It is peculiarly interesting, because it seems to involve so little physical change and to depend so completely upon the apparently subtle, but after all, very direct internal improvement that is brought about when the official is given a new viewpoint of his work and its relation to co-ordinate departments. The system establishes a third mode of bringing line direction and staff guidance into co-operation, a mode essentially different from either Emerson's efficiency staff or Taylor's functional management

The chapters assembled in this volume appeared originally in The Engineering Magazine as a series of articles, which ran from January to July, 1912. The volume forms a comprehensive definition of this philosophy of management, and forms a valuable addition to Efficiency Management textbooks.

Energy and Velocity Diagrams of Large Gas Engines.—By Paul L. Joslyn. Published by the Gas Engine Publishing Co., Cincinnati, O. Cloth; size, 6 x 9 in.; 70 pages, 62 diagrams. Price, $2.00.

The designer of large gas engines has to consider many things which on small engines are often left to be worked out after the engines has been built in its first form. With small engines it is not so expensive or so difficult to change some points, and it frequently happens that very radical changes in construction are so effected. But with the engine of several thousand horse-power it is impossible to do this. So far as can be done, everything must be worked out in advance. Castings and machine work run into a large amount of money on engines working on blast furnace gas, and to scrap a cylinder or a bed casting because some change is found necessary may amount to several thousand of dollars in initial expense, manufacturing cost, delays, etc. In this book, the author gives the methods of laying out energy and velocity diagrams for large engines operating on blast furnace, producer or natural gas, with instructions as to their use, etc. The data given is the result of actual designing of this character on some of the largest engines built in American and Europe, and will be found of inestimable advantage to the designer working on engines of this character.

Central Station Heating.—By Byron T. Gifford. Published by Heating and Ventilating Magazine Co., New York. Leather; size, 5½ x 9 in.; 208 pages.

Central Station Heating during the last three or four years has received a great impetus, and a new era in this branch of engineering is rapidly dawning. With the increased attention and interest it has become desirable that the engineers interested in this department of engineering design should have the existing data on the subject presented in concrete form. Central station heating in its broader sense is properly classed as a public utility, and will eventually be controlled by the different utility commissions. As the development of these plants increase the field for them will become larger. Many of the elementary principles of the science of heating have been omitted, but [illegible]

The Materials Used in Sizing.—[illegible]

[illegible]

Handbook for Highway Engineers.—By Wilson G. Harger and E. A. Bonney. Published by McGraw-Hill Book Co., 239 West 39th Street, New York. Size, 4 x 7 in.; 500 pages. Price, $3.00.

This admirable publication is divided into two parts:—
Part I. Theory of Design.
Part II. Practice of Design and Construction.

The authors are men actually engaged on roadwork, and are, therefore, in a position to state clearly and well the subject matter of the text.

The publication contains the information ordinarily used in the design and construction of roads warranting an expenditure of from $5,000 to $30,000 per mile.

The information is presented in a compact and convenient form, and in addition to a table of contents there is a complete index.

It is a book valuable to experienced and inexperienced road-builders alike.

The cost data furnished is a valuable contribution to the literature on road-making, but the table and lists of quantities is if anything more useful.

The following questions are dealt with in logical sequence: Grades and Alignment, Pavements, Surveyors, Estimating, Construction, Specifications, and in addition the book contains sixty-seven tables.—E.A.J.

Concrete Highways.—Published by the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa. Paper; size, 6 x 9 in.; 95 pages. Profusely illustrated; free.

Every person interested in the good roads movement is aware of the latest development in this important work through the use of concrete. This new type of road is now the subject of extended experiments by the United States Government. It has met with such pronounced success in Wayne county, Michigan, as to give that locality national celebrity. The Association of American Portland Cement Manufacturers has published for free distribution a comprehensive book, entitled "Concrete Highways," which will interest road supervisors, contractors and taxpayers in every section of the country. The book, which is handsomely and profusely illustrated, contains nearly a hundred pages. It was prepared by expert road engineers, and goes into every detail of construction, concluding with a tabular digest of concrete pavements in all sections of the country. The various chapters include discussion of bituminous compound wearing surfaces, grouted pavements, reinforced concrete pavements and specifications for the one and two-course types. In fact, the book covers the entire subject in the most reliable and authentic way. Road supervisors especially will find it of inestimable value, and the taxpayer will be extremely interested in the economical results obtained by the introduction of these durable concrete highways.

Tunneling: A Practical Treatise.—By Charles Prelini, C.E., author of "Earth and Rock Excavation," "Dredges and Dredging," "Earth Slopes, Retaining Walls and Dams"; Professor of Civil Engineering, Manhattan College, New York. Sixth edition, revised and enlarged. New York: D. Van Nostrand Co. Cloth; [illegible] Price, [illegible]

This standard treatise on tunneling needs little comment, for it is now in the sixth edition, and is recognized as an authoritative exposition of the subject. During the few years that have elapsed since the publication of the first edition of this work, the art of tunneling through different soils, and especially under large bodies of water, has made considerable progress. During the last ten years no less than eight sub-aqueous tunnels, involving the construction of sixteen tubes, have been constructed for the service of the city of New York alone.

This edition has been revised, so that the entirely new methods which have been introduced by professional men are here presented in due prominence.

Space has also been given to important tunnels recently built. This material illustrates the various methods discussed in the text, and brings out more clearly the characteristics of the different methods of tunnel excavation. The volume now forms an admirable treatise on the subject, and will, no doubt, meet the present requirements of both engineers and students.

Design of Steel Mill Buildings.—By Milo S. Ketchum, C.E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado. Published by McGraw-Hill Book Co., New York. Third edition; cloth; size, 6½ x 9 in.; 562 pages; 66 tables and 270 illustrations. Price, $4.00 net.

In this third edition Professor Ketchum has brought this treatise on the design of mill buildings and the calculation of stresses in frame structures to date.

In the preface to the first edition he states that the book is intended to provide a short course in the calculation of stresses in frame structures and to give a brief discussion of mill building construction. The original edition admirably filled the place allotted to it by the author. The book has received a well-merited appreciation since it was first published. In this edition the chapters on Stresses in Frame Structures and Stresses in Bridge Structures have been re-written and enlarged; the "Specifications for Steel Frame Buildings" have been revised and re-written and many changes have been made in the text. The additions to the book include two Problems in Graphic Statics, and Appendix III., "Structural Drawings, Estimates and Designs."

A Textbook of Physics.—Contributors: A. Wilmer Duff, E. Percival Lewis, Charles E. Mendenhall, Albert P. Carman, R. K. McClung and William Hallock. Edited by A. Wilmer Duff, D.Sc., Professor of Physics, Worcester Polytechnic Institute, Worcester, Mass. Third edition, revised. P. Blackiston's Son & Co., Philadelphia. Cloth; size, 5½ x 8½ in.; 686 pages; 595 text illustrations.

This textbook of Physics has now reached its third edition, the first edition being published in 1908. As noted, it is the combined work of seven experienced teachers of College Physics. For this edition, entirely new parts on Heat, and Electricity and Magnetism have been prepared, and extensive changes have been made in other parts. To facilitate reference a list of tables of constants has been given, and the indexes have been somewhat increased.

Machine Design.—By H. D. Hess, M.E., Professor of Machine Design, Sibley College, Cornell University. Published by J. Lippincott Co., Philadelphia. Cloth; size, 6 x 9½ in.; 368 pages; 18 plates; 318 figures. Price, $5.00 net.

The book deals specifically with machine design as applied to hoists, derricks and cranes. While the book is written with special reference to the student, it will be well received by the practising engineer, particularly those who are directly engaged in the design of this particular field.

A determination of the stresses in frames and machinery is developed by the use of elementary theoretical principles. While empirical formulas are used throughout the book where the conditions call for such use, the theoretic development is used where possible. Many examples are shown throughout the text, and these are practically all drawn from present-day practice.

The book is divided into twelve parts under the following headings: Introduction, Frames and Girders, Brakes and Clutches, Winches and Hoists, Pillar Cranes, Jib Cranes, Under-braced Jib Crane, Inverted Post Crane, Wall Crane, Overhead Electric Travelling Cranes, Hoisting Engine, Locomotive Cranes.

The Introduction includes a discussion of the properties of materials and fibres used in this class of machine design, and a few pages are given to an exposition of the elements of graphic statics, followed by a discussion of rolling and sliding friction crane blocks and block efficiencies for chain and wire rope. The other parts of the book are devoted to a presentation of the theory of columns and beams, methods of determining stresses in different frames, the various forms of brakes and clutches, and the remaining portion of the book takes up under the several headings the design of different types of cranes.

The treatise will be a most valuable one as a book of reference for the practising engineer and as a textbook for the student.

PUBLICATIONS RECEIVED.

Annual Report City Engineer, City of Ottawa. For the year 1911. City Engineer, Newton J. Ker, Ottawa.

Outline of the Smoke Investigation. Bulletin No. 1 of Department of Industrial Research, University of Pittsburg.

The Specific Heat of Wood. By Frederick Dunlap. Bulletin 110 of the Forest Service, U.S. Department of Agriculture.

Tests of Structural Timber. By McGarvey Cline and A. L. Hein. Being Bulletin No. 108 of the Forest Service, U.S. Department of Agriculture.

Department of Agriculture. Seventh Annual Report for the Province of Saskatchewan, 1911. W. R. Motherwell, Minister of Agriculture, Regina, Sask.

A Great Industrial Plant and Its Owner. Being booklet No. 1, Water Supply Educational Series, issued by the Bureau of Water, City Hall, Philadelphia.

The Simmen System of Railway Signalling and Despatching. By Paul J. Simmen. Reprint from *The Canadian Engineer*, September 12th, 1912. Copies may be secured from Northey-Plummer, Limited, Toronto.

Forest Products of Canada, 1911. Tight and Slack Cooperage, compiled by R. G. Lewis. Bulletin No. 31, Forestry Branch, Department of the Interior, Ottawa.

Report of the Chief Engineer of the Board of Estimate and Apportionment of the City of New York for the Year 1911. Office of the Chief Engineer, 277 Broadway, New York.

Summary Report of the Geological Survey Branch of the Department of Mines, for the year 1911. R. W. Brock, director, Geological Surveys Branch, Department of Mines, Ottawa.

Sewage Pollution of Interstate and International Waters. By Allan McLaughlin. Being Bulletin No. 83, Hygienic Laboratory, Public Health and Marine Hospital Service of the United States.

Provincial Board of Health of Ontario. The thirteenth annual report for the year 1911. Copies may be obtained from Dr. J. W. S. McCullough, Chief Officer of Health, Parliament Buildings, Toronto.

Association of the Ontario Land Surveyors. Annual report of the association and proceedings of the twentieth annual meeting held at Toronto, February 27, 28, 29, 1912. Secretary, L. V. Rorke, Toronto.

Plans for Concrete Houses. Being plans for small houses of poured concrete, as submitted in a competition for prizes given by the Blaw Steel Construction Company, Westinghouse Building, Pittsburg, Pa.

The Hetch-Hetchey Water Supply for San Francisco, 1912. Being a report by John R. Freeman, Consulting Engineer to the city of San Francisco. Board of Supervisors, San Francisco, Cal. Price, $3.50.

Steam Boiler Explosions. By Wm. H. Boehm. Being an illustrated lecture delivered at Cornell University May 3rd, 1912. Copies may be secured from the Fidelity and Casualty Company, 92 Liberty Street, New York City.

Canada's Canal Problem and Its Solution. Being a reply to the Toronto Board of Trade. Issued by the Canadian Federated Boards of Trade and Municipalities. Secretary, A. J. Forward, Castle Building, Ottawa, Ont.

Icebergs and Their Location in Navigation. By Prof. H. T. Barnes. Being a reprint of lecture delivered before the Royal Institution of Great Britain. Copies may be secured from the author, McGill University, Montreal.

Electrolytic Purification of Sewage. By F. C. Caldwell, Professor of Electrical Engineering, Ohio State University, Columbus, Ohio; Honorary Member of Ohio Electric Light Association. Paper; 6¼ x 9¼ in.; pp. 7. Address the author.

The-Lakes-to-the-Gulf Deep Waterway. By Wm. A. Shelton. Being a study of the proposed channel, terminals, watercraft freight movement, and rail and boat rates. Paper, 75c.; cloth, $1.00. The author, 6146 Greenwood Avenue, Chicago.

Engineering Index Annual, 1911. 530 pages; cloth; edited and published by The Engineering Magazine, 140-142 Nassau Street, New York. Price $2.00. With this volume (the tenth) a continuous index to the engineering and technical literature of the past twenty-seven years is available.

Utilization of Peat Fuel for the Production of Power. A report by B. F. Haanel, B.Sc., chief of fuel testing division, Mines Branch, Department of Mines; being a record of experiments conducted at the fuel station at Ottawa, 1910-11. Eugene Haanel, director, Mines Branch, Department of Mines, Ottawa.

◆

CATALOGUES RECEIVED.

Cranes, Etc. Herbert Morris, Limited, Empress Works, Canadian office 79 Peter Street, Toronto, forward very complete catalogue covering all the different types of lifting machinery made by them. Catalogue is bound in cloth, 472 pages, and is printed on a heavy enameled paper.

Stump-Pulling Machinery. A pamphlet forwarded by the Clyde Iron Works, Duluth, Minn., entitled "Cutting the Cost of Clearing Logged-off Land." This is a catalogue of stump-pulling and land-clearing machinery placed on the market by this company. The pamphlet is [illegible] attractively printed and illustrated.

Tool Holders, Drills, Etc. Armstrong Brothers' Tool Company, 330-357 North Francisco Avenue, Chicago, Ill., who are manufacturers of tool holders, ratchet drills, drop forged wrenches, etc., forward their catalogue [illegible] illustrating different types of their tools, together with a price list.

Suction Gas Plant. The British-Canadian Engineering and Supply Company, Limited, 122 Phœnix Block, Winnipeg, forward pamphlet entitled "No Power on Earth is Cheaper," being a description of the Ruston patent suction gas plant.

Tar Macadam Highways. The Barrett Manufacturing Company, of New York, Canadian agents, the Paterson Company, Limited, forward reprinted article entitled "Rhode Island's Tar Macadam Highways."

Hammer Drills. The McKiernan-Terry Drill Co., 115 Broadway, New York, forward illustrated catalogue of different types of their "Busy Bee" hammer drills.

Universal Packing. The H. W. Johns-Manville Company forward folder descriptive of their universal packing for use on rods, plungers and pistons.

Turn-Down Lamp. The Canadian General Electric Co., Limited, Toronto, forward folder illustrating a few of the many applications of the "Economical" turn-down lamp.

Modern Welded Pipe. The National Tube Company, of Pittsburg, Pa., have recently issued a book which gives a short history of the industry and considerable information relative to modern tubular products.

Sewer Flushing and Its Cost. A book on sewer flushing and a discussion of the cost of flushing at intervals; includes a discussion on the design of flush tanks. Issued by the Hydraulics Department, Merritt & Company, Camden, N.J.

Freight and Package Handling Machinery. Being Bulletin No. 74, illustrating the different types of freight and package handling machinery manufactured by the Jeffrey Manufacturing Co., Columbus, Ohio.

Motor Locomotives. A pamphlet issued by Ironside, Son & Dyckerhoff, 40 Mincing Lane, London, E.C., illustrating their "New Century" motor locomotives for surface haulages, also railway and passenger services.

Filters. Royles, Limited, Irlam, near Manchester, England, forward a complete set of their catalogues illustrating gravel filters, air heaters, calorifiers, steam traps, valves, etc.

Hydraulic Accumulators. Catalogue No. 84, just issued by the Watson-Stillman Co., and illustrating, tabulating and fully explaining the seven principal types of accumulators which they manufacture. A few pages are devoted also to accumulator accessories and to special hydraulic testing apparatus, reservoirs, etc. 56 pages; 6 in. by 9 in. A copy may be obtained by addressing the Watson-Stillman Co., 50 Church Street, New York.

The Pedestal Pile. The MacArthur Concrete Pile & Foundation Co., of 11 Pine Street, New York City, has recently published a new edition of their book, "The Pedestal Pile." The general layout of the book is the same as that of the first edition, but it contains a number of illustrations and descriptions of work recently completed and also other additions to the text. As the book contains much valuable data on the bearing power of soils, frictional resistance, etc., besides a complete description of the Pedestal Pile and how it is constructed, it should prove of interest to every engineer and architect.

Concrete Bridges. The Universal Portland Cement Company, Chicago, has published an attractive little booklet showing illustrations of a number of different highway bridges and giving a brief description of each. This booklet is entitled "Concrete Highway Bridges."

Appliances for Burning Fuel Oil. The Tate, Jones & Company, Inc., Pittsburg, has published a booklet entitled "Appliances for Burning Fuel Oil," which discusses oil as a fuel and illustrates and describes its various types of oil burners. Pumping systems for pumping, heating and regulating the oil flow to burners are also described.

COAST TO COAST.

Ottawa, Ont.—A sub-committee of the Dominion cabinet council has been appointed to consider the recommendation of the Royal Society of Canada for the establishment of a system of research stations throughout the country.

Vancouver, B.C.—By a vote of 37 to 24 the Vancouver Board of Trade rejected the report of the special committee which recommended that the Canadian Northern Railway be required to pay the city at least $2,000,000 for its terminals at False Creek.

London, Ont.—Scarcity of labor is proving a serious handicap to the extension work now being carried on by the Street Railway Company and they have notified the civic officials that they will be unable to complete their agreement by December 1st.

Saskatoon, Sask.—The Roberts filtration plant recently installed in Saskatoon is giving satisfactory results. The water is not only pure, but the bacterial contents are reduced to an infinitesimal point, with the result that the water is practically sterile.

Province of British Columbia.—The pay-roll of the Canadian Northern Railway for the month of September on account of construction work carried out in this province amounted to $1,454,000. The previous record for abnormal pay-rolls came to $1,100,000.

London, Ont.—Hon. Adam Beck is reported to have said that a friendly suit will be started against the Dominion Government in an endeavor to secure for the Hydro-Electric Commission control of all rivers in the province and of surplus water in the canals.

Athabasca Landing, Alta.—What is reported to be the heaviest flow of natural gas in the Peace River District has been located at this point. A pressure of 600 pounds to the square inch has been recorded so far and great precaution is taken to guard against accidental ignition.

Portage la Prairie, Man.—Mr. Hobbs, a civil engineer of Winnipeg, has arrived here to begin the work of locating a route for the proposed boat canal between here and Lake Manitoba. Some of the deep creeks extending into the prairie from the lake towards this place will be utilized in connection with the scheme.

Fort William, Ont.—The new million-dollar dock of the Canadian Pacific Railway has been placed in commission and the first freighter, laden with coal, will steam up the well-dredged McKellar River. A freighter laden with ten thousand tons of coal can be completely unloaded in ten hours at this new dock.

Outlook, Sask.—The bridge of the Canadian Pacific Railway across the Saskatchewan River at this point was sufficiently completed a day or two ago to allow trains on the main line between Edmonton and Minneapolis to pass. This bridge is a little over three thousand feet long and 156 feet high.

Sydney, C.B., N.S.—The "Duke of Connaught," the large drydock for Montreal, has been safely brought to this port. The trip across the Atlantic was made with difficulty, the towing cables parting five times. On one break the huge dock drifted thirty-five miles before it could be again secured to the tugs.

Quebec, Que.—Word has been received that Mr. Gauthier and Mr. Tremblay, of St. Jerome, Lake St. John, and Mr. Bedard, of Cape Bouge, three members of the expedition sent from Quebec in July by the government to survey the proposed James Bay route, were drowned in the Nottawa River during their journey.

Regina, Sask.—The commissioner of public health of Saskatchewan has strongly recommended the city of Regina to install a chlorinization plant for the purpose of treating the city water. This treatment of water by chloride of lime destroys typhoid bacteria without in any way injuriously affecting the water. While the source of Regina's water supply remains unprotected, it is the duty of the city to thus treat its water supply, thereby making it perfectly safe to drink. The water has been found by the city health officer to be polluted. He has recommended that it be boiled, but this is not always practicable. A chlorinization plant is very inexpensive to install and easy to operate.

Montreal, Que.—Judgment has been handed down by the Public Utilities Commission giving a general approval to the plans submitted by the Montreal Electrical Commission for the placing of the wires on St. Catherine Street, from Guy to Mance, underground. This approval is not, however, final, as certain modifications may be found necessary later, and the Electrical Commission can submit further recommendations and suggestions on which the Utilities Commission may act on its own responsibility without another inquiry. Work will be started next spring, and all the wires on this section of St. Catherine Street are expected to be safely stowed away in the conduit by the end of 1913. The conduits will be under the sidewalk at both sides of the street, ready access being given by large manholes at street intersections, and service manholes for making connections at various points. Sufficient space for all the wires will be provided, the conduits being 26 inches wide and 26 inches high. When the work is finished the appearance of Montreal's great shopping thoroughfare will be completely changed.

Regina, Sask.—Under an amendment to the Public Works Act of Saskatchewan, the Minister of Public Works was given power to make regulations governing townsites and subdivisions, and in accordance with this amendment regulations were brought into force on July 19, 1911. These regulations have undoubtedly accomplished a large amount of good in stopping undesirable subdivisions from going on the market and the selling of lots entirely unsuited for building purposes. The government sees that if a lot is sold a house can be built upon it, that there is proper access to it, and that the land is dry. A school site of at least one acre in every subdivision is insisted upon, and other provisions safeguarding the public interest are inserted in the regulations. The government, however, does not try to force any particular theory of town planning upon those laying out annexes. During the twelve months prior to February 29, 1912, there were 562 plans of subdivisions registered in the survey branch, as against 272 for the previous year. The fees to cover inspection and other services rendered by the department are about $4 per acre, and have resulted in the addition of about $60,000 to the revenue during the past year.

◆

MEETINGS.

UNIVERSITY OF MANITOBA.

Research work was the main theme in an address given by Dr. A. H. R. Buller at the opening session of the University of Manitoba. No university, he stated, could live to itself alone. It would indeed be shameful for the University of Manitoba to acquire all its knowledge from without and to contribute nothing. Besides this, there remained the consideration that the best teaching is always done in an atmosphere of research. To encourage research, professors should be free from lectures for at least half of every day. The question might be asked, what is the practical value of research work? Dr. Buller's reply was that the dollar was not the only form of wealth, and that intellectual wealth is the most valuable possession of any people.

A RECORD IN CONCRETE MIXING.

The rapidity with which concrete work can be done by an experienced gang and efficient machinery is exemplified by the following record recently made by workmen employed by the city of Toronto on Dundas Street, Toronto, using a Koehring No. 14 street mixer, made by the Canada Foundry Company, Limited. Seven hundred bags of cement, each weighing over 87 pounds, were put through the concrete mixer. It was also fed four cars of broken stone. Approximately 235 tons of concrete came out of the other end, and were laid in the roadway. This all happened in a working day of 540 minutes, so that about a ton of concrete was made, handled, and put in place every two and a third minutes. The 235 tons of concrete measured 175 cubic yards. In other words, it would have formed a pillar five feet square and [illegible] feet high—[illegible] feet higher than the Lumsden building.

Placing Concrete on Foundation for Civic Car Lines, Toronto.

◆

GENERAL REQUIREMENTS OF WOOD-PRESERVING OILS.

The value of any creosote as a preservative against decay is fundamentally dependent upon its ability to prevent the development of wood-destroying fungi. This prevention may be accomplished in either of the following ways:

1. By introducing a material sufficiently poisonous to wood-destroying fungi to prevent their development.

2. By introducing a material which will sufficiently exclude moisture so as to reduce the amount of either below that required by the fungi for their development.

In the past the creosotes which have been successful have generally possessed, at least to some extent, both of these properties; but the first is generally considered the more essential. In recent years, however, there has been some tendency to use materials not markedly antiseptic, but primarily intended to exclude moisture. As yet, however, it has not been completely demonstrated, nor generally accepted, that a product can be obtained to fulfil entirely the second requirement.

Aside from these considerations, it is of course essential that the creosote be of such a nature as to remain in the wood for the desired period of protection. In this connection its relative solubility in water and its volatility are important. However efficient it may be in poisoning the food supply or preventing the absorption of moisture, if it will not remain in the wood with a considerable degree of permanence, its ultimate value will be small. Where the treated wood is to be placed in wet situations or under water, as in the case of piling, a soluble preservative is inefficient; and a volatile preservative is especially unsuited for timbers exposed to the air in warm climates.

The relative ease with which a preservative can be injected is of much importance in wood-preserving operations; for this reason a product which is not sufficiently fluid at temperatures which can be conveniently used at commercial treating plants is undesirable. The presence of free carbon is known to decrease the penetrance of creosote and for this reason is objectionable.

◆

AMERICAN MINING CONGRESS.

As a result of the determined campaign for reduced rates to the fifteenth annual convention of the American Mining Congress, which will be held in Spokane, Wash., November 25-20, the transcontinental railroads have announced the following rates: From Missouri River points to Spokane and return, $[illegible]; from Chicago and return, $[illegible]. Tickets on sale November 9, 10, 11, 21, 22 and 23, with final return limit December 31. A rate of one and one-third fares, on the certificate plan, has been granted from local points.

DRAINAGE SCHEMES IN SASKATCHEWAN.

In a country such as the province of Saskatchewan, where the cultivated area is so small a percentage of the total acreage, it might at first sight seem superfluous for the people to spend much money and energy upon reclamation schemes, but the comparatively low cost per acre of such reclamation work, and the great fertility of what would otherwise be waste land, render such schemes very attractive.

Prior to the passage of the Drainage Act of 1909, the only drainage schemes in the province were built directly by the government out of the general revenue funds. The Act is now becoming more widely known amongst the agricultural community, and as a result there are several propositions under way at the present time. The following is a brief epitome of the working of the Act.

A petition to the government is prepared, which must be signed by resident owners representing at least one-half of the lands of resident owners. Upon receipt of the petition an engineer is appointed to prepare plans, estimates, and a report upon the feasibility of the scheme. When the report has been received and the plans examined, the whole must be submitted to the Lieutenant-Governor-in-Council for his approval. If approved, the next step is to advertise that it is the intention of the government to proceed with the work under the Drainage Act. The cost of the ditch is assessed against all the lands benefited. The signers of the petition have the privilege of withdrawing for any sufficient reason, such as, for instance, that the scheme is to cost more than they anticipated. After these withdrawals, if half the land of resident owners is not still represented, then no action takes place and the scheme falls through, otherwise the government proceeds to issue debentures, running for a term of from 20 to 35 years, to be retired by the assessments which are collected by the municipality.

There is no doubt that in course of time the Act will be more and more widely taken advantage of. The adoption of the Act not only gives a legal right to enter upon land and construct a drain, but renders possible very valuable reclamation work which would probably be beyond the means of a municipality or of any private company of settlers.

The drainage schemes mentioned here are all of them under way, and on some of them a large amount of construction work has already been done. There is the Egg Lake drain in township 20 range 15 west of the second meridian; a very large scheme near Invermay; one at Rama, and another near Shellbrook. The largest scheme of all is the reclamation of flooded lands southwest of Rouleau. It is estimated that this proposition will cost in the neighborhood of $40,000, but if carried out in its entirety will result in the reclamation of from thirty to forty thousand acres of land.

◆

MODULI OF ELASTICITY.

In a paper recently read before the Society of Engineers, Professor F. H. Hummel gives values of Young's modulus for a number of materials, as the result of experiments made on the flexure of thin strips:

Material.	E. Lb. per Sq. In.
Celluloid (1)	347,500
Celluloid (2)	547,000
Drawing-paper (in direction of rolling)	304,000
Drawing-paper (across direction of rolling)	581,500
Thick stiff paper	852,000
Box-wood	174,000
Whalebone	503,000
Copper	15,000,000
Brass	11,600,000
Aluminum-nickel alloy	10,000,000

PERSONAL.

MR. C. DURBAN, of the main drainage department, city of Toronto, has been appointed assistant city engineer of London.

MR. REGINALD A. DALY, formerly of Napanee, Ont., has been appointed head of the Geological Department of Harvard University, Cambridge, Mass., U.S.A.

LIEUT.-COL. GEORGE W. STEPHENS, chairman of the Montreal Harbor Board, in a letter to the Hon. G. D. Hazen, Minister of Marine and Fisheries, announces his resignation from the board.

MR. HARRY ANGUS, B.A.Sc., consulting engineer, Confederation Life Building, Toronto, has given up his practice and gone in with the Canadian Domestic Engineering Company, at their Toronto office.

MR. R. W. BROCK, director of the Canadian Geological Survey, visited Rossland, B.C., on his way east from Victoria, where he had been attending the British Columbia meeting of the Canadian Mining Institute.

MR. C. C. KRONK is in collaboration with Mr. Wynne-Roberts upon the question of development of electrical power for the province of Saskatchewan, and is making investigations into the possibility of economical transmission of such power.

MR. R. E. CHADWICK, who has been recently appointed as eastern manager in charge of the Montreal office of the Foundation Company, Limited, and who succeeded Mr. Alexander Allaire in that position, was born in Toronto. He is an honor graduate of the University of Toronto in mechanical engineering in the class of 1906. Mr. Chadwick was bridge engineer for the city of Toronto during 1909-10. He joined the Foundation Company, of New York in the first part of January, 1911, as superintendent on the Woolworth Building. In May, 1911, he joined the Foundation Company, Limited, of Montreal, Canada.

Mr. R. E. C. Chadwick.

DR. W. W. ANDREWS has been engaged in determining how the gumbo soil, found in some parts of the province of Saskatchewan, can be best treated to render it fit for road traffic. The work is being done under the Board of Highway Commissioners of the Province.

MR. M. J. BUTLER, general manager of the Dominion Steel and Coal Company, has resigned his position. Mr. Butler, as is well known, was deputy minister and chief engineer of the Department of Railways and Canals from 1905 to 1907 at Ottawa, when he was appointed to the general managership of the Dominion Steel Corporation. It is not known what he has in mind, although it is reported that he will become connected with another large undertaking.

MR. L. O. BEAM has resigned the position of inspector of public works of the province of Saskatchewan and has joined the staff of the R. J. Lecky Company. Mr. Beam was a bridge foreman under the old Territorial Government, whose outside staff he joined in 1889. He was afterwards in charge of ferry construction, and was appointed inspector of public works on the inauguration of the province in 1905. As a thoroughly practical man, with a thorough knowledge of all kinds of steel construction work, Mr. Beam's loss is a serious one. No successor has as yet been appointed.

MR. R. O. WYNNE-ROBERTS has been investigating since July 1st the lignite coal fields of Saskatchewan, in order to ascertain the feasibility of the generation of power and the distribution of it throughout the southern part of the province. Mr. Wynne-Roberts was city engineer of Cape Town during the Boer war, and was a consulting engineer in London, England, for some years. Since coming to Canada he made an inquiry into the water supply of the city of Regina.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Monthly Meeting will be held in the Rooms of the Society, 413 Dorchester Street West, Montreal. [illegible] Chairman Henry Holgate.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; [illegible]

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

[illegible] a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the [illegible]

[illegible] Building, Vancouver, B.C. Headquarters: McGill [illegible]

[illegible]

[illegible]

MUNICIPAL ASSOCIATIONS

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, [illegible] P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, [illegible] Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; [illegible] Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. [illegible] Hon. Secretary, Alcide Chaussé, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, [illegible] Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan [illegible] Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
10-24	Construction of about 7¾ miles of Combined Sewers, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 10,400 ft. reinforced concrete pipe, New Westminster, B.C. ....(P. & S.)	10-10
10-24	Supply of 1,660 ft. of 48" steel pipe, bends and specials, New Westminster, B.C. ...(P. & S.)	10-10

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work	Tenders Close.	Issue of.	Page
Cap-a-l'Aigle, P.Q., extension to wharf	Nov. 11.	Oct. 17.	65
Grimsby, Ont., public building	Oct. 30.	Oct. 10.	67
Isle aux Coudres, P.Q., extension to wharf	Nov. 5.	Oct. 17	65
London, Ont., bridge over Thames River	Nov. 13.	Oct. 17.	74
Midland, Ont., public building	Nov. 5.	Oct. 24.	65
Ottawa, Ont., designs for monument	Nov. 1	Aug. 1.	67
Ottawa, Ont., conveyance of H.M. mails	Nov. 29.	Oct. 24.	74
Point Grey, B.C., steel pipes	Dec. 2.	Oct. 17.	74
Quebec, P.Q., grain elevator	Nov. 30.	Oct. 17.	76
Rimouski, Que., wharves and dredging tidal basin	Nov. 21.	Oct. 24.	65
Seal Cove, N.B., breakwater wharf	Oct. 30	Oct. 10.	68
St. Boniface, Man., motor and pump	Nov. 8	Oct. 17.	76
St. John, N.B., wharf	Nov. 1.	Oct. 24.	65
St. Victoire, Que., wharf	Nov. 11.	Oct. 24.	65
Toronto, Ont., Long Branch Rifle Range	Nov. 4.	Oct. 24.	76
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., Fire Department apparatus	Nov. 13.	Oct. 17.	66
Winnipeg, Man., extension of water works	Nov. 15.	Oct. 24.	74
Yorkton, Sask., Fire Department apparatus	Nov. 4.	Oct. 17.	66
Yorkton, Sask., electrical plant	Oct. 31.	Oct. 3.	76
Yorkton, Sask., auto fire truck	Nov. 12.	Oct. 24.	74

◆

TENDERS.

Albert, N.B.—Tenders for the construction of a wharf with approach and a bed for vessels, at Albert, Albert Co., N.B., will be received until November 18, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Specifications, etc., at the office of that department, and at the offices of F. G. Goodspeed, Esq., district engineer, St. John, N.B., and on application to the postmasters at Albert, N.B., Moncton, N.B., Hillsboro, N.B., and Sussex, N.B.

Bassano, Alta.—The corporation of the town of Bassano, Alta., invite tenders, to be received until November 18th, 1912, for labor and materials required in connection with the waterworks system. Geo. B. R. Bond, secretary-treasurer. (See advt. and full particulars elsewhere in The Canadian Engineer).

Brandon, Man.—Tenders will be received at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until November 6th, 1912, for the construction of horse stable, Experimental Farm, Brandon. Plans, etc., at the office of Mr. H. F. Matthews, Architect, Winnipeg; the Superintendent, Brandon Experimental Farm, and at the office of the Secretary.

Cherhill, Alta.—Tenders for the erection of a school house in School District No. 2735, will be received until October 30th, by John Seedhouse, Secretary, Cherhill, Alta.

Dunnville, Ont.—Tenders for one steel elevated tank of 100,000 imperial gallons' capacity, will be received until November 11th, 1912, by B. L. Edgecombe, Chairman of Water commission. Alan Mair Jackson, superintendent. (See advt. in The Canadian Engineer).

Kamloops, B.C.—Tenders will be received up to noon of November 14, 1912, for the construction of intake dam and flume system for the proposed hydro-electric power plant on the Barriere River. Plans and specifications may be seen at the office of the City Clerk, Kamloops, and at the office of DuCane, Dutcher & Co., consulting engineers, Suite 911-914 Rogers Building, Vancouver, B.C. J. J. Carment, city clerk.

Kindersley, Sask.—The corporation of the town of Kindersley, Sask., invite tenders for all labor for constructing steel water supply main and distribution system, consisting of about 3 miles of 10-inch to 4-inch pipe, with specials, valves and hydrants, and to be completed July 1st, 1913. Tenders to be received until October 31st, 1912. D. MacTavish, Secretary-Treasurer.

Ottawa, Ont.—Tenders for the supply of sorting cases for post offices, and tenders for rural mail sorting cases for postal service, will be received until October 30th, 1912. Plans, etc., at the office of Mr. T. A. Hastings, Clerk of Works, Postal Station "F," Toronto, Ont., and at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders for the re-erection and completion of a Lobnitz rock breaker, will be received until November 14, 1912, at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa. Plans, etc., at the office of the secretary, and at the offices of T. H. Schwitzer, Esq., mechanical superintendent, Birks Building, Ottawa, Ont.; and C. E. W. Dodwell, Esq., district engineer, Halifax, N.S.

Paris, Ont.—The time for the reception of tenders for additions and alterations to public building, Paris, is extended to Monday, November 4th, 1912. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received until November 5th, 1912, addressed to the Chairman of the Board of Control, City Hall, for gradings, concrete walks, sewers, and supplying of 30-inch cast iron pipe, on a number of streets in the city of Toronto. Specifications may be seen at the office of the Commissioner of Works, Toronto. H. C. Hocken (Mayor), chairman, Board of Control, City Hall, Toronto.

Toronto, Ont.—Tenders for the installation of one or more fifteen million imperial gallon pumping engines and boilers at the main pumping station, will be received until noon of December 10th. Specifications, etc., may be obtained on application at the office of Mr. James Milne, mechanical and electrical engineer, Department of Works, City Hall, Toronto. H. C. Hocken (Mayor), chairman, Board of Control, City Hall, Toronto. (See advt. in Canadian Engineer.)

Winnipeg, Man.—Tenders for 17 library bookcases required in connection with the St. John's and Kelvin Technical High Schools will be received at the office of the Winnipeg School Board until November 7th, 1912. Full particulars may be had from J. B. Mitchell, Commissioner of Supplies.

Winnipeg, Man.—Tenders addressed to the Chairman, Board of Control, will be received until October 31st, for supply of labor and materials required in the excavation of earth for an 18,000,000-gallon reservoir. Plans, etc., at the office of the City Engineer, 223 James Avenue. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders addressed to the chairman, Board of Control, will be received at the office of M. Peterson, secretary, Board of Control office, Winnipeg, until November 8th, 1912, for supply of twenty-five 36-inch gate valves for the domestic water works system. Specifications, etc., at the office of the City Engineer, 223 James Ave.

◆

CONTRACTS AWARDED.

Beaverton, Ont.—Construction of breakwater, sheet piling and dredging: Contract given to D. Conroy, Esq., of Peterboro, Ont., at $41,874.

Fairhaven, Deer Island, N.B.—Construction of public wharf: C. A. Huntley, Esq., of Parrsboro, N.S., at $5,750.

Fort William, Ont.—Dredging: The Great Lakes Dredging Co., Ltd., of Port Arthur, at 25c. per cubic yard, place measurement.

Lanoraie, Brethier Co., P.Q.—Partial reconstruction and extension to wharf: Contract given to Arthur Taigneault, of Longueuil, P.Q., at $6,345.

Lethbridge. Alta.—The contract for the building of the Empress Theatre on Fifth Street, has been let to Messrs. Smith Bros. & Wilson. The building will cost $25,000.

Massett, B.C.—Contract for the construction of wharf here has been awarded to W. G. Gillett, of Vancouver, at $4,875.

Niagara Falls, Ont.—The contract for the installation of a new centrifugal pump has been awarded to the Canada Foundry Company, of Toronto, their contract price being $5,700. Tenders were also received from the following:—Messrs. Escher Wyss & Co., Montreal; John Inglis Co., Toronto; Buffalo Steam Pump Co., Buffalo; John McDougall Iron Works, Montreal; Drummond McCall Co.

Port Arthur, Ont.—The Canadian Stewart Co. are reported to have [illegible] the contract for [illegible] eight story building. Excavation has been begun.

Regina, Sask.—Messrs. Lyall-Mitchell Company were the successful tenderers to bid for the work of erecting a new warehouse for the H. G. Smith Company, Ltd. The cost of this work will be $[illegible]. The construction will be of [illegible] mill method.

Seaforth, N.S.—The Dominion Government has awarded a contract to the [illegible] Co. for the construction of a breakwater at this point to cost $[illegible].

◆

RAILWAYS STEAM AND ELECTRIC

Edmonton, Alta.—The directors of the Edmonton Interurban Company have commenced construction operations on an electric line from the city to St. Albert, a distance of [illegible] miles. This company, organized by Canadian and French capitalists and has a charter which empowers it to construct and operate about [illegible] miles of electric lines in the province of Alberta. Mr. [illegible], of Paris and Vancouver, is the representative for the French investors and [illegible], consulting engineer, is in charge of construction work.

Regina, Sask.—The Grand Trunk Pacific will build a [illegible] mile spur to connect Regina with the present line from [illegible], which runs southward to the international boundary and links up with the Great Northern.

LIGHT, HEAT AND POWER.

Brantford, Ont.—The ratepayers carried the hydro-electric by-law with a majority of 248. This calls for an expenditure of $115,000. T. H. Jones, city engineer.

Toronto, Ont.—Street lights will be erected on both sides of the Lake Shore Road from West of Keele Street to Sunnyside railway crossing.

Vancouver, B.C.—The following tenders have been received by the corporation council for the installation of lighting facilities on several streets.

Main Street—Standard Engineering Company, $7,490; Electrical Construction Company, $5,256; Mather, Yuill & Company, $5,307; M. P. Cotton Company, $7,899; Hudson Brothers, $7,333; Waugh, Misener and Bailey, $3,850.

Granville Street—Standard Engineering Company, $4,930; Electrical Construction Company, $3,650; Mather, Yuill & Company, $3,704; M. P. Cotton Company, $5,385; Hudson Brothers, $7,333; Waugh, Misener and Bailey, $3,850.

Carrall Street—Standard Engineering Company, $10,700; Electrical Construction Company, $7,527; Mather, Yuill & Company, $7,641; M. P. Cotton Company, $10,695; Hudson Brothers, $7,333; Waugh, Misener and Bailey, $3,850.

Hastings Street East—Standard Engineering Company, $6,850; Electrical Construction Company, $4,001; Mather, Yuill & Company, $4,216; M. P. Cotton Company, $6,180; Hudson Brothers, $4,359; Waugh, Misener and Bailey, $3,850.

Victoria, B.C.—The management of the British Columbia Electric Company have decided on a further expenditure of $1,500,000 to bring the capacity of the Jordan River plant up to 24,000 h.p. This is in addition to the increase that has just been commenced.

◆

GARBAGE, SEWAGE AND WATER.

Niagara Falls, Ont.—Notice of a by-law to build a trunk sewer along Muddy Run, has been given to the city council, Mr. J. C. Gardner, City Engineer.

Toronto, Ont.—The municipal controllers have had submitted to them the specifications of the new $350,000 pumping equipment to be installed in the main pumping station. Commissioner Harris will call tenders in a short time if the plans meet with the approval of this body.

Winnipeg, Man.—Col. Ruttan, city engineer has estimated the cost of a new reservoir to be erected on Logan Avenue West, to be $532,000. Tenders for the excavation work are to be called in a few days.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Calgary, Alta.—A party of Vancouver capitalists are about to erect a factory in this city for the manufacture of paper from waste straw. This plant will cost about $75,000.

Fort William, Ont.—As soon as plans are passed the Canadian Northern Railway will erect a station in this city to cost about $20,000.

Fort William, Ont.—Alderman O'Donnell, of the municipal council, is advocating the erection of a civic rock crushing plant for use in the various paving works to be carried on by the city.

Guelph, Ont.—Dr. Howitt, medical health officer, has recommended the erection of a civic rendering plant to cost $1,500.

Guelph, Ont.—A report states that the management of the Page Hersey Company, will increase the capacity of their pipe mills by the addition of a $[illegible] plant, providing that satisfactory arrangement regarding a fixed assessment can be concluded with the civic officials.

Medicine Hat, Alta.—The directors of the Medicine Hat Rolling Mills, at a meeting held recently, decided to commence building operations at once. Messrs. A. J. Scott and B. Shragge, of Winnipeg, Manitoba, are interested in the project.

Montreal, Que.—A new $5,000,000 plant for the manufacture of steel barrels and commercial packages is to be

Tarvia

Preserves Roads
Prevents Dust—

Section of Government Parkway, Ottawa, Canada, treated with Tarvia B.

The Property Owners' Investigation.

IN the City of St. Thomas, Ont., the property owners on Gladstone Avenue contemplated petitioning the City Council to improve the roadways. They commissioned one of their number to visit various American cities, inspect pavements and make a report. Their investigator, Mr. E A. Horton, visited various cities in New York and New Jersey. In his report he made the following statements:

"I saw a 'Tarvia X' road in Rochester which extends from the city to the lake front, a distance of about six miles. It had been in use for eighteen months, and when I saw it, it was in excellent condition, with heavy traffic over it every day. I........inspected a piece of road in Newark........the surface when finished was smooth, and to my mind was one of the finest pieces of road it was my privilege to see. We then inspected another piece of 'Tarvia X' which had been done by the Road Commission two years ago........Constant heavy traffic passes over this road every day, and trucks have loads of from 6 to 8 tons. Steel-tired drays were used with most of their heavy traffic. This piece of road, as I saw it, did not show any wear whatever, and was apparently in as good condition as when it was put down.

"I did not confine my attention to Tarvia roads as I saw (here he mentioned five of the commonest types of road treatment) and every other kind of road that is known.

"I must say after making enquiries from people who were in no way interested, nor did they know I was seeking information, that everyone had a good word to say for the Tarvia road. I have no hesitation in recommending it for use on our street, and at the estimate cost that has been given us, after seeing the many pieces of road that I have seen, I think it is the cheapest road that can be built."

The foregoing is quoted from the St. Thomas, Ont., Journal on February 20th, 1912. Since that date Gladstone Avenue has been constructed with Tarvia X.

Anyone who will investigate the road problem with the same thoroughness will reach similar conclusions. Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B" (applied cold) for dust prevention and road preservation.

Booklet describing the latest developments in methods for building tarviated roadways and pavements will be sent free on request. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

erected near Montreal, a group of influential Canadians, including Sir William Van Horne, Sir William Mackenzie, and Messrs. George F. Johnston, C. W. McLean, and J. Wesley Allison, having secured from the Steel Package Company of New York the patents to carry on the business in Canada. The new concern is to be known as "The Canadian Steel Package Company," and it is probable that Sir William Van Horne will be the first president.

Montreal, P.Q.—Mr. L. G. Read, consulting engineer and financier, is at the head of a recently formed syndicate that propose to erect a number of large buildings on the water front of this city and rent out various spaces to manufacturers for the carrying on of their business.

Ottawa, Ont.—The management of the Ottawa Electric Railway Company have received a permit for the erection of a $25,000 addition to the car barns on Coburg Street.

Ottawa, Ont.—The management of the Merchants Bank of Canada will erect a tall office building in this city. It will be 8 story in height and will be erected on the lot now occupied by the Seybold building.

Port Arthur, Ont.—W. H. Nelson has commenced the construction of a 2-story block at corner of Cumberland St. and Cameron St. Estimated cost $30,000. J. E. Jenkinson, contractor.

Port Arthur, Ont.—The Industrial department of the municipality state that a large plant for the manufacture of wire, nails, fencing, etc., will be established in this city. Messrs. Swimmerton and Bruitnel, Montreal, are acting for the interested parties in the preliminary stages of the proposition.

Preston, Ont.—The council will ask the ratepayers to vote on an industrial by-law in connection with the locating in this town of a large industrial manufacturing concern. The names of the interested parties are not made public.

Prince Albert, Sask.—Mr. H. C. Struchen, of Minneapolis, U.S.A., has completed all arrangements with the municipal council for the erection of a $250,000 pulp and paper mill.

St. Thomas, Ont.—The Industrial Committee have appointed a committee to make a thorough report on the standing of a Detroit shoe manufactory that desire to locate in this city. Ald. Saunders is a member of the committee.

Toronto, Ont.—The municipal board of control have received an offer to rent the property now occupied by the Bay Street fire hall. It is reported that a syndicate headed by ex-alderman Norman Heyd will erect a tall office building if the terms of the agreement meet with the approval of the [illegible]

Vancouver, B.C.—Mr. J. W. Weart, is forming a company [illegible] 15 story [illegible] building in this city, to be completed by April 1914. The cost of this work is placed at $700,000 and already the directors of the scheme are considering the calling of tenders and other building materials that will require time for delivery.

◆

BRIDGES, ROADS AND PAVEMENTS.

Galt, Ont.—[illegible] the ratepayers of Galt will [illegible]

Hamilton, Ont.—[illegible]

Niagara Falls, Ont.—[illegible]

St. Boniface, Man.—[illegible]

CURRENT NEWS.

Haileybury, Ont.—The plant of the Energite Explosive Company, at this point was destroyed by an explosion the force of which gave the entire town a severe shaking up.

Montreal, P.Q.—Chief Tremblay, of the Montreal Fire Brigade, has recommended that the civic officials purchase a fire boat for the protection of the rapidly growing harbor of this city.

Preston, Ont.—A report states that the management of the Preston Car and Coach Company, Preston, Ont., have made an offer to the Toronto city council to build the cars required for operation on the proposed civic car lines.

Regina, Sask.—It is reported that an early start will be made on a hotel for the Grand Trunk Pacific Railway costing $1,000,000.

St. Lambert, P.Q.—The following tenders have been received for the construction of an outfall sewer:—Superintendent of works, $75,070.76; C. J. Wills (Montreal and London, Eng.), $76,000; A. S. Dickison, $79,100; T. Guay, $80,332; J. Jackson, $85,000. Eight applications for specifications, etc., had been received. The original estimate for the work was $99,622.60, which included a 10 per cent. contingent. To each of the above contracts must be added $18,580.80 for pipes to be supplied by the town, and $195.95 for manhole covers. The award has not yet been made.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending October 14th, 1912:—

A Lancashire firm make inquiry for the names of Canadian firms able to supply short-end lumber in 500 and 1,000-ton lots, suitable for the box-making trade.

A Dundee firm manufacturing jute cloth, burlaps, etc., used for packing and covering purposes, desire to appoint agents at Berlin, (Ont.), Hamilton and Toronto.

A London correspondent is commissioned to arrange for the Canadian representation of a United Kingdom firm of machinery manufacturers, and would like to hear from reliable firms in the Dominion.

From the branch for city trade inquiries, 73 Basinghall Street, E.C.

A Scottish firm manufacturing household and toilet ammonias and liquid cleansers, wish to arrange with some resident Canadian firm who cover the whole of Canada to introduce their specialties.

A London firm manufacturing building specialties, and more particularly a novelty in flooring tiles, wishes to be placed in touch with Canadian resident firms who could handle these lines.

A London firm are desirous of getting into touch with firms handling Canadian chrome ores (50 per cent. Cr_2O_3).

◆

BUILDING PERMITS IN CANADA.

The building permits for forty-nine cities and most of the larger towns has been estimated for the past twelve months, and makes a total of $[illegible]

◆

HEATING AND VENTILATING DESIGN.

The Federal Government has appointed the Canadian Domestic Engineering Company of Toronto, Winnipeg and Montreal, as consulting engineers for the heating, ventilating, plumbing and electrical work for the Calgary Examining Warehouse, and also for the Toronto Military Barracks. The warehouse will probably cost about $[illegible] total, and the barracks will cost about $[illegible]. The barracks is said to be the first of a group of buildings which it is claimed the government will build at Toronto at a cost of about $[illegible]

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

CONTINUOUS STAVE PIPE

RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

DEPT. OF RAILWAYS AND CANALS, WELLAND

Superintending Engineer's Office,
Messrs. Wettlaufer Bros., St. Catharines, Feb. 7th, 1912.
No. 178 Spadina Ave., Toronto.

Dear Sirs :—Replying to yours of the 6th, I beg to say that the two Mixers received from you last summer proved to be very handy, useful machines. They turned out excellent concrete and we had no trouble with them at all.

Yours truly, J. L. WELLER, Superintending Engineer.

CANADIAN NORTHERN RAILWAY

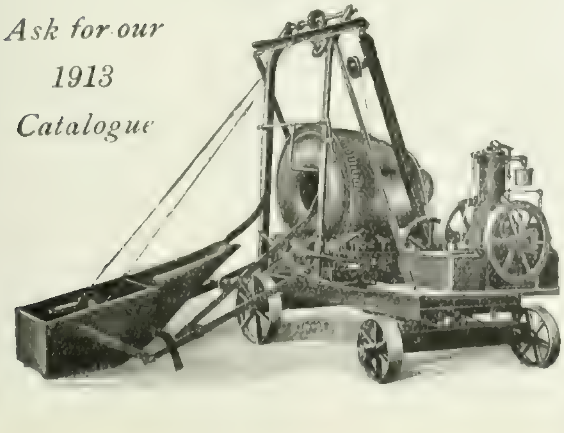
Belleville, Ont., Feb. 14th, 1912.
Wettlaufer Bros.,
178 Spadina Ave., Toronto, Ont.

Dear Sirs :—I think it is my duty to inform you that I am entirely satisfied with the two Concrete Mixers purchased from you last season. I have tested them in every way possible, and in every case I have found them capable of doing first-class work. Yours sincerely, J. O. GIROUX.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

Compare the thoroughness, simplicity and durability of our mixer with other makes. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing and the saving of power.

Ask for our 1913 Catalogue



WETTLAUFER BROS.

Head Office and Ware-rooms

178 SPADINA AVENUE,

WORKS AT MITCHELL, ONT. **TORONTO** DETROIT, MICH. BUFFALO, N.Y.

HOOTON & MOORE, 613 Ashdown Block, Winnipeg
LAVALLE-ROSS, Alexander Block, Edmonton, Alta.
A. R. WILLIAMS MACHINERY CO. 15 Dock St., St. John, N.B.
WETTLAUFER BROS., 316 Lagauchetiere St. W., Montreal, Que.

CLASSIFICATION OF CLAYS.

Considering the different ways in which clays have been formed, it is possible to formulate the following classification, based primarily on their origin, and also bringing out, somewhat, their commercial characters. This classification is abstracted from a preliminary report on the clay and shale deposits of the western provinces by Heinrich Ries and Joseph Keefe, of the Geological Survey Branch, Canada, Department of Mines. Examples are given where known in the western provinces.

A. Residual Clays. (By decomposition of rocks in place).

I. Kaolins or china-clays. (White burning, and derived from igneous or metamorphic rocks low in iron oxide).

(a) Vein-like deposits derived from pegmatite veins, or dykes of igneous rock, such as rhyolite.

(b) Blanket deposits, derived from extensive areas of igneous rock. (Kyuquot, Vancouver Island).

(c) Pockets in limestone, as the indianaite of Indiana, U.S.A.

II. Red-burning residuals, derived from different kinds of rocks. These may be formed by the decomposition of such rocks as granite, by a process of solution as in limestone, or by simple disintegration as in many shales.

B. Colluvial Clays, representing deposits formed by wash from the foregoing, and of either refractory or non-refractory character. (Field, B.C.).

C. Transported clays.

I. Deposited in water.

(a) Marine clays or shales. Deposits of ten of great extent. (Pierre shales)

White burning clays. Ball clays and plastic kaolins.

Fireclays or shales. Buff burning. (Dirt hills, Sask., and Clayburn, B.C.).

Impure clays or shales (Calcareous, Niobrara shales, Non-calcareous, Coleridge, Sask., shale).

(b) Lacustrine clays (deposited in lakes or swamps).

Fireclays and some shales.

Impure clays or shales, red-burning. (Edmonton shales).

Calcareous clays, usually of surface character (Cochrane, Alta., clay).

(c) Flood-plain clays. Usually impure and sandy. (Edmonton, Alta.).

(d) Estuarine clays (deposited in estuaries). Mostly impure and finely laminated. (New Westminster, B.C.).

[illegible]

Boulder clay. (Estevan, Sask.)

◆

POLES USED IN CANADA, 1911.

[illegible] over 21 per cent. of the total number were treated by the creosote or other methods. This is an increase of some forty-five per cent. over the number treated in 1909. At present the United States have a large number of timber-treating plants, while Canadian pole-users are only now beginning to treat their poles. It is to be hoped that this great inequality will soon be done away with and that pole-users in Canada may take up this cheap and rational method of securing greater service from the poles used and thus lessening the drain on the forest.

◆

CONDITIONS IN VANCOUVER.

Figures for the past month showing the activity along various lines in Vancouver may not appear so large in comparison with those of the same month of a year ago. It must be remembered that for many months this city's statistics were higher than those of all cities in Canada, and of all except the very largest cities in the United States. This could hardly be maintained, and if figures now show a falling off in percentage it does not indicate that a slump has occurred. Conditions on the coast have been somewhat peculiar during the past summer. Work has been active in every line of industry, perhaps more so that for some years past, yet actual money has been scarce. In past seasons there was often some disturbing influence. Perhaps it was a difference between employers and employees, with a cessation of labor as a result, or it might have been a slackness in the demand for a commodity that British Columbia produces.

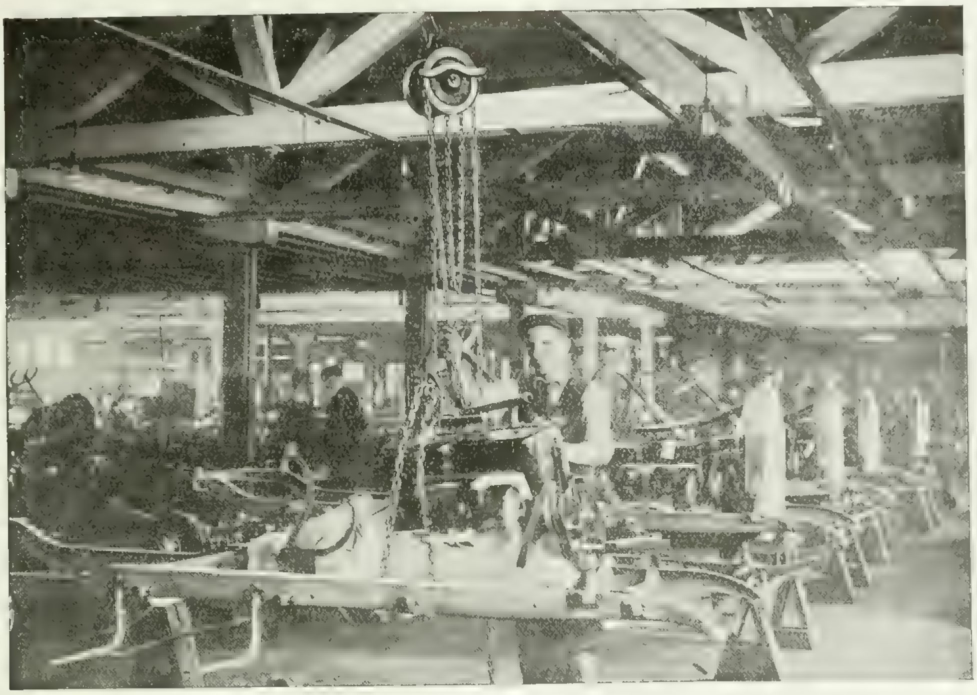
This year it has been all the other way. The price of copper has been better than for a long time past, and metalliferous mines in the southeastern part of the province, and on the coast, have been in active operation. In the lumber industry, there has been a strong demand locally and foreign. Railway construction has been proceeding on a large scale all over the lower and upper mainland and on Vancouver Island, and a very large amount of money must have been put in circulation owing to this work, both in wages and supplies. Yet money has been scarce for four months past, and big firms which usually are not affected by these temporary stringencies, have had to resort to paper. The cause of this is said to be the numerous real estate subdivisions, which have taken a large portion of the ready money and diverted it into a few hands. Rather than forfeit payments, buyers have let merchants' accounts stand, and this has meant that other dealers have missed the circulation of the cash. The good conditions of the past few months are continuing and business is opening up better, and with a good crop on the prairie the outlook is exceedingly satisfactory.

Negotiations between Vancouver city council and the Canadian Northern are proceeding, and have reached the stage where the agreement as completed in committee will be submitted to the city council. The city has been successful in securing many of the concessions asked for, and the railway company's representatives, while not disguising the [illegible] Creek, have made very reasonable allowances. Already the ratepayers in one section of the city, through an association meeting, have approved of the plan as drafted, which indicates the satisfactory [illegible]

◆

[illegible] Montreal.

THE TRIPLEX BLOCK



Placing engine in chassis with a half-ton Triplex Block.

A 100-page Book on Hoists

Practical engineers are all agreed that radical cuts in cost can be brought about by solving hoisting problems. Such problems are not solved satisfactorily by heavy cranes which do not give continuous service. A load that is waiting to be moved is costing money just as much as a load which is taking a gang of workmen to move.

A hoisting problem is not solved until each workman can readily lift and transport any load, single handed, that comes to him.

The new Book of Hoists shows examples of hand and power hoisting and overhead apparatus for conveying in model plants, here and abroad. The information is the most complete we have ever published. We will be glad to send a copy free on request.

Triplex Blocks; **16 Sizes:** One-quarter of a ton to forty tons. **300 Active Stocks** all over the United States. **Every Block Tested to 50 Overload.**

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for a small fee.

[illegible]—October [illegible]—Authorizing C.L.O. & W. (C.P.R.) to construct across [illegible] road in Lot 25, Con. 7, Tp. Camden, Co. Lennox and Addington, Ont., mileage [illegible] from Glen Tay, [illegible] a bridge.

17766—October 16—Authorizing C.P.R. to construct spur for Great Western Lumber Co., Ltd., at Red Deer, Alberta.

17767—October 16—Authorizing C.P.R. to construct spur for the Dodge Manufacturing Co., Ltd., at West Toronto, Ont.

17768—October 16—Authorizing C.P.R. to open for traffic second main line track between Adirondack Jct., and St. Constant, Que., distance of about 4.70 miles.

17769—October 14—Authorizing G.T.P. to carry traffic over its railway in [illegible], between mileage [illegible] and mileage [illegible], east of Prince Rupert.

17770—October 15—Authorizing G.T.P. to construct spur to serve city of Edmonton Yards, Edmonton, Alberta.

17771—October 16—Allowing correction of errors in plan of location of Tofield-Calgary Branch of G.T.P. Branch Lines Co., from Sec. 21, Tp. 29, R. [illegible], W. 4 M., to Sec. 1, Tp. 2[illegible], R. 1, W. 5 M., Dist. South Alberta, Alta., [illegible] to mileage 1[illegible] (approved by Order No. [illegible]).

[illegible]—October [illegible]—Authorizing G.T.R. to construct siding for the Massey-Harris Co., Ltd., in city of Toronto, Ontario.

[illegible]—October 14—Authorizing Esquimalt & Nanaimo Ry. Co., to construct spur for D. McKenzie, in city of Victoria, B.C.

[illegible]—October [illegible]—Authorizing Municipality of Tp. Barton and the Hamilton City and Suburban Homes, Ltd., to construct Rosedale Ave., at grade, across [illegible] line of T.H. & B. Ry.

[illegible]—October [illegible]—Authorizing C.P.R. to construct bridges Nos. 24.2 and 24.1 on its Toronto Subdivision, over Otonabee River.

17776—October 16—Authorizing C.L.O. & W. (C.P.R.) to construct bridge at mileage 130.21 across road allowance between Lots 18 and 19, Con. [illegible], Tp. [illegible] Hope.

17777—October 16—Authorizing Can. Nor. Alta. Ry. to construct across G.T.P. Ry. [illegible] N.E. ¼ Sec. [illegible], Tp. [illegible], R. 1, W. 5 M., Alta., by means of structure carrying its railway under G.T.P.

17778—October 17—Authorizing C.N.R. to construct Prince Albert-Battleford Line across [illegible] highways in Prov. Saskatchewan.

17779—October 17—Authorizing C.N.Q. Ry. to construct across public road in village of St. Eustache, between Lot 51, Parish St. Eustache, and Lot [illegible], village of St. Eustache, Co. Two Mountains.

17780—October 17—Authorizing G.T.P. Ry. to carry traffic on its Moose Jaw Branch between Regina and Moose Jaw, in Prov. of Saskatchewan, [illegible]

17781—October 16—Postponing effective date of Order No. 17552, dated September 21st, 1912, directing G.T.R. to restore proportion, namely 88 [illegible] Bradford, [illegible]

17782—October 17—Authorizing C.N.O.R. to construct across public [illegible]

[illegible] C.N.O.R. [illegible] St. Lawrence Boulevard and St. Denis Boulevard, in city of Montreal, by means [illegible]

[illegible] Railway to take [illegible] Ry.

[illegible]

[illegible] press Co.'s delivery limits in city of Halifax, N.S., be enclosed by water front as north-westerly boundary from east end of Miller St., from south [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

17796—October 18—Approving C.L.O. & W. (C.P.R.) plan of undercrossing at mileage 1[illegible].48, between Cons. 3 and 4, Tp. Pickering.

17797—October 17—Approving V.V. & E. Ry. & Nav. Co. plan showing additional land required for the accommodation of its slopes and bridges over Sumas River, British Columbia.

17798—October 19—Approving C.N.O.R. location through unsurveyed territory in Dist. Thunder Bay, mileage 398 to mileage 413, from Sudbury Junction.

17799—October 19—Approving G.T.P. station site and station at Tete Jaune, Dist. Fort George, B.C.

17800—October 17—Approving James Bay and Eastern Ry., location of station grounds at Pointe Bleue, Tp. Ouiatchouan, Que., mileage 5.

17801—October 18—Granting leave to N. St. C. & T. Ry. to cross G.T. Ry. on Welland Ave., in city of St. Catharines, Ont.

17802—October 12—Authorizing C.N.R. to construct bridge across the Atikokan River at mileage [illegible].

17803—October 18—Approving revised location C.N.O.R., through Tp. Nelson, up east side of Tp. Flamboro, mileage 31.54 to mileage 37.50 from Toronto.

17804—October 19—Authorizing C.P.R. to construct spur for Robertson Gravel Co., Ltd., Lot 2, R. 5, and Lot 1, R. 6, Tp. Waxford, Co. Terrebonne, Que.

17805—October 16—Authorizing C.P.R. to move station on Lot 2, Con. 5, to Lot 2, Con. 3, Tp. West Zorra, at Ingersoll Jct.

17806—October 18—Directing G.T.R. to provide and construct farm crossing for Julius E. Rosger, Lot 7, Con. 10, Tp. Ellice, Ont.

17807—October 11—Authorizing C.N.R. to construct bridge across Kashabowie River on main line east, mileage 80.7.

17808—October 19—Requiring C.P.R. to fence its right-of-way at Duck Cove, N.B., on south side of D. R. Jack's west line to a point 100 ft. east of Mrs. De Soyres' Gate

17809—October 19—Authorizing C.P.R. to construct extension to side already constructed for Guelph Stove Works, Guelph, Ont.

17810—October 21—Approving location C.N.R. through town of Estevan, Sask., mileage 8.02 to mileage 8.98.

17811—October 21—Authorizing C.N.O.R. to construct across Concession Road between Cons. [illegible] and 11, Tp. Chisholm, station 47.53.

17812—October 22—Authorizing C.P.R. to operate trains, without their first being brought to a stop, over westbound second track where same crosses C.N.R., Bird's Hill Branch in S. ½ Sec. 16, Tp. 11, R. 4, E. P. M., mileage 11[illegible].18 near Woods, Manitoba.

17813—October 19—Approving Joint Passenger Tariff of Tolls, Supplement No. [illegible] to C.R.C. No. [illegible], of the White Pass & Yukon Route.

17814—October 21—Directing C.N.O.R. to construct farm crossing for George Boyce, Lot [illegible], Con. [illegible], Tp. Nepean, Co. Carleton, Ontario, at Station 4[illegible].

17815—October [illegible]—Appointing Commissioner McLean to examine, under oath, any witness resident or at present in Canada, who may be produced to give evidence material to complaint of Blind River Board of Trade and London Rolling Mill Co., Ltd., alleging that G.T.R. and C.P.R. unjustly discriminate against town of Blind River on shipments of bar iron.

17816—October [illegible]—Authorizing C.N.O.R. to construct across six (6) highways in Tp. Chisholm, Dist. Nipissing.

17817—October 22—Authorizing (temporarily) G.T.P. Branch Lines Co. to carry traffic over Oban-Battleford Branch, mileage 0 to mileage 48.5.

17818—October [illegible]—Authorizing C.P.R. to take, for the construction of a team yard, certain lands in the Civic Delorimier Ward of city of Montreal, Que.

17819—October 22—Authorizing C.P.R. to cross, at grade, Pelham Ave., at West Toronto, Ontario.

17820—October 22—Approving location C.N.R., through Tps. 35-38, R. [illegible], W. [illegible] M., Sask., mileage [illegible] to mileage 135.5.

17821—October 21—Approving location Vancouver, Victoria and Eastern Ry. & Navigation Company's [illegible] track between mile post [illegible]

[illegible]—October [illegible]—Authorizing C.P.R. to take, for purposes of constructing a Team Delivery Yard, certain lands fronting on Mance St., and Esplanade Ave., [illegible] Ward in city of Montreal, Que.

17823—October 22—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible] to mileage 16[illegible].

17824—October 21—Approving location C.N.O.R. through Con. Hochelaga, [illegible]

[illegible] C.P.R. [illegible] spur for Paquette [illegible] Laval, Quebec.

[illegible] tariffs of C.P.R., G.T.R., Can. Nor. Que., & Temiscouata Rys. increasing rate on shipments of pulpwood.

[illegible] branch line from [illegible] Mine and rescind [illegible] May [illegible]

[illegible] G.T.R. [illegible] siding in the [illegible]

[illegible] siding for the [illegible]

[illegible] to construct [illegible] Tp. [illegible], R. 1, [illegible]

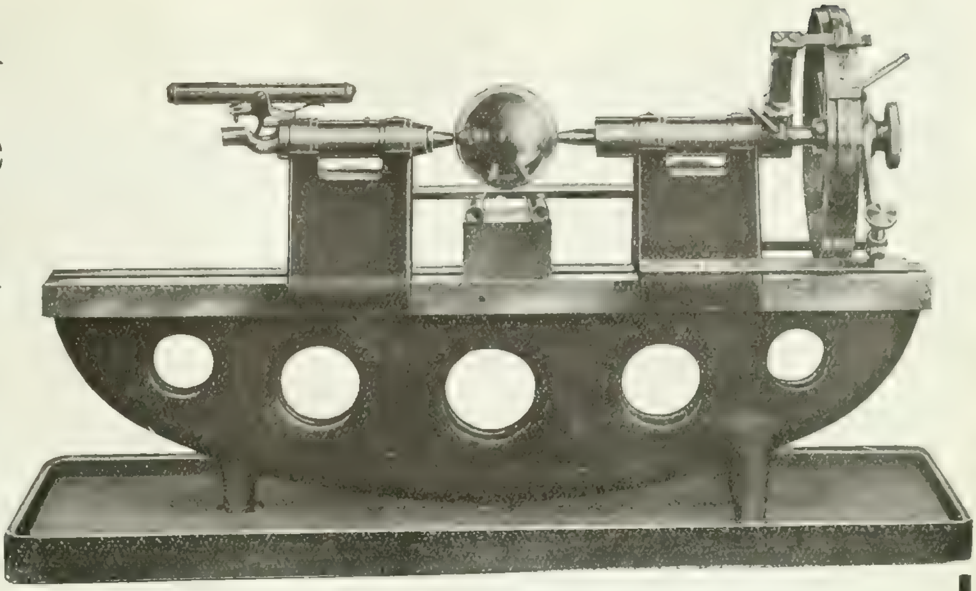
[illegible] freight traffic on [illegible]

[illegible] traffic its new second [illegible] at South Switch

[illegible] spur for the Can[illegible] Winnipeg, Man.

[illegible] C.N.O.R. station grounds at [illegible] Tp. [illegible], Ontario.

[illegible] Authorizing C.N.O.R. to construct across public road between Cons. A and B, Tp. Westmeath, Co. Renfrew, Ont.



Guaranteed Accurate to Within $\frac{1}{10,000}$ of an Inch.

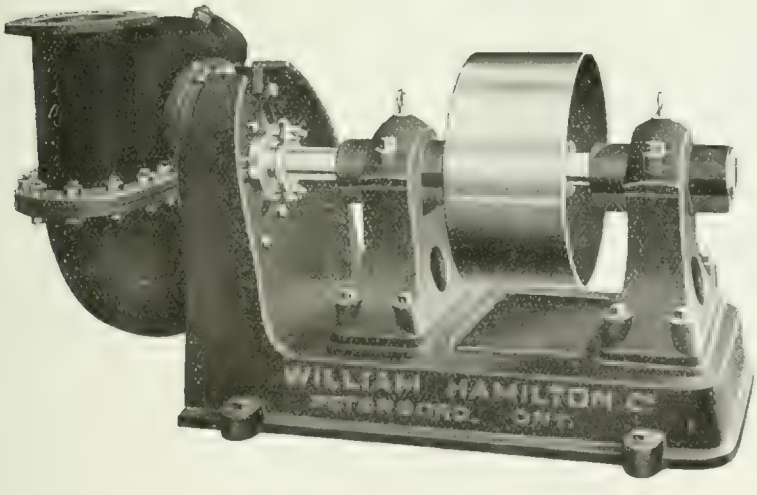
NEWALL MEASURING MACHINE

HOFFMANN STEEL BALLS

Hoffmann Steel Balls are all perfect spheres, and the utmost care is taken to make them, as nearly as is commercially practicable, correct to standard size. For this purpose all Hoffmann Standards have been verified by the National Physical Laboratory at Bushey, Eng., and all gauges used are tested against these standards by means of a Newall Measuring Machine.

Any Hoffmann Steel Balls which vary one ten-thousandth of an inch from standard size may be rejected, and will be replaced free of charge.
All sizes in stock, from 1/16" to 4".

JOHN MILLEN & SON, LIMITED
MONTREAL WINNIPEG TORONTO VANCOUVER
Address all correspondence to 321 ST. JAMES STREET, MONTREAL



Centrifugal Pumps

For Contractors,
Pulp Mills, &c.

Our pumps, you will notice, are split horizontally instead of vertically. This makes them much easier to take apart when necessary, as you have only to take the bolts out of the top half of case and lift it off.

Their construction is simple and strong, and you'll find them good pumps.

MAY WE QUOTE?

William Hamilton Company, Limited
PETERBOROUGH - ONTARIO

TENDERS CALLED FOR

TOWN OF BASSANO, ALBERTA.

WATERWORKS.

The corporation of the town of Bassano, Alberta, invite tenders for the following:—

CONTRACT "T"—

All labor and materials for constructing a concrete pump shaft, 130 feet deep, and laying 18-in. steel intake pipe in tunnel from shaft to Bow River, 225 feet in length, and constructing intake crib in river.

CONTRACT "H"—

All labor and materials for constructing frame power-house at Bow River.

CONTRACT "F"—

All labor and materials for constructing frame frost casing for standpoint, 25 feet diameter x 112 feet high.

CONTRACT "P"

Supply and erection of a deep well pumping engine, or alternatively, of a centrifugal pump and steam turbin.

CONTRACT "R"—

Supply and erection of two return tubular steam boilers and stack.

CONTRACT "S"—

Supply and erection of a steel standpipe, 20 feet diameter x 100 feet high.

Plans and specifications for Contracts "T," "H," and "F" may be obtained from the John Galt Engineering Company, Limited, Winnipeg and Calgary, on deposit of cheque for $10.00, which will be returned to bona fide tenderers.

Specifications for Contracts "P," "R," and "S" will be sent on application to the Engineers.

Tenders, which must be accompanied by an accepted cheque for five per cent. of the amount of the tenders should be sent to the undersigned not later than 20 o'clock, on Monday, [illegible]

The corporation does not bind themselves to accept the lowest or any tender.

GEO. B. R. BOND,

Bassano, Alberta, [illegible]

Secretary-Treasurer

WATER COMMISSION,

TOWN OF DUNVILLE, ONT.

Sealed tenders addressed to B. L. Edgecombe, Chairman [illegible]

[illegible]

[illegible]

[illegible]

TOWN OF YORKTON, SASK.

TENDERS FOR AUTOMOBILE FIRE TRUCK.

[illegible]

[illegible]

Secretary-Treasurer

[illegible]

TENDERS FOR INSTALLATION OF ENGINES AND BOILERS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on

TUESDAY, DECEMBER 10th, 1912,

for the installation of one or more Fifteen Million Imperial Gallon Pumping Engines and Boilers at the Main Pumping Station.

Specification and tender form may be obtained upon application at the office of Mr. James Milne, Mechanical and Electrical Engineer, Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company approved as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman, Board of Control.

City Hall, Toronto,
October 22nd, 1912.

QUEBEC HARBOUR COMMISSION

NOTICE

Sealed Tenders addressed to the undersigned and endorsed "Tender for Grain Elevator," will be received at the Quebec Harbour Commissioners' office up to 12 o'clock noon of October 21st, 1912, for the construction and delivery in complete order of a 1,000,000 bushel capacity Grain Elevator, with Marine Tower and shipping apparatus, to be situated on the Princess Louise Embankment, Quebec. Each Tender is to be accompanied by plans and specifications, exhibiting and describing the Elevator for the construction of which the Tenderer has submitted prices. Particulars of the requirements for the Elevator, etc., may be obtained by applying to the Harbour Engineer's office, Quebec.

Each Tender must be accompanied by an accepted bank cheque for $25,000 made payable to the order of the Chairman of the Harbour Commission. This sum will be forfeited should the tenderer refuse or neglect to enter into a contract for the construction of the Elevator, etc., if called upon to do so, and will be retained during the progress of the work as partial security for its due fulfilment; the unsuccessful Tenderers will have their cheques returned. The Commissioners do not bind themselves to accept the lowest or any tender.

RAOUL RENAULT,
Secretary-Treasurer,

EXTENSION OF TIME

The Quebec Harbor Commissioners have extended the time for the reception of the tenders for a grain elevator [illegible] until [illegible] and the time of delivery until August [illegible], 1914.

RAOUL RENAULT
Secretary-Treasurer

For further Tenders see page 76.

Volume 23. Toronto, Nov. 7, 1912

Contents of this issue on page 707

The Canadian Engineer

An Engineering Weekly

THE APPLICATION OF DIESEL ENGINES TO LAND AND MARINE WORK.

By D. M. BRIGHT.

Introductory.—Within the last decade no prime mover has provoked so much comment as the Diesel engine, and as within the last two years, almost daily reference has been made in regard to its development, it may be of interest to make some particular reference to its early history.

The earliest known internal combustion engine was invented and made by a French Abbé in the year 1682. This engine utilized the energy produced by the explosion of an inflammable powder, but difficulty was experienced in controlling the power. About two hundred years later Rudolf Diesel, a German scientist, after many years of study and experiments on different types of heat engines, formed the opinion that very little improvement in their heat efficiency could result until the principles of working were modified.

Herr Diesel, in order to demonstrate his theories, decided to construct a new type of heat engine to utilize the maximum amount of heat from the fuel used.

In this engine only pure air is drawn into the cylinder and compressed, then the oil fuel is injected into this compressed air in the form of a fine spray and burns gradually as long as the injection is maintained. During the whole cycle the pressure in the cylinder does not rise above the compression pressure, unlike the ordinary gas engine where the combustible charge is drawn into the cylinder, is ignited and burned instantaneously or exploded.

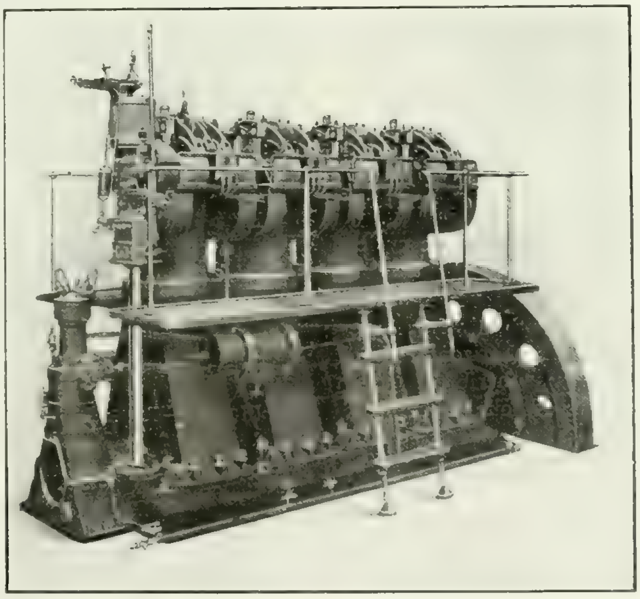


Fig. 1.—Four-Cylinder 200-h.p. Diesel Oil Engine.

In 1897, after four years of difficult experimental work, Dr. Diesel completed the construction of the first commercially successful motor in the Augsburg Works, and it was announced by the numerous engineering and scientific committees and deputations from various coutries, who tested the machine, that a higher heat efficiency was attained by it than by any other known heat engine. As a result of subsequent experience in practice, and the gradual improvement in the manufacture, still better results have been obtained and at the present time the thermal efficiency the motor attains is up to about 48 per cent., and the effective efficiency in some cases up to 35 per cent.

The results of this first motor were considered so satisfactory that a large number of engineering firms obtained licenses to build. At the beginning of 1901 twenty-five firms on the Continent, one in the United States, and one in Great Britain were costructing Diesel engines.

General Description.—The engines work on the four- and two-stroke cycle and run according to requirements at low or high speed, and are made in vertical or horizontal types.

Four- (Stroke) Cycle Engines.—(1) In the first downward stroke of the piston air is sucked into the engine cylinder direct from the atmosphere through the main air inlet valve on the top of the cylinder. At the end of this stroke the cylinder is full of pure air at practically atmospheric pressure, ready for the compression stroke.

(2) In the next upward stroke the air is compressed to the required pressure, usually about 500 lbs. per sq. inch, thereby having a temperature of about 1,000 deg. Fahr., all the valves, of course, being closed during this action. As the compression is very approximately adiabatic nearly all the work in it is returned.

(3) During the early portion of the third and working stroke the fuel oil is injected into the cylinder above the piston by a blast of air at a higher pressure than that in the cylinder (about 800 lbs. per sq. in.) through a special form of needle spray valve. Combustion takes place during this period as the temperature of the compressed air in the cylinder is above the burning point of the oil fuel. After cut-off, when the fuel inlet valve closes, combustion continues for a short period, expansion then occurs and work is done on the piston for the rest of the stroke. Just before the piston reaches the end of its stroke the exhaust valve begins to open.

(4) In the final stroke the exhaust valve remains open and the burnt gases are expelled from the cylinder into the exhaust pipe, leaving the cylinder ready to receive a further charge of gas on the next down stroke of the piston, when the cycle of operations begin once more. Fig. 2 shows an indicator card of an actual Diesel engine of this type.

Two- (Stroke) Cycle Engine.—(1) Consider the piston at the end of its stroke in the bottom position. The cylinder is then full of air at nearly atmospheric pressure, and this is compressed during the first or upward stroke of the cycle to the usual top compression pressure of 500 lbs. per sq. in., as in the second stroke of the four-stroke cycle.

(2) During the second stroke, combustion, expansion, expulsion of the burnt gases to the exhaust and the filling of the cylinder with fresh air are the operations which have to be effected. Fuel is sprayed into the cylinder during the early portion of the stroke, through the inlet valve, by compressed air as before. This valve then closes and expansion occurs while the piston passes through about 78% of its stroke, at which point the exhaust valve opens and the products of combustion begin to pass out. Air under pressure of about 4 to 8 lbs. per sq. inch then enters the cylinder through a separate valve or port in the cylinder, being supplied from a so-called scavenge pump, which is quite separate from the air compressor for the provision of fuel injection and starting air supply.

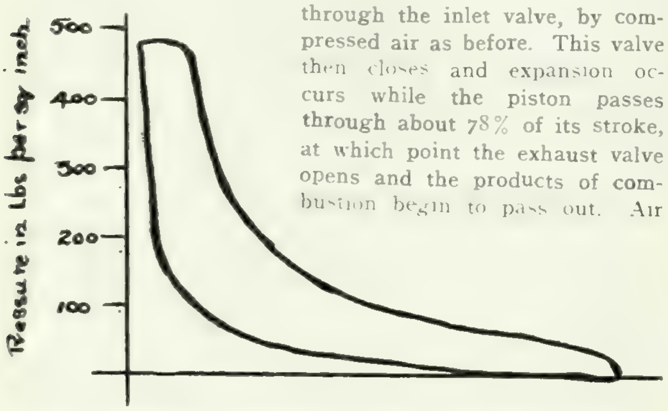


Fig. 2.—Indicator Daigram of Four-Cycle Diesel Engine.

All the exhaust gases are thus forced through the exhaust ports and at the end of the stroke the cylinder is left full of pure air with all the valves closed ready for the first stroke of the next cycle.

The indicator diagram for this cycle, as seen in Fig. 3, does not differ materially from that of the four-stroke cycle, as seen in Fig. 2, the most notable difference being the rapid fall off of pressure to F along E F; also during the process of exhaust the cylinder is filled with air from the scavenge pump. There is no longer a horizontal line representing the entrance of the air at atmospheric pressure, as in the four (stroke) cycle diagrams, since all the air is admitted at a pressure above atmospheric.

Figs. 1 and 4 are illustrations of Diesel engines used for electrical installations and pumping.

The main advantages of the Diesel engine are: (1) Its ex[illegible]

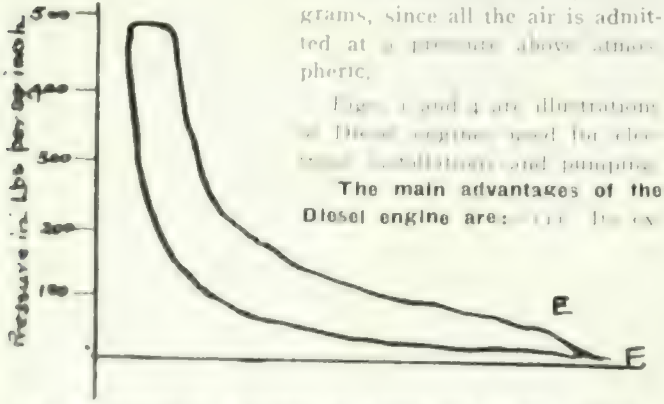


Fig. 3.—Indicator Diagram of Two-Cycle Diesel Engine.

[illegible]

(2) [illegible] large quantities all over the world.

(3) [illegible]

a not infrequent cause of breakdown in other forms of internal combustion engines.

(4) No carburetters, vaporizers or troublesome ignition devices are requied on the Diesel.

(5) The engine can be started up from cold and put on load in one minute. and is ready for any load up to its full capacity at any moment.

(6) Lastly, one of its most important features is its great reliability, even when running for long periods with variable conditions of load.

Application of Diesel Engines to Marine Work.—A marine engine must, before everything, be absolutely reliable, and with the present perfection of the steam engine, as a result of close on a century's practical experience, it is easy from this to see that the Diesel engine had to stand a long, severe trial during its progress up to the present before it could be seriously considered as a motor for marine work. After some eighteen years, during which the engine has proved its excellence for stationary work, with a reliability equal to the best steam engine and excelling all others, it may be said to have proved its worth beyond question. Of course, marine practice is in many ways different to stationary working. Marine engineers are naturally a little apt to exaggerate this point, still, there is no doubt that the conditions of service at sea are in general much more severe than on land. That over 400 vessels at present equipped with Diesel engines, many of these running for years, and the many that are being built is proof that there will be many such vessels in the future.

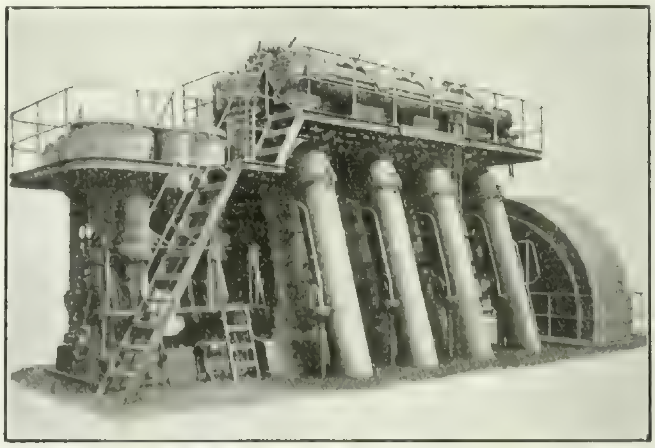


Fig. 4.—Four-Cylinder Two-Cycle 2,400 b.h.p. Engine.

Advantages of the Diesel for marine work are:—(1) Reduction in fuel cost over steam or other known engines.

(2) Reduction in weight of fuel carried for same power, giving greater cargo space.

(3) The Diesel engine is relatively much more efficient than any steam engine in fuel consumption at low speed. This fact is of particular importance for vessels which run most of the time much below their full power and speed, such as war vessels, trawlers, coasting boats and boats on internal waterways.

(4) There are no stand-by losses, which may be an important point worth consideration when ships make frequent calls at ports.

(5) Fuel can be stored almost any place in vessel.

(6) Economy of space, and economy in weight of Diesel engines as compared with steam engines and accessories weigh on an average one ton to every 5 to 8 i.h.p. Diesel engines and accessories of slow speed type, that is, under 300 revolutions per minute, weigh one ton to every 10 to 15 b.h.p. For high speed types it is as much as 25 b.h.p. per ton.

(7) The reduction in staff, as no stokers are required.

Taking all the economies effected in weight of fuel, weight of machinery and engine-room space it may be safely estimated that the extra cargo which could be carried would be about 15% of the displacement of the vessel.

A comparative estimate has been made, showing that in a vessel of about 5,000 tons the net saving between Diesel engines and steam worked out over $5,500 per annum.

When a Diesel engine is installed in a vessel, the lines of vessel may be finer than if a similar powered steam engine were installed, still the most suitable speed of Diesel engines is, generally speaking, more than the most economical propeller speed. However, these two considerations about balance each other.

The ease and cleanliness in handling oil, as compared with coal, is another important point.

All the operations of the engine are under the eye of the engineer in the engine-room.

The absence of smoke is also noteworthy.

The initial cost of a Diesel plant is from 15 to 20% more expensive than a steam installation, including all auxiliaries in both cases, but it is to be emphasized that price-cutting would be a fallacy if the perfection of construction is to be maintained.

The Diesel engine can be used directly reversible or geared to propeller shaft.

There is a type of engine called the Semi-Diesel engine being used largely on cargo boats, barges and lake boats. This is an extremely simple engine, very reliable for class of boats stated above.

This engine compresses air alone and uses crude oil as a fuel. It operates on the two-cycle with crank chamber air compression. (See Fig. 6).

Air is drawn into the crank-case on the up-stroke of the piston through flap valves (B) on the side of crank case (C). This air enters the working cylinder (D) at the end of the down-stroke at (I), just after the expulsion of the exhaust at (G) from the previous power stroke. On the return of the piston this air is compressed still further to about 125 lbs. per sq. in. into a "hot bulb" (E) on the cylinder head. The charge of oil is then injected through (F) at the moment of maximum compression. The heat of the bulb automatically fires the mixture. This bulb is heated by a blow lamp for a few minutes before starting up.

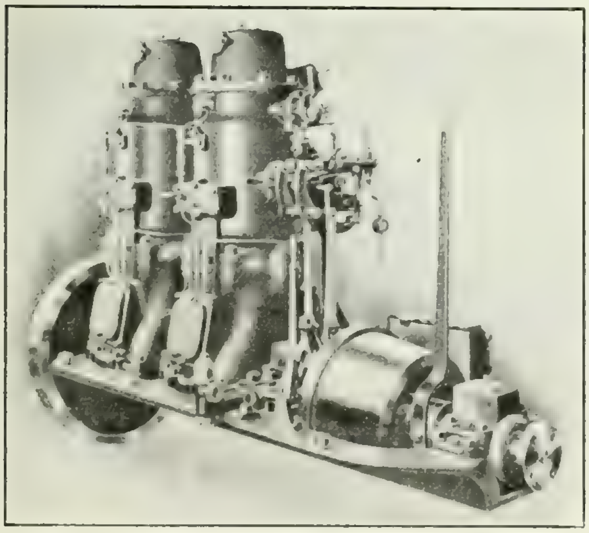


Fig. 5.—Direct Reversible Marine Engine.

It is one of the simplest and most reliable types of engines and shows almost equal economy of fuel. Initial cost is much cheaper for smaller powers than the Diesel.

Comparative Tables of Running Costs.
(Actual Log Book Figures).

Cents, per kilowatt hour generated.

Item.	Steam.	Producer Gas.	Diesel.
Fuel	1.78	1.74	0.60
Oil, waste, water, stores	0.24	0.38	0.06
Men's wages	0.64	1.36	0.34
Repairs and maintenance	0.74	1.60	0.16
Total operating costs per kw. hour generated	3.40	5.08	1.16

Load factor 12.45%, 16%, 14%.

The Birmingham Electric Tramways (England) show total operating costs in cents per kilowatt generated at switch-board to be .74 cents.

The Diesel engine should be of special interest to Canadians, as its fuel is more prevalent in Canada and easier to transport than coal. Value of crude oil at the oil fields is about $3.50 per ton. These are the so-called residual oils which are obtained by the distillation of the oil from the well, the lighter bodied oils, benzene and lighting petroleum coming over first and leaving a residual oil. Its specific gravity is about .87, and owing to its high flash point is quite unsuited for lamp oil. There are certain other oils which have been used on Diesel engines, and in particular cases may prove of great value. A Diesel engine has been working on ordinary coal tar as a fuel, so one can readily see that there are many liquid fuels available.

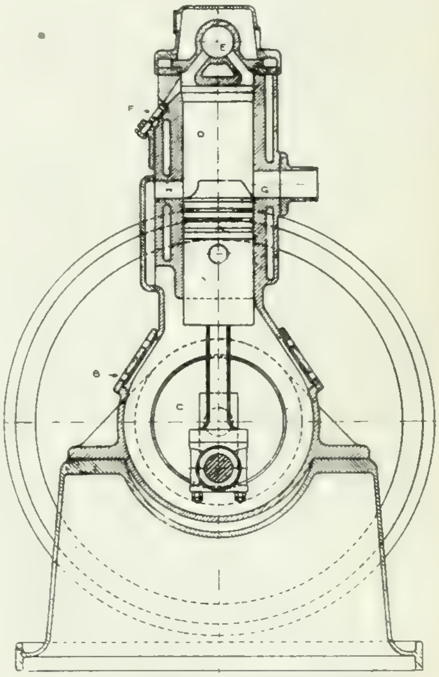


Fig. 6.—Section Through Direct Reversible Marine Engine.

◆

ELECTRIFICATION OF MELBOURNE SUBURBAN RAILWAYS.

Offers of a representative character, from the leading firms throughout the world engaged in the manufacture and supply of electrical machinery and equipment, are now receiving the attention of the government of Victoria, Australia, in view of the conversion of the Melbourne suburban railways from steam to electric traction. While no figures have yet been disclosed, it has been announced that the competition amongst the tenders has been very keen. The offers give the option of adopting either the single phase alternating current or the direct current system. This proposed change in traction will involve a huge expenditure in a suburban railway system which (excluding the extensive cable tramway service also in operation) carried 96,163,296 passengers last year. A leading English electrical engineer is now in Melbourne for a limited period for the purpose of giving expert advice to the government.

THE NEW LOCK AT THE SOO.

Coincident with the construction of large permanent steel ore docks at Lake Superior shipping ports, capable of accommodating the mammoth carriers recently built, provision is being made to facilitate the passage of such vessels through the channel at Sault Ste. Marie, where the existing locks are proving inadequate to the service. The principal work now in progress there is the building of the new Davis lock, recently described in the Mining and Engineering World, which was begun in March, 1907, and will not be completed until 1916.

Next to the Panama canal this is the most important aid to navigation now being carried out by the federal government; and it is due entirely to shipments of ore from Lake Superior ports.

The total length of the lock will be 1,715 ft. and its width 80 ft., 1,350 ft. being within the inner gates. Six culverts are provided for; 1,200 ft. of the wall is 50 ft. high and 26 ft. wide at the base. It is to be built up from bed rock in sections, alternate sections being constructed first and the intermediate sections later. They are 25 to 35 ft. in length. The concrete of the lock floors will be 1½ ft. thick. The work also includes lining about 325 linear ft. of tunnel rock, and the building of about 170 linear ft. of tunnel in trench, in addition to the tunnels and passages through the masonry. To furnish the crushed rock for the concrete work there has been built for the concern having the complete contract, viz., the Great Lakes Dredge and Dock Co., the plant described in the following. It is located in the vicinity of the new lock.

This plant is designed to crush Lake Superior trap rock. There are two gyratory breakers. One is a No. 7½ machine, with receiving opening 14 by 52 ins. set to crush to 3½-in. cubes, and the other is a No. 5 breaker with 10 by 38-in. opening which makes a 2½-in. product. Their foundations are flush with ground level, or about 8 ft. above the normal water line. Both machines are fitted with manganese mantles and [illegible].

The discharge from the breakers is taken by a No. 7½ continuous bucket elevator, with centres 68½ ft. apart, and discharged to a 48-in. by 16-ft. iron-frame, revolving screen. From this the oversize rejections are returned through a spout to the No. 5 breaker, while the screen product falls to a storage bin, of heavy-timber construction, set 12 ft. above the rails of the 36-in. gauge loading track. This bin is 16 ft. wide, 48 ft. long and 21 ft. deep, with steel-rod partitions and suitable discharge gates in the bottom.

There are also provided two troughing-belt conveyers, [illegible] supported on light wooden trestles, which have ⅛-in. rubber covering on their [illegible]. By these the [illegible] can be diverted, as required, and borne to two stock piles, 60 ft. high, and [illegible]

[illegible]

[illegible]

provements that have been found necessary in the operation of the two locks now there. The length in use will not only be utilized in handling longer boats, as they are built from year to year, but it also will make possible the entry of two of the longer craft in tandem style, a practice never yet indulged in.

At present the two or more boats often passing the locks together are locked through abreast of each other. Vessel owners and masters declare this is a dangerous proceeding. The boats, they say, not only require more time to take their positions in the locks in this way, but also that there is great danger from suction to the boat remaining in the lock when the first one steams away.

On more than one occasion lines have snapped and boats have drifted temporarily in a helpless manner in the locks.

The present largest lock, the Poe, is 100 ft. wide. The new one will measure but 80 ft., making it impossible to lock vessels through in any other way than tandem.

Probably the most distinctive feature of the new lock will be its depth. When opened for navigation it will present a loading depth of 24½ ft., or 6½ ft. more than the present depth accorded the boats of the great lakes. While all channels on the lakes are now dredged to a depth of but 21 ft., experts declare it will prove of less expense to dredge the channels deeper than to construct or remodel other locks.

The practical value of the depth presented by the present locks, an average of 18 ft. is displayed in the trouble the larger boats experience in locking through. Unnecessary delay is now experienced by the masters in locking through by the upheaval of water at the bow of the boat. Such conditions, engineers say, are due to the excess of water caused by the entrance of the boat to the lock being unable to escape fast enough at the sides of the boat. With the additional depth presented by the new lock, this water, it is figured, will be forced under the boat to the escaping channels beneath the flooring. With such facilities at hand vessels will be able to lock through in less than half an hour, while it now takes many of the larger ones over an hour.

The importance of the work now being done by the federal government on the new locks and canal here, may be seen from the fact that the present locks already float the greatest commerce of any inland waters of the globe. In 1911 the total tonnage amounted to [illegible], which is two and one-half times greater than that passing through the Suez Canal, and seven times greater than that of the Kiel Canal. What the traffic will amount to with the addition of another lock, the greatest yet constructed, remains to be seen.

The present commerce exceeds that borne by all ships, British and foreign, entering the ports of Great Britain in one year, and valued at an average of $654,010,844 annually. When completed the new lock will not only be by far the largest in the world, but will represent an expenditure of about $9,000,000.

◆

PATRICIA LAND.

Mr. J. B. Tyrrell, who led the Government expedition to the Hudson Bay through the new district of Patricia, has returned to Toronto and commenced the preparation of his report to the proper authorities.

According to him there is a larger area of tillable land in this section than was at first supposed, and he is confident that the bog lands are so situated that their drainage is a simple problem. The best land in Patricia is forest covered, and other large stretches resemble Temiskaming, [illegible] in which hardly a clear acre of good soil may be found, alternate with large sections of promising land. Mr. Tyrrell states that this portion of the Dominion will some day be a sportsman's paradise, as the swamps teem with flocks of wild ducks and the rivers abound with fish.

TEN THOUSAND HORSE-POWER HIGH-PRESSURE TURBINES FOR THE BIASCHINA ELECTRIC POWER STATION.

The Biaschina electric power station near Bodio, Northern Italy, built by the A. G. Motor, utilizes the water of the River Tessin, with its tributaries, with a total head, between the Gotthard Railway stations of Lavorgo and Bodio, of 840 feet.

The water intake is located 500 feet down the valley from Lavorgo Station, on the right bank of the River Tessin, where the water is diverted by means of an overflow weir, built slantingly across the river. The water is then conducted to a special filtration reservoir, where it is cleared of any deposits of sand or other impurities; from here a closed canal of about 5½ miles length takes the water to the forebay, from which the water is led to the four turbines, each consuming at a head of 840 feet about 138 c.f.s.

The upper portion of the feeder conduit is in the form of a pressure tunnel, which at the point where the pressure reaches 260 lbs. per sq. in. is connected up to two separate steel pipe lines of about 67-in., inner diameter.

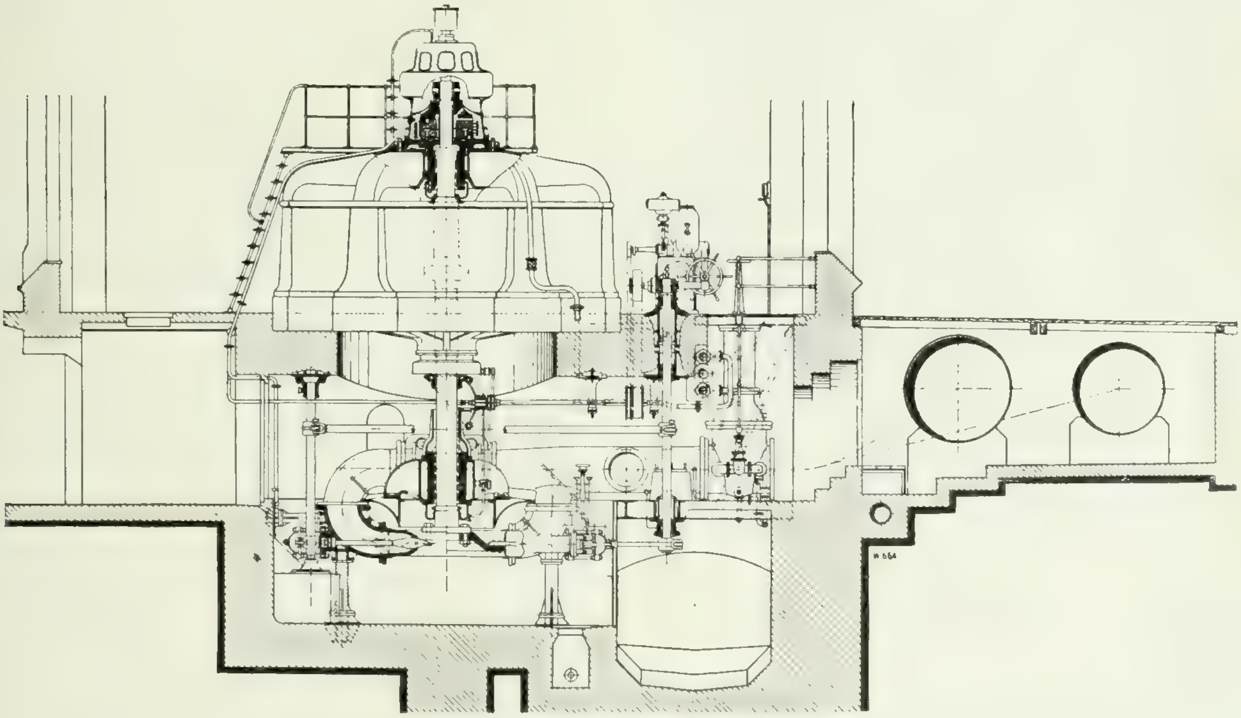


Fig. 1—Longitudinal Section through 10,000 H.P. High-pressure Turbines.

Each of the two pipe lines delivers the necessary amount of water required by two high-pressure impulse wheels, each capable of developing an output of 10,000 horse-power when running at 300 revolutions per minute. However, in accordance with the specifications, each of the wheels is designed so as to yield a maximum power, at full opening, of 12,000 horse-power.

For various reasons the vertical shaft arrangement was given the preference over the horizontal type, following recommendations made by Escher Wyss & Co., as similar turbines running on a vertical shaft designed and constructed by the same firm had given great satisfaction. The accompanying cuts show the general design of this type of turbine. The initial installation consists of three units with a total maximum output of 36,000 horse-power.

The two inlet pipes for each turbine are arranged symmetrically to the turbine axis, and are connected to the main pipe lines at an angle of 90°. The hydraulically operated gate-valves of 24-in. diameter are located inside the power-house, near the wall. These valves may be opened or closed from the machine house floor by a hand-wheel controlling an intermediate distributing valve, which directs the pressure water to the servomotor, or pressure cylinder, accordingly. In front of each valve an expansion piece is fitted in order that, in case of repairs, the valve may be quickly and safely removed.

The total power of 12,000 horse-power is developed by only one single runner wheel fitted with double pear-shaped buckets of cast-steel mounted around the circumference of the wheel. The water is discharged under full pressure of 840 feet through four needle nozzles, forming a circular solid jet, which again impinges upon the buckets of the runner. The nozzles from which the water is escaping with a velocity of 220 feet per second are most carefully designed and supported in such a way that the forces originating from the reaction of the water cause least possible vibration.

The governing mechanism for controlling units of this large capacity requires to be designed most carefully in order to safeguard the operation of the machines in cases of sudden changes of load. For this plant Escher Wyss & Co.'s patent Universal oil-pressure governors have been installed. Their oil-pressure pumps and speed pressure and speed pendulum are driven by belts off a transmission shaft situated underneath the power-house floor. The governor is usually operated by pressure oil, but each governor is also provided with a hand-wheel, so that the whole unit may be temporarily controlled by hand. The servomotor of the governor operates the vertical main regulating shaft, which latter, by means of a system of levers and rods, is connected up to the needle nozzles; the regulating needles are consequently controlled directly by the governor. These needles are so designed that they, in any position, are practically balanced, so that the capacity of the governor might be reduced, and also a most even working of same is obtained. The various pins and joints are provided with bearings on both ends, designed for grease lubrication, so that the wear and friction is reduced to a minimum. From the servomotor each nozzle can be adjusted according to the load under which it is to work, and it is also possible, if necessary, to entirely close two or more of the nozzles of each unit.

All bearings, not only those of the main shaft, but also those of the transmission gear and regulation shafts, are fitted with removable babbitted bearing bushes. The shafts are provided with continuous ring oil lubrication, except that the governing shaft, the movement of which is limited, is lubricated by grease. The oil-pressure thrust bearing, which carries the total weight of the rotary parts (about 100,000 lbs.) is placed on the generator frame. On top of this the exciter stator is mounted.

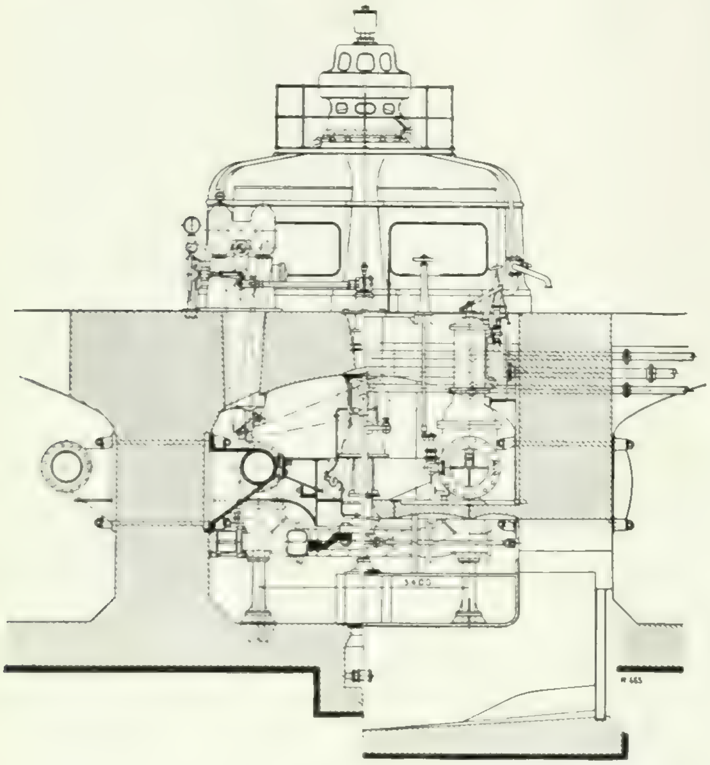


Fig. 2.

An oil-pressure plant has been installed for the special purpose of balancing and lubricating the thrust bearing.

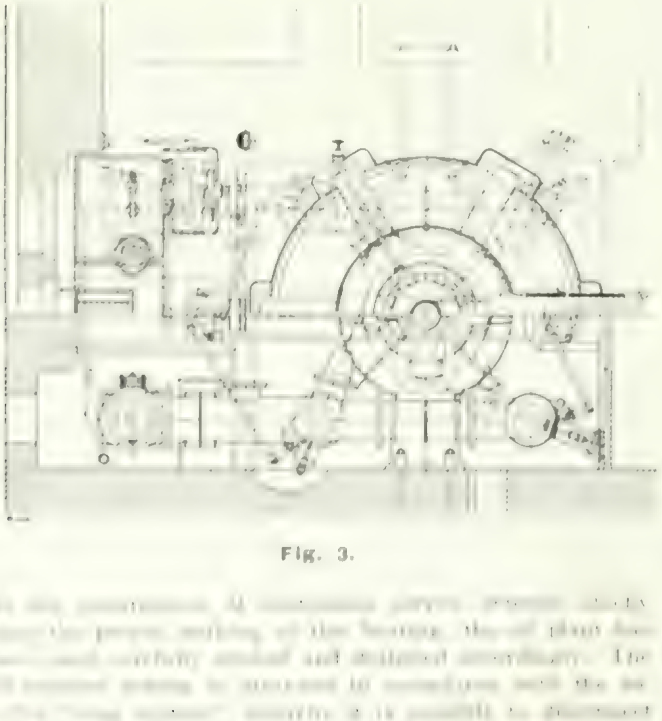


Fig. 3.

[illegible] the maintenance of continuous proper pressure [illegible] upon the proper working of the bearing, the oil plant has been most carefully studied and designed accordingly. The oil-pressure piping is arranged in connection with the so-called "ring system," whereby it is possible to disconnect any one of the four units without having to stop any of the other machines. There art two pumps, of which one always is kept in reserve. Both are of the Escher Wyss & Co. type, and each is driven by gear from a separate impulse wheel of about 30 horse-power. In the basement, immediately beneath the pumps, two oil reservoirs with a capacity of about 1,750 gallons have been provided. The two reservoirs are so connected one to the other that it is possible for any pump to take oil from either of the reservoirs. Each pump is also fitted with an air-chamber; the air for the latter is furnished by the sniffing cock, which is mounted on the air-chamber so that the oil may not be mixed with the air.

In order to be able to undertake repairs in the turbine pits also without having to shut down the whole plant, arrangements have been made so as to separate the various chambers by water-tight partitions. For emptying these chambers, each has been fitted with an injector with which it is possible to drain about 2,200 gallons of water per hour. The necessary pressure water for this purpose is tapped from the pressure pipe line, and in such a way that should one or the other pressure pipe line not be working, any of the chambers can still be emptied.

◆

A RARE OCCASION.

By James Hedley.

Detroit River has been, within the past few days, the scene of an event celebrated in an unusual way. This event is the completion of the Livingstone Channel, excavated to a depth of 23 feet and a width of 400 to 600 feet for thirteen miles into the head of Lake Erie, six miles of this distance being through solid limestone, known as the Limekiln Crossing of Detroit River. This work is one of the wonders of science and enterprise, undertaken by government at a cost of $10,000,000, and all of it paid by "Uncle Sam" except a few hundred thousand contributed by the Canadian Government.

So greatly is this boon to navigation prized by the Lake Carriers' Association and by the marine and commercial men of the inland States and Canada, that its practical completion is signalized by a procession of steamers upon a great scale. Yachts, ferries, passenger boats, revenue cutters, motor boats and great, modern freighters, from 400 to 600 feet in length, passed through this enormous cut, first downward with the current, then back to Detroit, 22 miles, to the accompaniment of flags, bands, siren whistles and the shouts of thousands of spectators, assembled from the lake cities. One steamer, the "Britannia," carried 1,700 guests. The great steel steamer, "William Livingstone," appropriately named, as the channel is, after the president of the association, an indomitable pioneer in the modern improvement of the Great Lakes waterways, headed the procession.

Work was begun on this important achievement in the spring of [illegible] when the contractors began the huge cofferdam which enclosed what is known as the dry work section, about [illegible] mile of the river bed near the upper end of the [illegible]. Actual channel digging was begun in the fall of the same year, after powerful steam pumps had drained that part of the river bed enclosed by the dyke. Of the four contracts let, Nos. 1 and 2 were to Chicago parties. Section 3, about [illegible] feet in length, was completed by McNaughton & O. J. Dunbar, of Buffalo, and Section 4, in Lake Erie, [illegible] feet by G. H. Breymann & Bro., of Toledo.

MEASUREMENT OF ACTUAL STRESSES IN REINFORCED-CONCRETE STRUCTURE.*

By W. K. Hatt.†

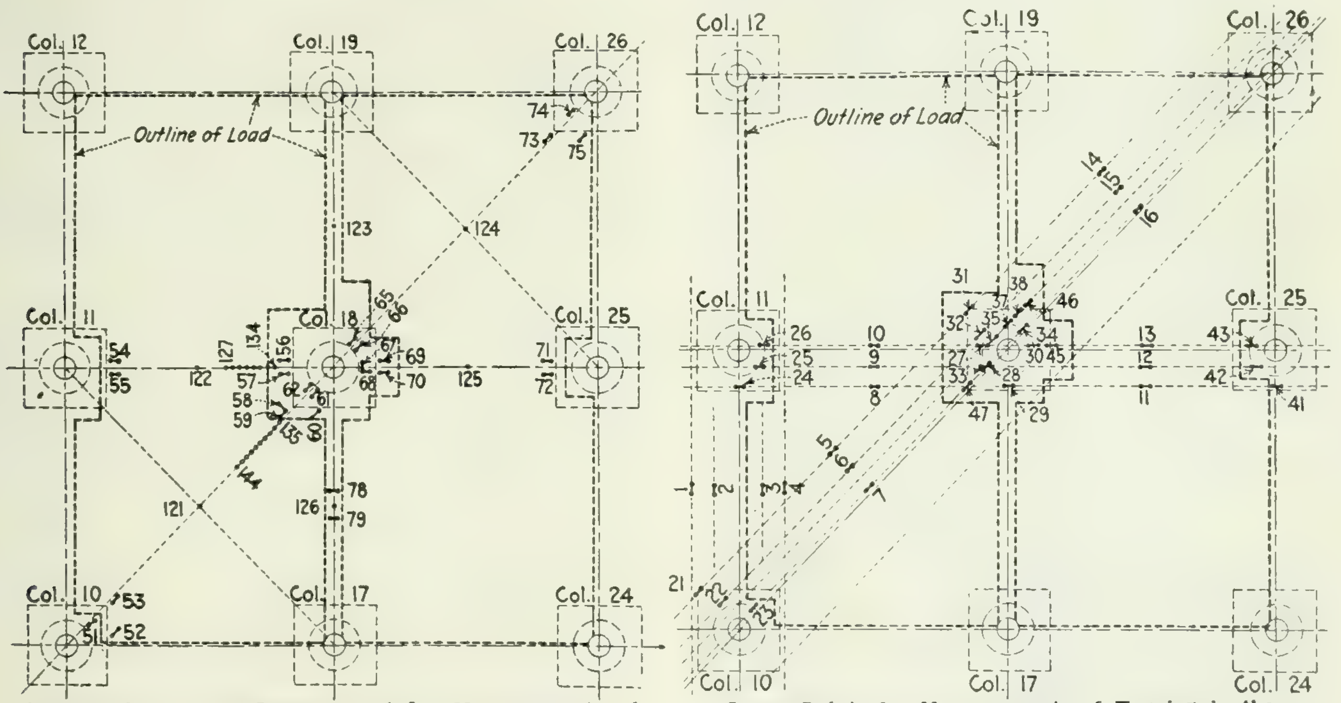
This paper is mainly an account of the general features of a test of a reinforced-concrete floor of flat-slab construction. The full report of the test with all pertinent data was made to the Leonard Construction Company, Chicago, which has permitted the writer to use the report as a basis for this paper.

Nature of Tests.—In brief, the floor was loaded with pig iron in increments, and the accompanying deformations were measured in the steel and in the concrete at all critical points, with a view to fixing a safe limit of loading and to understanding the mechanical action of the structure.

The Structure Tested.—The building tested is the Franks Building, Chicago, Ill., a 10-story-and-basement warehouse used by the printing and paper trades and the type of construction used was the "Cantilever Flat Slab" system. The design load on the floors was taken at 250 lb. per sq. ft. The panel dimensions were 19 ft. 4 in. by 20 ft. 3 in.

The four panels under observation were in the interior of the building, and on the tenth floor, where the columns were of minimum size. As the effective clear span and the eccentricity of column loading were the greatest, the location was such as to insure the most severe test possible.

The diagonal reinforcement was eighteen ½-inch round bars, 40 feet long, spaced 5⅝ in. on centres. The cross bands were composed of sixteen ½-inch round bars 44½ feet long, spaced 6⅜ in. on centres. The slab thickness was 9¼ inches, increased to 13¼ inches near the columns. The concrete mix was 1:2:4 in the floors and 1:1:2 in the columns.



Gauge-Points for Deflections and for Measurements of Compression in Concrete.

Gauge-Points for Measurements of Tension in the Slab Steel.

Fig. 1.—Locations of Gauge Lengths for Steel and Concrete Stresses, and Points at Which Deflections were Measured.

Methods of Observation.—The observations were made by experienced observers: Prof. H. H. Scofield, of Purdue University, and Prof. W. A. Slater and W. E. Ensign, of the University of Illinois Engineering Experiment Station, with the assistance of Prof. L. W. Weeks, of Purdue University.

The deformations were determined by the use of extensometers of the type devised by Prof. H. C. Berry, of the University of Pennsylvania, a former pupil of the writer at Purdue University. On the steel a gauge length of 10 in. was used, which, with the multiplying lever in the instrument, gave direct readings of unit deformations of 0.00002 in. per in., corresponding to stresses of 600 lb. per square inch in the steel, and it was possible to estimate clearly fractions of this amount. For the concrete readings the gauge-length was 6 in., and the direct reading of unit deformations was 0.000033 in. per in., corresponding to a stress of 133 lb. per square inch, and it was possible to estimate fractions of this amount with accuracy.

Errors in operating the instrument were reduced to a minimum by taking every reading at least five times, and by calibrating on a standard bar at frequent intervals. Four standard bars were used throughout the test, all of these being embedded in the concrete and subject to the same temperature changes as the rods in the test floor, but free from any stress due to applied load. By reading on these bars between sets of five or six test readings, the observations on the materials under test were freed from errors caused by temperature differences and from systematic errors.

Deflections were measured to 0.0001 in. by use of the deflectometer described in a previous test for actual stresses.

Tensile deformations were measured throughout the test over 42 gauge-lengths on the steel reinforcing rods. Compressive deformations in the concrete were measured over 26 gauge-lengths. Deflections were observed at 24 points. Also, 27 other readings of deformations were taken throughout the test, to study such phenomena as the arch and slab action, the distribution of stress, and the eccentric loading on the columns at the edges of the loaded area. The locations of the various gauge-lengths are shown by the two diagrams Fig. 1; see, also, the view Fig. 2.

The observations were arranged in groups, each designed to cover adequately some particular feature, and symmetrically located observations were obtained as a check in every case where possible, in order to cover variations in the quality of the concrete at different points.

---

* A paper read before the Indiana Engineering Society.

† Professor of Civil Engineering, Purdue University, Lafayette, Ind.

It should be remarked that the results from the use of the Berry extensometer are reliable only after the observer has had considerable preliminary practice with this instrument. The holes in the steel bars must be carefully reamed, the instrument must be protected from the heat of the hands, and the contact points must be seated under uniform pressure. Observance of these requirements, multiplied observations, and frequent reference to the standard calibration bar, are the conditions of success.

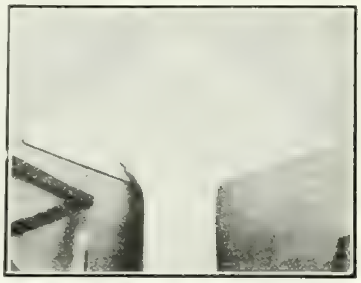


Fig. 2.—View of Slab from Below, Showing Column Capital and Several of the Gauge-Points.

(At the time these pictures were taken the four panels shown carried 20 % overload)

The conditions were exceptionally favorable to a satisfactory test. The building was practically completed at the time of test. The temperature varied but little, being about 74° at the start of the test, dropping gradually and uniformly to 70°, and rising again at the end to 74°. The slab was poured on June 23, 1911, and was 64 days old when the maximum load of 624 lb. per sq. ft. of panel area was placed upon it.

Loading.—The amount of loading was determined by the weight of the pig iron as recorded on the weigh bills delivered by the teamsters, and was checked by weighing a number of piles of pig iron from the test load on a platform scales.

The pig iron was piled on the floor in separate piers, each placed within a 2-ft. square, so that no arch action existed in the load itself to relieve the panel from movement. It was necessary to leave several of these squares vacant about columns and to leave an aisle between the columns to allow space for observations. (See view Fig. 3). The pig iron belonging on these vacant squares was distributed over the remaining squares of the same panel. It will be apparent that under this procedure the real load intensity, as affecting bending stresses and deflections, is the intensity of load [illegible] over the loaded area (about 90% of the panel area), rather than the nominal or average load over the entire panel area.

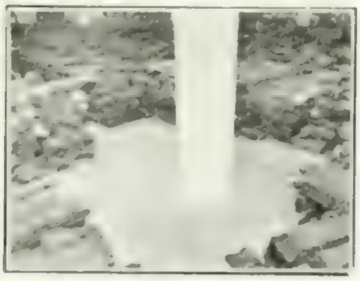


Fig. 3. View of Slab with Pig-Iron Loading, Showing Space Left for Making Readings.

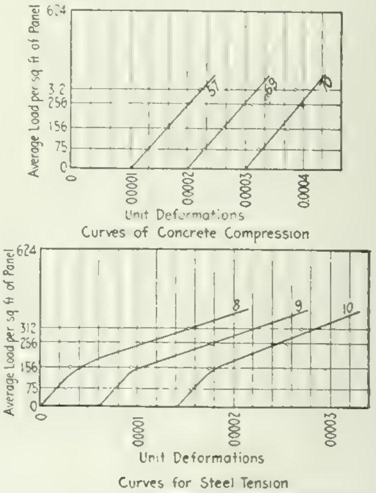
[illegible]

[illegible] Readings were [illegible] taken with 312 on the [illegible] diagonal panels and 156 on the others, but without waiting for the six-hour interval to elapse before taking readings.

The total number of complete observations over single gauge-lengths was over 2,000, and the total individual readings over 10,000. The test occupied one week's time.

Stresses.—The stresses were determined from the observed deformations by using a modulus of elasticity of 30,000,000 lb. per sq. in. for the steel, and 4,000,000 lb. per sq. in. for the concrete. The latter value was determined from tests of three concrete prisms poured from the concrete in the test slab and tested at Purdue University at an age of 77 days.

Load-deformation curves were plotted for each observation point, the known nature of the curve under flexure being used as a basis; typical curves are shown in Fig. 4 herewith. The dead-load stress has been taken from these curves as equal to the stress caused by an equal live load.



Curves of Concrete Compression

Curves for Steel Tension

Fig. 4.—Typical Load-Strain Curves from Tests in Franks Building.

The table below gives a summary of the corrected values of the total dead- and live-load stresses found from the various groups of observations. The detailed summary of individual stresses at the various observation points is omitted in this paper.

Comments on the Results.—The writer is not prepared at the present time to state the significance of the results obtained with respect to the mechanics of this form of construction. Such statements would be somewhat speculative, and should be separated from the report of test, which is one of measured facts.

The Slab Design.—As compared with the design requirements of the Chicago Building Code, it is interesting to note that at design load the highest average stress in the steel is [illegible] lb. per sq. in. (average of observations 11, 12 and 13), while the highest average compressive stress in the concrete is 677 lb. per sq. in. On the basis of safe working stress in the steel of 16,000 lb. per sq. in., and in the concrete of 35% of the ultimate strength (which averaged [illegible] by tests of prisms) or 1,100 lb. per sq. in., it appears that the steel is stressed to 31% of its safe load, while the concrete is stressed to 62% of its safe load. It

Table of Actual Stresses Observed in Test of Franks Building.

All stresses are the final values for total dead and live load, and are given in pounds per square inch

Average of Observations Nos.	Description	Live load lb. per sq. ft. 256	312	624
STRESSES IN SLAB RODS				
5, 6, 7, 14, 15, 16	Center of span, diagonal band	1071	1920	6050
8, 9, 10, 11, 12, 13	Center of span, cross band	4549	6140	[illegible]
41, 42, 43, 44, 45, 47	Over capital at center column, diagonal band	3140	1350	9280
27, 28, 29, 30	Over capital at center column, cross band	1575	1840	8140
[illegible]	Over capital at corner column, diagonal band	1920	2780	7540
24, 25, 26, 41, 42, 43	Over capital at side column, cross band	2090	3138	5815
COMPRESSIVE STRESSES IN CONCRETE				
56, 57, 58, 61, 65, [illegible] 70	On slab at center column	500	650	1906
[illegible] 62, 65, 66	On drop at center column	677	778	1085
[illegible]	On drop at corner column	418	[illegible]	1515
[illegible]	On slab at corner column	129	[illegible]	650
[illegible] 73	On slab at side column	180	217	[illegible]
MAXIMUM BENDING STRESSES IN COLUMNS				
[illegible]	Compression in concrete, corner column	[illegible]	540	1000
[illegible]	Compression in concrete, center column	116	[illegible]	1000
[illegible]	Tension in steel, corner column	[illegible]	6000	[illegible]
[illegible]	Tension in steel, side column	[illegible]	[illegible]	[illegible]
DEFLECTIONS IN INCHES				
[illegible]	Center of panel at 6 hours	0.103	0.156	0.475
	Center of panel at 24 hours			0.500
	[illegible] 6 hours	0.11		
	[illegible] unloaded 14 days	0.06		

[illegible] pounds per square foot were on four diagonal panels. The [illegible] two panels adjacent [illegible] appears, therefore, that the design is overbalanced with an excess of steel. At the highest applied load of 717 lb. per sq. ft. the ratio of the steel and concrete stresses remains practically unchanged.

Column Bending.—The eccentric action of the test load was most marked on the corner columns of the loaded area, and was sufficient to produce a tension in the steel of 4,980 lb. per sq. in.

With respect to the strength of the structure, it may be said that a nominal load of 624 lb. per sq. ft. of panel, which actually was 717 lb. per sq. ft. of loaded surface, was applied without producing any permanent damage to the building. At this load the highest observed average total dead- and live-load stresses were less than 12,000 lb. per sq. in. in the steel and less than 1,700 lb. per sq. in. on the concrete.

◆

IRON AND STEEL PRODUCTION IN CANADA.

The American Iron and Steel Association has compiled from returns furnished direct by makers the following statistics of the output of finished iron and steel in the Dominion:—

Finished Rolled Iron and Steel.—The production of all kinds of finished rolled iron and steel in Canada in 1911 amounted to 775,424 tons, as compared with 739,811 tons in 1910, an increase of 35,613 tons, or over 4.8 per cent. Of the total production in 1911, 86,383 tons were iron and 689,041 tons were steel, against 83,918 tons of iron and 655,893 tons of steel in 1910. The following table gives the production of leading articles of finished rolled iron and finished rolled steel in Canada in the last three years in tons (2,240 lbs.). The production of one plant has been estimated for 1910 and 1911:—

	1909. Tons.	1910. Tons.	1911. Tons.
Rails	344,830	366,465	360,547
Struct. shapes and wire rods	74,136	80,993	76,617
Plates and sheets	36,241	26,642	14,833
Nail plate, bars, etc.	207,534	265,711	323,427
Total	662,741	739,811	775,424

Forged Iron and Steel.—The total production of forged iron and steel by rolling mills and steel works in Canada in 1911 amounted to about 18,832 tons, of which about 787 tons were iron and about 18,045 tons were steel. In 1910 the production of forgings amounted to about 18,165 tons, of which about 1,258 tons were iron and about 16,907 were steel.

Cut Nails and Wire Nails.—In 1911 the rolling mills and steel works in Canada which operated cut nail or wire nail factories produced about 652,861 kegs of steel cut nails and steel wire nails of 100 lbs. each, as compared with about 327,580 kegs in 1910, about 374,100 kegs in 1909, and about 298,000 kegs in 1908.

Active Rolling Mills and Steel Works.—In 1911 there were 27 works in six provinces which made steel ingots or castings, or rolled iron or steel into finished forms, against 24 works in six provinces in 1910, a gain of three works. Of the total in 1911 there were 21 works which rolled iron or steel into finished forms and six which made steel ingots or castings but not finished forms of rolled iron or steel, while in 1910 the number of works which rolled iron or steel into finished forms was 20 and the number of works which did not roll finished forms was four. In 1911 there were four idle rolling mills and steel works, against three in 1910.

Of the 27 active rolling mills and steel works in Canada in 1911, six were located in Nova Scotia, six in Quebec, 11 in Ontario, two in Manitoba, and one each in New Brunswick and British Columbia. On December 31st two plants were being built in the province of Quebec.

ELEMENTARY THEORY AND PRINCIPLES OF STREET CLEANING.[*]

By S. Whinery, Consulting Engineer, New York City.

The cleaning of city streets is necessary for reasons which may be summarized as the preservation of the public health, the physical comfort and convenience of the people, and a regard for decent cleanliness and good appearance. Of these, the preservation of the public health must be considered of first importance.

Filthy streets have long been held by sanitary authorities to be a prolific cause of disease, but our views as to the exact way in which street filth causes or propagates disease have, in the light of more recent investigations and conclusions, undergone a notable change. The prevailing idea in the past among sanitarians and physicians, as well as in the public mind, has been that filth and organic matter in the process of decay give off poisonous gases or exhalations capable of conveying, if not of creating, various diseases in the bodies of those exposed to them. Thus, it was held that the effluvia from sewers entering dwellings through untrapped pipes and fixtures was the direct cause of much sickness.

More recent investigations and the development of the germ theory of diseases lead to the conclusion that a large number, if not all, of the infectious or contagious diseases that affect mankind are caused, directly or indirectly, by specific organisms which propagate and multiply in the blood, and that these organisms or their germs are carried into the body not by gaseous exhalations, but only by solid or fluid matter with which the germs are incorporated or to which they are attached. These conclusions have an important bearing upon the theory and practice of street cleaning.

From the sanitary point of view street dirt may be divided into two physical classes or forms: first, the comparatively fresh, coarse and recently deposited material, such as animal excrement and the usual refuse matter and rubbish that reaches the streets; and second, the finely comminuted matter, which, when dry, is called street dust.

The first, especially when damp, possesses sufficient ponderability to prevent its being taken up and carried by ordinary currents of the air. In the second form named, that of dust, street dirt is, from the sanitary standpoint, wholly different from the first.

When the coarse material reaching the street is not removed with reasonable promptness it is subjected to the drying effect of the sun and air and to the pulverizing action of travel, and is thereby reduced to a condition of powder so fine and light that it readily floats in the air when disturbed, and may be carried by winds or breezes to considerable distances. While thus suspended in the air it may be breathed into the lungs or deposited upon the bodies of those in the vicinity. Assuming that this street dust is infected with disease germs, it is obvious that the conditions could not be better for disseminating them and conveying them into susceptible human bodies.

If the views here outlined are accepted as true, they indicate that important changes should be made in the present practice of street cleaning. Efforts should be more particularly directed, first, to preventing the formation of street dust; and second, to the removal by efficient methods and in a manner that will prevent unnecessary dissemination of such dust as may be unavoidably formed.

Heretofore in American cities the principal object has been to remove the coarse street dirt at such intervals of time as convenience or necessity might dictate by methods and apparatus not well adapted to removing the dust, which was largely allowed to remain on the street. If the quantity of dust became sufficient to cause discomfort when blown about by the winds, the streets were sprinkled with water to lay the dust. This was a palliative only, since but a small part of the dust was washed into the sewers and the remainder was left on the street to be again converted into dust when the intervals between sprinkling were long enough to allow the moisture to evaporate. Until quite recently the streets in all our cities were cleaned almost exclusively with coarse-fibre street brooms or the horse-power sweeping machine, and this practice still largely prevails in most cities and towns. As a means of removing the coarser dirt these methods are reasonably effective, and would be quite satisfactory if the sweeping could be done at sufficiently short intervals. But where the streets of heavy travel, and consequently of large accumulations of refuse, are swept but once daily, or at longer intervals, and usually at night, the heat and travel during the day are sure to convert much of the dirt into dust which the coarse-fibre brooms stir up but do not satisfactorily remove.

---

[*] Abstract of a paper read before the American Public Health Association, September, 1912.

It is true that the sweeping machines are usually preceded by the sprinkling wagon for the purpose, mainly, of preventing the clouds of dust that would otherwise be raised to the annoyance of those exposed to it, rather than to facilitate the removal of dust from the street. If not enough water is used to just moisten the dust and cause it to adhere and aggregate, most of it will remain on the street, while if too much water is used the dust is converted into a paste, which the brooms plaster upon the street surface to again be converted into dust under the action of [illegible] travel.

For the purpose of removing the coarse accumulations, patrol or hand-cleaning with broom or scraper, or both, is most efficient and satisfactory. This is true if for no other reason than that the dirt is more promptly and frequently removed. The cleaner passes over his beat several times during the day and thus removes the refuse before it has had much time to dry out and become pulverized.

For the removal of such dust as cannot be prevented, the only effective and satisfactory way yet developed is to wash the surface with water. This may be accomplished either by the use of machines of the squeegee type, which scrub the surface, or by flushing with water under pressure [illegible] carry away the fine material. For the latter either flushing machines or hose attached to fire hydrants are available.

[illegible] the removed dust into the sewers or drains, which is regarded by many as objectionable, and as likely to clog the [illegible] dirt, coarse and fine, is thus carried together into the [illegible]

[illegible]

volume of water used tends rather to flush and clean out the sewers.

If the views here outlined are sound, the theory and controlling principles of street cleaning may be summed up as follows:—

First—Street dust is the form in which street dirt is the most dangerous to the public health.

Second—From the sanitary point of view, therefore, the most important function of street cleaning is the prevention of the formation of street dust and the prompt and safe removal of any such dust as may accumulate on the streets.

Third—To prevent the formation of dust the coarse and usually most excrement and refuse should be collected and removed as effectually and as frequently as practicable, before it becomes dried and pulverized. The most effective and satisfactory way of doing this is the patrol or hand-sweeping method.

Fourth—For the removal of the dust that will accumulate to some extent, scrubbing or washing the street surface with water is the only practical and effective method yet devised.

The ideal system of street cleaning would, therefore, be efficient patrol or hand-cleaning through the day, or during a longer period if the volume of travel in the evening requires it, and thorough scrubbing with squeegees, or washing with water under pressure by flushing machines or hose at night, as often as may be necessary.

It may be objected that the funds at the disposal of the street cleaning departments of most cities would not permit the adoption and adequate application of this system in many American cities. To this it may very properly be answered that in matters seriously endangering the public health the question of cost should not be controlling, unless that cost be absolutely prohibitive, or wholly out of proportion to the benefits that would result.

Actual experience, however, seems to prove that the method here recommended need not be so expensive as to be discouraging.

The streets of Washington are notable for their cleanliness. The method here recommended has been in use there for nearly two years with most satisfactory results both as to effectiveness and cost. In the report of the Street Cleaning Division for 1911 it is stated that in the neighborhood of 1,000,000 sq. yds. of street surface were cleaned every day except Sundays and holidays by the patrol system. The hand-cleaning was supplemented by washing the surfaces about one and one-half times each week. The report states (see Report of Street Cleaning Division, [illegible]):

"Under the above system of street washing it is found that the streets are almost entirely free from dust. Any dirt which may accumulate does not have time to be pulverized, and the particles are too heavy to be disturbed or blown about by an ordinary wind. Under the old method of sweeping these heavier and coarser particles were removed, but most of the dust remained to become a source of annoyance when disturbed by the wind or rapidly passing vehicles, although the streets might have appeared to the eye to be clean."

The cost of the work per 1,000 sq. yds. cleaned once is stated to have been as follows:—

Hand-cleaning, patrol system	$[illegible]
Washing by squeegees	[illegible]

But as the washing was done, on an average, only one and one-half times per week, the sum of the above figures does not give the correct average cost, which, for 1,000 sq. yds. cleaned once during a week (six days), may be arrived at as follows:—

Hand cleaning, 1,000 sq. yds. daily equals 6,000 sq. yds. per week at 17.53 cents per	$1.052
Washing with squeegee 1,000 sq. yds. 1½ times per week, equals 1,500 sq. yds.	0.1743
Total for combined cleaning once of 6,000 sq. yds. of street	$1.1795
Equal to a cost per 1,000 sq. yds. cleaned once of	0.1966

This figure seems very low, and probably could not be duplicated in many other cities where the business streets carry a much heavier travel, but it proves that this system of cleaning need not be unusually expensive.

The cost where the flushing machines were used is reported to have been 31.57 cents per 1,000 sq. yds. cleaned once. Assuming that the streets were flushed one and one-half times per week, as in the case of the squeegee, the cost of the combined cleaning once of 1,000 sq. yds. will be found to be 25.42 cents, which must still be regarded as a very reasonable figure.

It should be noted, however, that in neither case do these figures of cost include the value of the water used for washing. The quantity of water required per 1,000 sq. yds. cleaned once as determined by trials in New York, is about 150 gals. for the squeegee and about 470 gals. for the flushing machines; but the cost of this water would be offset, in a measure at least, by the cost of that which would otherwise be used for supplemental sprinkling where the ordinary sweeping machine is used.

SLUDGE ACCUMULATIONS AT SEWER OUTFALLS.

The subject of the relation of sludge deposits to nuisance was discussed by Mr. Langdon Pearse, assistant engineer, Sanitary District of Chicago, at the recent meeting of the American Public Health Association in Washington, D.C.; the paper, slightly condensed, is given below.

The sludge nuisance in the Back Bay Fens in Boston, as reported by Mr. John R. Freeman to the Charles River Basin Commission in 1903, was so marked and the deposits of sludge so large for a small stream (amounting to one-fourth the entire capacity of the basin) that extensive dredging and the removal of the sewage by means of sewer extensions was recommended. In the case of the Providence River in Rhode Island, dredging has relieved conditions. No exact measurements or details, however, have been given.

In the report of the Sanitary District of Chicago, October, 1911, Mr. George M. Wisner, the chief engineer, has described conditions of the fill in the Main Channel of the Sanitary District and given analyses of the same. The anlytical data show a rather heavy material compared to the sludge found in sewage disposal plants, resembling more nearly a grit-chamber sludge than a true sewage sludge. The effect of the sludge on the water passing above in the canal is detrimental, although quantitatively difficult to express. From the most marked sludge deposits just above the power house, considerable ebullition of gas occurs in the summer, and even in the winter, which helps in maintaining the oxygen content at a very low level. In portions of the canal near the city, studies have been made on the distribution of oxygen in the cross-sections, and a difference has been noted between the content at the top and the bottom, the bottom usually being lower. Some variation has also been found between the two banks before mixing is complete, a distance of four to five miles. Where the oxygen content is low the distribution through the section is practically uniform, complete mixing having taken place.

The presence of large sludge deposits and scum in the arms of the Chicago River, known as the Stock Yards slip or Bubbly Creek, is responsible for a condition of nuisance and degree of odor which might not occur to such extent could the suspended matter be kept moving and even partially oxygenated. Dredging has been carried on at times.

In New York harbor, reference has been made to sludge deposits in the report of the Metropolitan Sewerage Commission, and comment has been made on the indications of oxygen in the lower layers of the water through the presence of a reddish surface on the black sludge. This phenomenon indicates the oxidation of the ferrous sulphide. This has also been observed in experiments in the laboratory of the Sanitary District of Chicago, where several inches of sludge were placed in the bottom of shallow jars, the liquid above containing oxygen.

A few quantitative experiments, made by Mr. H. W. Clark, are given in the report of the Charles River Basin Commission, 1903, in which two grams of mud or sludge were placed in ½-gal. bottles full of fresh water, or salt, and the reduction of oxygen was followed. In five days the oxygen in fresh water was reduced to an average of 61 per cent. saturation from an initial complete saturation, the extremes being a reduction to 81 and 33 per cent. saturation. An experiment was also made, with continuous flow, using 9 in. of mud in a tank 12 ft. deep, the liquid being at first 5 and later 7 per cent. sewage. In general the surface layers contained more oxygen. Comment is also made on the production of odors in tidal waters by bacterial reduction of the sulphur compounds in sea water. In the examination of the conditions in the Fens basin, referred to previously, it was found that hydrogen sulphide was formed which rose through 6 ft. of water. No oxygen was found below a surface layer 6 in. deep.

On the absorption of oxygen by sludge, some comments have been given by Mr. Almon L. Fales, supervising chemist of the Sewer Department in the city of Worcester, Mass. In 1903 he conducted some experiments on the aeration of sludge and liquid in a tank holding 1,500 gals., and found that in the early period of the experiments it was necessary to aerate several times a day, but later once in 12 hours proved sufficient. It was also observed that the dissolved oxygen disappeared much more rapidly in the layer just above the sludge. Occasionally after 12 hours or less had elapsed after aeration the dissolved oxygen would be exhausted in the layer just above the sludge, while the top liquid would still contain as high as 25 per cent. saturation. After the experiments had been continued for three weeks it was found that the liquid just above the sludge lost all dissolved oxygen in 24 hours, while the top liquid showed 125 per cent. saturation. The super-saturation was caused by the propagation of chlorophyl containing micro-organisms which gave the liquid a greenish tint. Similar phenomena can be noticed at times in streams of intermittent flow where the dilution is not sufficient to prevent nuisance.

In shallow, wind-swept waters, sludge deposits may prove a greater source of odor, owing to the constant agitation of the waves. An experiment has shown that any disturbance of sludge under water is undesirable from the standpoint of prospective odors.

Of the remedies at hand, dredging seems to be in general but a temporary expedient, aside from its value in cleaning up offensive conditions. Unless a hydraulic suction dredge be used and large space be available for the ponding of the sludge, it may be difficult to remove all the material which should be classed as sludge. With a dipper dredge probably only the more gritty material would be removed, although conditions may be much improved thereby. The composition of sewage sludge, as found in sedimentation tanks of various types, ranges from a specific gravity of 1.01 to [illegible], and seldom exceeds 1.10, the water content running from 85 to 95 per cent. This is a material which is fairly liquid.

The only permanent remedy, Mr. Pearse states, is to prevent deposits. The dilution available, however, may require further treatment. To-day, screening is available where the areas tributary are relatively small and the sewage fresh, and in case screening be not sufficient, various styles of sedimentation tanks, either of the single or double-deck type, can be used to advantage.

It is difficult to state any hard-and-fast criterion that will cover all cases. The amount of dilution affords one key. Mr. Pearse suggests that where a stream is large and the dilution great, so that oxygen is always present to a high degree except in the vicinity of the sludge banks, dredging may prove an appropriate remedy. This is particularly true when the velocities of flow are sufficiently high to keep the settling material moving at other points.

Comparison on the basis of the cost per cubic yard of dredging and of sludge collected in tanks, is difficult. Roughly speaking, per cubic yard of material handled, dredging has the lower cost price. The total annual cost per cubic yard of sludge collected in a sedimentation plant, with Emscher tanks, would be considerably higher. The effectiveness and scope for application of sedimentation plants is, however, quite distinct from that of dredging.

The conclusions are: (1) Sludge deposits may form when velocities of flow are low. (2) The effect of sludge deposits is governed somewhat by dilution; nuisance may exist, locally, even though dilution be very great. (3) Sludge deposits will use up oxygen from the supernatant liquid. (4) Three remedies are available: dredging, by-passing the locality, and the removal of suspended matter before discharge. (5) Dredging is efficient as a cleaning-up process; it is not a permanent remedy, in that it may not reach all material, and is executed at infrequent intervals. (6) By-passing the locality is a temporary expedient, which may relieve present conditions and perhaps cause trouble later elsewhere. (7) The removal of suspended matter by screening or sedimentation is effective, and of permanent service. (8) Screening will remove the coarser material, the results depending very largely on the character of the sewage. (9) Sedimentation will remove practically all the settling suspended matter. (10) Effectiveness and cost must be balanced against physical conditions.

◆

STREET ENCROACHMENTS IN TORONTO.

The question of street encroachments was the subject of a report by Mr. T. D. LeMay, O.L.S., [illegible] of the city of Toronto, to the City Council. The [illegible] report is as follows:—

The problem of reducing street encroachments [illegible] and failure to insert [illegible] [illegible] [illegible] Ontario Land Surveyor. [illegible] and boundaries, [illegible] The general question of taking such steps [illegible] would be [illegible] the appointment of an official whose duties would be the definition of all street lines [illegible] buildings, and the [illegible] encroachments [illegible] [illegible] information at present in this office being of such a meagre nature, would involve unlimited access to the field notes accumulated by the old established land surveyors of the city, which are, of course, their private property, and which they would not be prepared to throw open to the inspection of such an official, whose duties must very appreciably interfere with their practice, especially in the case of the older portions of the city, where the side lines of the lots are to a certain extent defined by possessory boundaries, and where the location of the street line constitutes for the purpose of the builder the whole survey. It might, of course, be possible to arrange some fee to be paid for each copy of notes taken, amounting to from $5 to $20 each, which, estimating the number of permits for 1912 at 8,000, would amount to a very considerable sum in the course of a year, even if the city were only called on to take action in, say, one-third of that number; and further, estimating at the rate of ten surveys a week for each such specially appointed official, it would be necessary to employ about six fully qualified land surveyors and a similar number of assistants, with an aggregate expenditure for salaries of about $14,000 per annum. The cost in this case appears to me to be prohibitive, and after careful consideration I would strongly recommend as an alternative that a by-law be passed enacting that every person applying for a permit to erect a building, any portion of which is designed to be at a less distance that two feet from the street line, or a building on any street upon which the building line is fixed by by-law, shall be required to hand to the City Architect simultaneously with his application, a plan of survey, made by an Ontario Land Surveyor, showing clearly the street line with reference to the kerb or some other permanent offset point. These plans to be forwarded to this office, where they could be placed on record with other information of a like nature. It would then be the duty of a specially appointed permanent official, being a duly authorized Land Surveyor attached to this office and working under my supervision, to check by means of the information given on the surveyors' plans the position of such buildings with regard to the street line or building line. A further duty of such an official would be to look out for and make careful enquiry into any apparent existing encroachment, and generally to compile such information in the way of ties to existing monuments as would tend to place this office more in a position of being able to dispense with the very valuable assistance that we obtain as a matter of courtesy from other surveyors in the city. In conclusion, I cannot too strongly suggest that immediate action be taken to do away with the property encroachments on public highways that are already of [illegible] to allow for the volume of traffic that they must carry.

◆

AMERICAN SULPHURIC ACID INDUSTRY.

It is estimated that some 200,000 tons of sulphuric acid are used annually in the iron and steel and coke industry in the United States out of a total consumption of [illegible] tons. The iron and steel industry, indeed, uses such quantities that a tendency is developing for steel companies to erect and operate their own sulphuric acid plants. A coke plant consuming [illegible] tons of coal per day would produce from [illegible] to [illegible] tons of sulphate of ammonia daily, according to the nitrogen content of the coal used. Therefore each [illegible] tons of coal high in nitrogen converted into coke daily, would call for a production of 10,000 tons of [illegible] deg. Bé. sulphuric acid per year. By-product coke ovens are now projected which will require 100,000 to [illegible] tons of [illegible] deg. Bé. sulphuric acid per annum in addition to the figure shown above.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: **62 Church Street, and Court Street, Toronto, Ont.** Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, NOVEMBER 7, 1912. No. 19

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Protection of Canal Lock Gates 707
Accidents and Safety Precautions 707

Leading Articles:

The Application of Diesel Engines to Land and Marine Work 695
The New Lock at the Soo 698
Ten Thousand Horse-power High-Pressure Turbines for the Biaschina Electric Power Station 699
Measurement of Actual Stresses in Reinforced Concrete Structure 701
Elementary Theory and Principles of Street Cleaning 703
Sludge Accumulations at Sewer Outfalls 705
Big Bend Water Power Developments of the Feather River in California 709
Driving a Double-Track Tunnel in Japan 712
The Upper Athabasca Region 714
Light Compression Members 715
New Westminster's Harbor 710

Coast to Coast 721
Personals 723
Coming Meetings 724
Engineering Societies 724
Market Conditions 24-26
Construction News 65
Railway Orders 72

PROTECTION OF CANAL LOCK GATES.

The protection of canal lock gates from possible injury from vessels is most important. Injury to the gates always means delay of less or greater length of time, and delay during navigation season on important traffic routes is most serious. Conditions demand the utmost facility in passing vessels through the canal during the open season.

An accident on the Welland Canal last week makes a total of five to date this season. This accident, which is noted in another column of this week's issue, is very similar to the others which have occurred this season. It caused a delay of some forty-eight hours in the operation of the canal, at the close of the season, when it is most important that the route should be open. The necessity for more adequate protection for the lock gates is very apparent. The Gowan safety device, which was described in a recent issue of *The Canadian Engineer*, has been very successful on the Welland Canal as a protection for vessels striking the gates lightly and forcing them open. This device consists of four very strong cast-steel fingers, two on each leaf of the gate, one towards the top and the other towards the bottom. These fingers project a couple of feet beyond the miter, so that one leaf can be pushed back very nearly the full length of the finger, but still give support to the opposite leaf. As vessels rarely hit the gates with great speed, this device prevents a number of accidents which would otherwise occur.

The number of serious accidents which have occurred this year, however, demonstrates the fact that a more efficient means of protection must be used.

The Panama Canal gates are protected by chain fenders. The function of these fenders is to prevent the lock gates from being rammed by a ship that may approach too near the gates under its own steam, or by escaping from the towing locomotives. In operation the chain is stretched across the lock chamber from the top of the opposing wall; when it is desired to allow a ship to pass the chain is lowered into a groove made for the purpose in the lock floor, and is raised again after the ship has passed. A hydraulically operated system of cylinders holds the ends of the chain. If a vessel should run into the fender, the chain is paid out gradually by an automatic release until the vessel comes to a stop.

It is time that the lock gates of the Welland Canal were equipped with some such protection as this. The capital cost of installing such devices is insignificant as compared with the resulting damage and delay due to these constantly recurring accidents.

◆

ACCIDENTS AND SAFETY PRECAUTIONS.

This week a railroad collision in Ontario accounted for several deaths and a large number of injuries. A prominent citizen in an automobile on his way to the station to meet the hospital train, was sufficiently hurt in a street car collision to prevent him from proceeding on his errand of mercy. These two incidents are passing from memory with the usual few days' wonder, indignation and sympathy. Within a week or so the stories will be buried in official records and newspaper files. Leaving them out of consideration, for the moment, they are still a grim reminder of the toll this country is paying for its craze for speed, its disrespect for human life. Every day brings its tragedies which might have been averted were the desire for haste reduced and the respect for the individual life increased. Is the price we pay for our much-vaunted hustle worth the hustle and the dregs we get? Here is the account in part for the three latest years:—

Three years, 1909-1911.	Killed.	Injured.
Fires	792	.....
Industrial	2,729	5,873
Steam railroad	1,407	4,751
Electric railroad	295	7,347
	5,253	17,971

No official record has been kept of persons injured in fires, but the number is large. The above figures, compiled from official sources, show that fires, industrial and railroad accidents have killed five persons and injured sixteen persons every day during the past three years. That is the total, in cold facts, of the quickly forgotten daily incidents. In addition to lives lost in fires, the annual fire waste in Canada amounts to an average of $20,000,000. These losses of life and property are shown, by careful analyses, to be caused largely by carelessness, caused in turn by an insane desire for speed. Adequate fire resistance is sacrificed for the sake of speculative building, which has become almost synonymous with the erection of poor quality in the quickest time for the most money. Our building by-laws are generally lax. Loose matches are an everyday danger. On every hand, one sees carelessness with fire risks.

Sometime ago, the subject of industrial accidents was discussed in parliament. Mr. H. H. Miller submitted a resolution, stating it to be the duty of the government to make a thorough investigation as to the facts and conditions as a result of which some means might be devised for the better protection of employees and of preventing so great a loss of life and so great and frequent accidental injury. The Minister of Labor at that time made the following statement: "We can say with certainty at this moment that a year hence another 2,000 lives will be swept off the list of workers in Canada, and in another two years there will be 20,000, whose industrial efficiency will be permanently impaired as a consequence of the callings in which they are engaged."

Our railroad accidents constitute the worst feature of the price we pay for hustle. Since 1888 to the end of 1911 7,728 persons have been killed on Canadian railroads and 27,574 persons injured, an annual average of 322 killed and 1,149 injured. Here, again, we can find the same basic cause, viz., the delusive craze for speed. Delayed trains are forced to make up time with disastrous results. Hazardous risks are taken by those responsible for operation with the lives of hundreds at stake. Taking chances is the curse of American railroading. Carelessness, which usually is the direct result of speed ambition, in some shape or form, accounts for a large number of accidents. Last year, for instance, [illegible] persons were killed and [illegible] injured by trains at highway crossings. An improvement was seen in the number of protective crossings [illegible] increased by [illegible] over the preceding year. There is probably in that fact a direct connection with the reduced number of accidents at highway intersections during 1911. These crossings are usually protected by gates, overhead bridges, subways, bells and watchmen. The last two have been proved by experience to be of little value. Gates, which usually consist of some bars under which pedestrians can climb and under which [illegible] can pass, are practically useless in that form. The present style should be abolished and one substituted which [illegible] should be non-negotiable by any kind of traffic. Overhead bridges and subways are by far the best form of protection.

A tendency was shown during the recent parliamentary discussion respecting industrial accidents, for the Minister of Labor to place the responsibility upon the industries concerned. That is a right view only after parliament has enacted stringent laws, and, more important still, has seen that they are enforced. The standard of public safety to which we are supposed to adhere is too low. It must be raised by our legislators and we must act up to it. After that, workmen's compensation is largely a matter for the railroad or other industry involved in lengthening the list of killed and injured.

These figures do not make good advertising for Canada, but idle boasting of our progress without self-examination of our weaknesses ultimately will only work to our own disadvantage. The public are demanding speed. They are being given it. The price paid is shattered nerves, human life and limb. In the meantime, legislators remain idle in face of duty.

◆

EDITORIAL COMMENT.

In an editorial on "Sanitary Engineers Needed," one of the daily papers of Ottawa states: "The people are coming to realize the reason for the unsatisfactory results obtained from the public health service in charge of medical doctors. They are beginning to see that the public health to be adequately protected must be looked after by sanitary engineers, rather than by general medical practitioners. There are still some, however, who hold the opinion that a Federal department of public health would correct the shortcomings of the existing provincial and municipal health departments. This proposal, however, as at present outlined, could only result in increasing the number of general medical practitioners in the public health service, and the chief cause for the unsatisfactory results would thus be left untouched, if, indeed, not increased." We are glad to note that the public are beginning to appreciate the difference between the practical methods of the engineer and the visionary schemes of many of the medical profession.

◆

LETTER TO THE EDITOR.

Sir,—The following is a simple method for determining voids in sand. I don't know whether this has been used before, but if you have no record of it, I would be glad to have you publish it. I would also like to have the opinions of the various engineers upon this method.

For convenience use a glass cylinder graduated to [illegible] c.c. Fill with water up to the 100 c.c. mark and then pour in [illegible] of sand. There will be no necessity of measuring the sand before hand, as the cylinder containing the water will [illegible] measure the sand. When the [illegible] c.c. mark is reached, the water will have risen a certain amount; subtracting this reading from [illegible] will give the percentage of voids in sand, without any weighing.

This is obvious, due to the fact that there were [illegible] c.c. of water to start with, and if there are, say, 62 c.c. of water above the sand, there must be [illegible] c.c. filling of voids in the sand, and as there are [illegible] c.c. of sand, the percentage of voids would, therefore, be [illegible]. Taken another way, the [illegible] reading in this case would be [illegible] c.c., which, subtracted from [illegible], would equal [illegible].

E. S. BRUNER,
Manager of Publicity,
Canada Cement Company, Limited.

BIG BEND WATER POWER DEVELOPMENT OF THE FEATHER RIVER IN CALIFORNIA.

One of the largest hydro-electric power developments in the West has been partially completed by the Great Western Power Company, of San Francisco, Cal. The development is on the North Fork of the Feather River, a branch of the Sacramento River, which rises in the Sierra Nevada Mountains in the Northeastern part of California. The power house is at Big Bend, 18 miles above Oroville, and 160 miles from San Francisco, where most of the power is used.

At Big Bend, as the name would indicate, the river makes a long detour of a horseshoe shape; the distance around the bend is about 11 miles, but the distance across the neck of land is only 3 miles. The natural fall in the river in this distance is 413 ft. By means of a dam at the upper end of the bend the flow of the river is diverted into a pressure tunnel 3 miles long, across the neck of land, to the power house at the lower end of the bend where the total fall in this length of the river can be obtained. Here there are at present 4 units installed, each of 15,000 horse-power or 60,000 horse-power in all. The station is only one-half the size to which it will ultimately be built, but the tunnel is large enough for 4 more units.

In a paper before the Brooklyn Engineers' Club Mr. H. P. Rust describes the Big Bend power development in detail. An abstract of the paper follows:

Big Bend Development.—The development consists of a concrete diverting dam 40 ft. high, which will finally be raised to 130 ft. in height above the original water level. This dam turns the flow through a concrete lined pressure tunnel three miles long. Part of this tunnel is an old mining tunnel, formerly used to drain the river bed around the bend, which has been enlarged and lined. At the outlet there is a riveted steel header pipe securely concreted into the end of the tunnel. This branches into four smaller penstocks down the side of the canyon and connects with each of the four turbines in the power house below. The end of the harder pipe is turned up the hillside to a level 35 ft. higher than the crest of the dam and forms a surge pipe, or vent, and prevents any excessive pressure of water hammer in the tunnel due to quick closure of the turbine gates. The problem of the development was a peculiar one and there are several conditions which make it unlike any other in the West. First, there was the old mining tunnel which had to be used. This had a steep grade and a fall of 70 ft., too much to be wasted by using a gravity tunnel, so this necessitated a pressure tunnel. A new tunnel or extension was necessary from the exit of the old one in Dark Canyon to the main river, 3,400 ft. long, to obtain all the head available with the shortest possible head-race. With a pressure tunnel and pipe lines, all enclosed, the quantity of water flowing could be quickly changed, thus allowing for changes in the load on the generator without having to waste water over spillways, as would be necessary with a gravity conduit, in which the flow would have to be constant nearly all the time.

The pressure tunnel allowed the use of a high dam at the intake to increase the head and to form a balancing reservoir to carry daily peak loads or store water over Sunday. With such a reservoir no water need be wasted on account of any load factor which may be obtained for the plant, and the average flow during the day could be stored when the load was light and used when the demand for power was at its greatest. By means of the reservoir and pressure tunnel the amount of water which could be obtained from the low flow in the river is increased from 50 to 60 per cent.

The chief disadvantage of a pressure tunnel in such a case is the difficulty of taking care of the water hammer and providing for close regulation, but by special precautions afterwards described this may be safely taken care of. This design necessitated engineering and construction work of a high character, much more so than is customary with most power plants in the West.

In order to get the plant started as soon as possible and cheapen the first cost, only half the power was first built and the high dam has been deferred. But the tunnel has been made large enough and all connections provided so that the power house may be doubled and four more units installed without interfering with the operation of the first installation.

Construction Plant and Camps.—The main problem before the railroad was completed, as far as the work, was transportation. This had been promised for early in the summer of the first year's work, but the railroad engineers also had their trouble and it was not in operation as far as the power house until the following spring. During this time all supplies and plant had to be hauled 20 miles from Oroville. About 25 miles of new roads were built into the different camps and the saw mills.

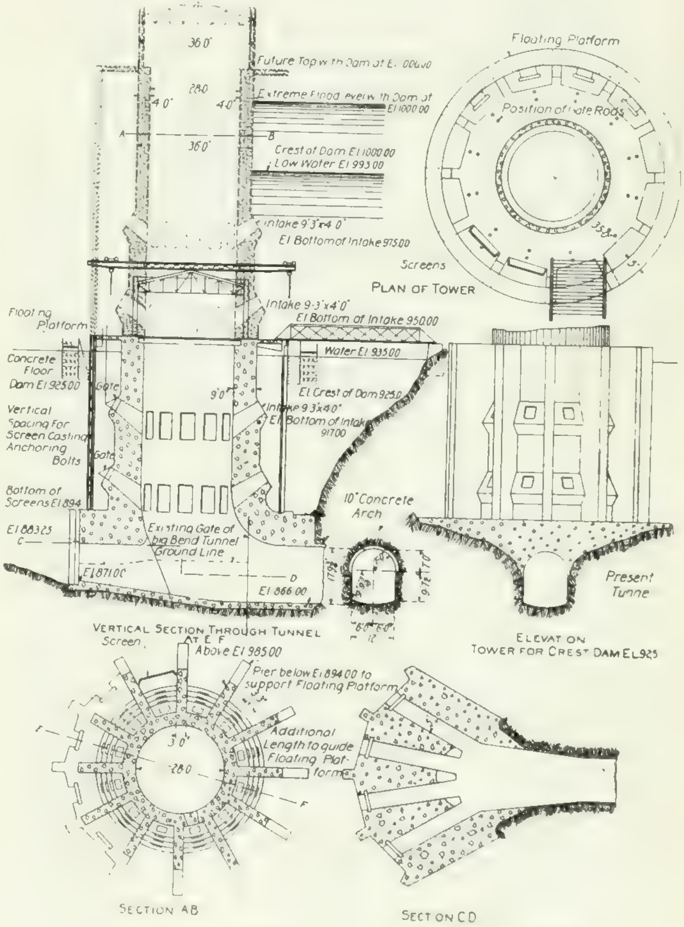


Fig. 1.—Details of Tunnel Intake Tower.

Work was started in the fall of 1906, and the weather during the first winter was very bad. There was a great deal of rain and snow and the roads were almost impassable. However, sufficient plant, boilers, compressors and supplies had to be hauled in to start the tunnel excavation. At the intake there was a camp (Camp No. 7) accommodating about 300 men. Besides the concrete plant here, there was a 1,250-cu. ft. steam-driven compressor and boilers, etc.

The principal camp (Camp No. 3) was in Dark Canyon, at the exit of the old tunnel. Here there were accommodations for about 600 men and the principal repair shops, etc. The camp at south portal above the power house (Camp No. 4), had accommodations for about 300 men. Besides these, there were two saw mills, Camp No. 6, and Camp No. 8, each with a capacity of 10,000 ft. of lumber per day; and also the headquarters, Camp No. 1, and the various storehouses, commissaries, etc.

As the work was carried on shortly after the San Francisco fire, labor was very scarce and of poor quality. The maximum force was about 1,600 men and it averaged 1,200 most of the time. No contractor could be found who would undertake the work at a reasonable price, as all who were asked to bid seemed afraid of the inaccessibility of the site, so all the work at Big Bend was carried on by the engineers by day labor. Among other troubles, there were two severe floods, the first of which washed away most of the buildings in the headquarters camp, and one bad forest fire which burned over a large portion of the company's property at Big Bend and endangered the camps and equipment.

Intake Tower.—In order to control the water entering the tunnel at all levels at which the water might stand in the reservoir, and also to provide access to the tunnel from this end, a concrete gate tower has been constructed. It is of somewhat unusual construction (Fig. 1) and is a massive piece of work. It consists of a heavy hollow concrete cylinder 28 ft. in inside diameter, with walls from 12 to 7 ft. thick; it is now finished to 76 ft. high, but, when the high dam is built, will be 163 ft. high.

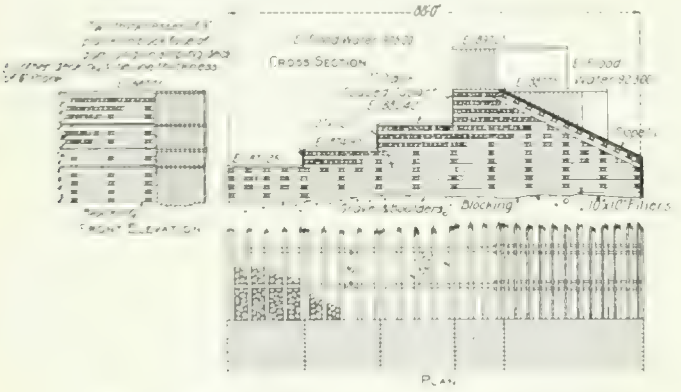


Fig. 2.—Details of Temporary Timber Dam.

Around the outside there are 12 buttresses 3 ft. thick, between which there are now 2 tiers, but ultimately 4 tiers of 12 flap gates, making in all 24 gates now in use, and ultimately there will be 48. They are each 3 ft. 4 ins. x 4 ft. in the clear and are made of steel plate. The frames, however, are cast iron. The gates can be opened by the rod extending up to the floor, which is lifted by a hand-operated crane. Their principal advantage is that they can be closed so easily; by simply releasing the rod at the top, they close of their own accord, so that in case of accident all the gates can be closed very quickly and it does not require any power. In opening them one of the upper gates, which does not require much power, is first opened, allowing the tunnel to fill gradually and equalize the pressure on each side, so that the lower ones can then be easily opened.

Outside the gates and between the buttresses are the racks. These are made up of [illegible] flats, spaced [illegible] apart, and [illegible] girders bolted to the side of the buttresses. They are arranged to be raked from a floating platform moving between the buttresses.

This arrangement allows water to be taken from nearer the surface and insures freedom from sand, silt or debris. It [illegible] with a minimum of [illegible]

In order to start the plant before the dam was finished, [illegible] temporary openings were left through the bottom of the tower. These were controlled temporarily by steel and red-wood gates, [illegible] But since the completion of the dam they have been closed permanently and will not be used in the future.

During construction of the tower, access to the tunnel had to be allowed for as it was being excavated and lined at the same time. A crushing and concrete mixing plant was erected near the tower and concrete was mixed here for both the tower and for lining this end of the tunnel. A quarry of hard trap rock was opened up just upstream. There was also a compressor located here of 1,250 cu. ft. per min. capacity to supply compressed air to this end of the tunnel.

No sand for concrete could be obtained nearby, so 2 sets of 24-in. crushing rolls were installed in the crushing plant to crush rock fine enough for use as sand.

There was not room for a camp and quarters near the river, so this was located about 350 ft. higher up the canyon side, above the tower, with accommodations for about 300 men.

Timber Dam.—In order not to interfere with work in the tunnel and protect this end of it from a higher water level, the intake tower had to be practically finished before the diverting dam could be started. Work on the tower could not be rushed without interfering with work in the tunnel, so that it required all the first working year to complete the tower and the dam could not be started until the second summer.

In order to get the plant started as soon as possible, this left only one season in which to build a dam and it would have been impossible to put in the foundations and build a masonry dam in one summer, only about six months. So it was decided to build a temporary timber dam (Fig. 2) sufficiently high to turn the water through the lower sluiceways of the intake tower and build the masonry dam later.

The timber dam was located just above the site for the masonry dam, and built so it would later act as a cofferdam for the masonry dam. It is about 700 ft. downstream from the intake tower. Also, as the Western Pacific R. R. was not finished as far as the intake, the cost of cement and sand would at that time have been excessive for the construction of any large amount of masonry. The timber dam is shown in plan and cross-section. It has a slope of 2 in 1 on the upstream side, a level crest 10½ ft. wide, and three steps on the downstream side, each 16 ft. wide. It was arranged so 8 ft. of flash-boards could be added on the crest. The crest is 22 ft. above the tunnel invert at the intake. It is about 18 ft. above the original water, or about 26 ft. above the river bottom, and is about 280 ft. long. The dam is built of 12-in. x 12-in. square timbers bolted together with ⅞-in. drift bolts 26 ins. long. Additional longitudinals and rakers are spaced 4 ft. apart to support the deck. This is made of two layers of 3-in. plank on the upstream face and of one layer of 6-in. plank on the crest and the downstream face.

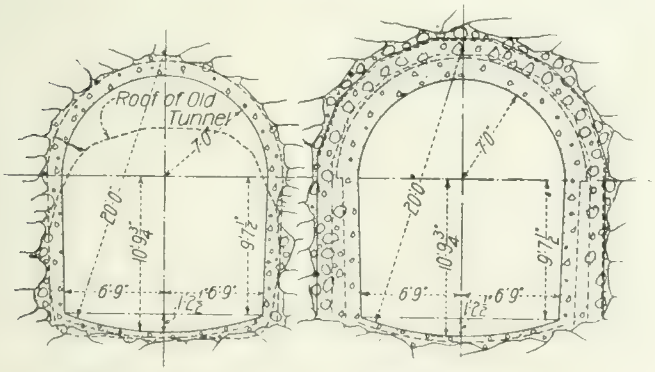
The dam was built in the dry between two cofferdams. It is founded on solid rock, at each end, but in the centre of the river rests on the boulders and hard pan of the river bottom. A row of timber sheet piling was driven along the upstream face to prevent leakage under the dam. During the first winter it successfully withstood a flood of 95,000 sec. ft., about three-fourths the maximum expected in the river. This overtopped the crest about 22 ft. No leaks developed, except one at the end, through a crevice in the rock, and the pond above was filled with so much silt it made the dam quite tight. However, the large amount of silt in the water caused a sand blast action, which wore away the decking in some places from 2 ins. to 4 ins. The timber for the dam was all obtained from the company's property near Camp 8, on the east side of the Bend, and was sawn at the mill there. It is mostly pine.

Permanent Dam.—The masonry dam was not started for a year after the timber dam was finished, and has just been finished up to El. [illegible]. It is about [illegible] ft. long on the crest and is [illegible] ft. high above the river. It is high enough to turn the water through the gates of the intake tower and to form a regulating reservoir to store water for the daily peak loads and enable the station to operate at any load factor without wasting water. It has a gravity Ogee section of cyclopean concrete masonry, and is very broad at the base on account of the severe floods. The maximum flood will overtop the crest about 23 ft. The foundation is a very hard and tough diorite rock, locally called greenstone. The bottom of the river was covered with large boulders and gravel, which had to be excavated. The lowest point of the foundation is 45 ft. below the original water level. In constructing the dam a new camp and quarters were built. Four Lidgerwood cableways were used and a large new rock crusher plant and concrete mixing plant installed. Of course, it is intended, as explained before, that this dam will ultimately be built 90 ft. higher.

Tunnels.—As was shown on the map, the old tunnel of the Big Bend Mining Co. only discharged into Dark Canyon, and did not go completely across the neck of land to to the main river below. This old tunnel has quite an interesting history. It was started in 1883 at the time placer gold mining was booming in that part of California, the idea being to divert all the dry season flow of the river through the tunnel of 12,300 ft. long to Dark Canyon, and leave the river around the bend dry, thus allowing the company during the summer to work the gravels and sand in the river bed and extract the gold which was supposed to be there.

The tunnel was started from the Dark Canyon end, and required three years to complete. It was about 8 ft. high by 13 ft. wide, and had a grade of 5 per 1,000. The progress was rapid, 400 ft. being made one month. A timber diverting dam was built across the river just below the intake, but when the water was turned through the tunnel it was found that unfortunately the tunnel had not been made large enough, and would not take nearly all the summer flow. It was then enlarged, requiring another year, by taking 4 ft. more from the roof of the tunnel, making it 12 ft. x 13 ft. in cross-section. The cost of the complete tunnel was then $750,000.

Work was started prospecting the river in 1888, but with poor success. The next year the company spent $100,000 to obtain about $40,000 worth of gold, hardly a paying proposition, so the project was abandoned. The tunnel then lay idle until purchased by the Great Western Power Company to be used as part of their development.



CROSS SECTION IN SOLID ROCK TIMBERED SECTION

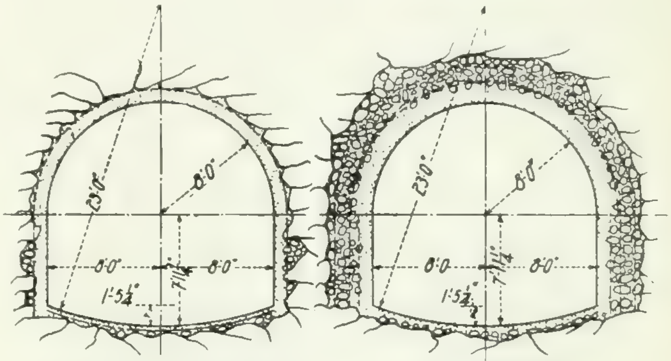
Fig. 3.—Typical Sections of Enlarged Tunnel.

The maximum flow required in the tunnels is 2,500 sec. ft. The maximum allowable velocity decided on was 11 ft. per second, so the net cross-section was made 220 sq. ft. inside the concrete lining. The old tunnel measured about 12 ft. x 13 ft., so it had to be considerably enlarged. It was made of a horseshoe section 18 ft. high x 14 ft. wide inside the lining, or 20 ft. by 16 ft. outside the lining, Fig. 3. The enlargement was made by taking from 5 to 6 ft. from the roof and by trimming 2 to 4 ft. from one side. This is the reason for making the section so high in comparison with its width, as it was considered more economically in making the enlargement to take as much from the roof as possible.

The 3,400 ft. extension, or new tunnel, being entirely new, could be made a better section. As shown, Fig. 4, it is 16 ft. wide x 16 ft. high inside the lining, horseshoe shape, but the same net area.

The concrete lining is intended to be 12 ins. thick. The minimum allowed on the sides and arch was 6 ins., and 4 ins. on the invert. From careful cross-section taken with a sunflower the actual thickness averaged 21 inches.

At the intake the invert is 54 ft. below the present crest of the dam; throughout the new tunnel and in the header pipe about 120 ft. below. When the dam is raised to its final height, the header pipe will be 200 ft. below, and the tunnel has to withstand the internal pressure due to this.



CROSS SECTION IN SOLID ROCK TIMBERED SECTION

Fig. 4.—Typical Sections of New Tunnel.

The ground is solid rock throughout. The new tunnel and both ends of the old tunnel are through shale, but about 6,000 ft. in the middle of the old tunnel is through a very hard and tough blue trap, really a diorite.

The surface of the ground is mostly from 400 to 1,500 ft. above the tunnel and all rock. The few springs encountered in the tunnel or appearing along the canyon side, tended to show that the ground water level was much higher than that necessary to counteract the internal pressure in the tunnel. On this account weepers (2-in. diam. pipe) were placed in the lining to relieve any pressure from the outside, one for each 100 sq. ft. of lining, and extra ones where any springs were encountered. However, the tunnel was very dry, and none were struck which gave more than what a 1-in. pipe would carry.

There were, however, three exceptions where all weepers were omitted and the lining was made at least 24 ins. thick. First, for about 200 ft. in from the intake. Second, for about 400 ft., where the new tunnel branched off from the old and ran under Dark Canyon. At one point here there is only 80 ft. of rock overlaying the tunnel. Third, for about 373 ft. in from the header pipe or to a point 500 ft. away from the portal above the power house. Great care was taken at these places to secure dense concrete closely packed against the rock.

In the other parts of the tunnel the rock is depended on to take the pressures, and the lining is considered merely as a means to obtain a smooth tube with small hydraulic losses. In fact, one engineer seriously proposed lining the tunnel with planed red-wood timbers supported on concrete cradles.

The proportions of the concrete mix were 1:3:5. Pudding stones were embedded in the concrete where possible, keeping them 6 ins. from the face. Very little timbering was necessary except at each portal. At the intake end and throughout the tunnel the timbering was all left in place; but at the portal above the power house it was removed, before the lining was placed.

The exit into Dark Canyon was closed by a concrete bulkhead 25 ft. thick. Two 12-in. pipes fitted with gate valves were left through this to drain the tunnel and act as sand traps.

The excavation from the roof of the old tunnel was carried on from heavy traveling timber platforms 24 ft. long. The rock was blasted directly onto these, then mucked into the cars below, and hauled away by electric locomotives. There were generally three platforms for each gang of miners drilling being done on one, while mucking from a second and moving the third ahead. Twenty travelers, or jumbos, were required in all, a number being broken in the hard trap rock. The progress varied according to the hardness of the rock, from 10 ft. per day to 3 ft. per day per gang of men.

The new tunnel was driven with a full width heading followed by a single lift bench. It was worked from both ends; that is, from Dark Canyon, and also from the power house end. The result was a maximum progress of 64 ft. a week in each heading.

The lining was not started until the excavation was nearly finished, as it was considered better to wait until the Western Pacific R.R. was running as far as the power house, so cement and sand could be obtained at a reasonable cost, by saving the wagon haul from Oroville. On this account it was necessary to rush the lining in every way possible when it did start.

The concrete was placed back of traveling forms operated in sets, made of timber. Each set consisted of an air hoist, 60 ft. of side wall forms and 60 ft. of arch forms.

These were arranged so the forms could be released as soon as the concrete had set and the carriage run ahead on rails to its new position. A 60-ft. form could be released, run ahead and set up again in from 3 to 6 hours by a small gang of men.

One gang operated two sets of these forms and would fill one while the concrete was setting behind the other. From four to five gangs, both day and night, were employed, and the record progress was the equivalent of 860 ft. of complete lining in one week.

The concrete was all mixed outside the tunnel and was hauled in by the electric locomotives.

There were three mixing plants, one at the intake, one above the power house and one in Dark Canyon. Each consisted of a No. 5 rock crusher and two ½-cu. yd. Smith mixers. There were two sets of 24-in. crushing rolls at the intake to crush rock fine for use as sand. Sand for the other plants was obtained from Marysville, 46 miles down the river on the Western Pacific R.R.

At Dark Canyon was located the principal camp and equipment. It was crowded and inconvenient, as there was practically no level ground on which to place anything. There were accommodations here for about [illegible] men. There were also an air compressor with a capacity of [illegible] cu. ft. per minute, eleven 50-horse-power boilers, machine shop, blacksmith shop and the concrete plant. Cord wood was used for fuel until most of that in the district was burned, and then crude oil was used. [illegible]

* * *

CARE OF BOILERS.

[illegible]

DRIVING A DOUBLE-TRACK TUNNEL IN JAPAN.

The Japanese people have given us many evidences of their progressiveness, but nothing emphasizes their spirit of progress more than the work which they are now doing in building a double track, wide-gauge electric railway, between Osaka and Nara. Mr. W. L. Saunders describes some of this work in a recent issue of the Mining and Engineering World, from which we have abstracted the following:

Osaka has been called the Pittsburg of Japan. It is the commercial metropolis, with 1,000,000 inhabitants, covering an area of more than 8 square miles, intersected from east to west by the river Yodo, and with numerous canals running through it, Osaka is admirably situated for a manufacturing city. Its principal trade is with China. On arriving at Osaka one is impressed by its industrial activities as illustrated by the large number of chimneys. Old Osaka has left its monument in the great castle built by Taiko Hideyoshi in 1583. Little remains of the old castle but the ruins, and principally the walls of the moat. These walls contain huge blocks of hard granite, some of them measuring 40 feet in length and 16 feet in height.

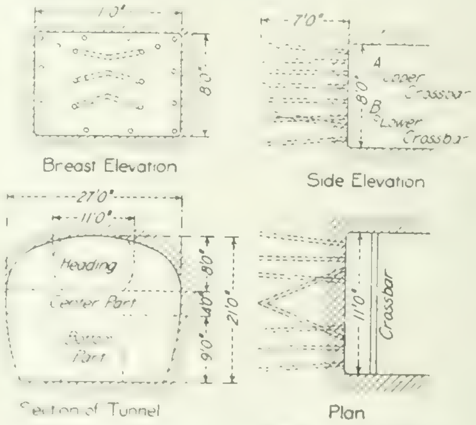


Fig. 1.—Scheme of Drilling Heading.

From Osaka to Nara is from new to old Japan, for Nara is in every respect representative of what Japan used to be. It was the ancient capital during seven reigns, and until the seat of government was removed to Kyoto. At Nara is the largest statue of Buddha, built in the year 746.

The railway now under construction is a short cut designed to reduce the time of travel and the mileage. The line runs through Mt. Ikoma, which is located about half way between Osaka and Nara.

The contract for the construction of this tunnel was awarded to Obayashi Gumi, the engineering work being in charge of Dr. Eng. T. Oka. The tunnel work begins in the eastern end at Ikoma village, extending westwardly to Hineichi village, a distance of about two miles.

The finished dimensions of the complete tunnel are [illegible] feet in width by [illegible] feet in height. Work was begun on July 3, 1911, and is now being prosecuted from the two ends.

Fig. 1 shows the methods pursued in this work. The upper pictures represent the heading, one being an elevation showing the breast, and the other representing a vertical section, or elevation, through the heading.

The lower sketch to the left in Fig. 1 shows a section across the tunnel, illustrating the entire width and height, and [illegible] the heading in the upper central part, with the centre pillar separating the heading and the bench, or bottom part.

To the right and to the left of the heading, and to the right and to the left of the bench, are sections which are excavated by the use of stoping drills. The centre prism is also removed in the same manner.

The plan immediately to the right of this section illustrates the cross-bar used for mounting the drills in the heading. The heading is 8 feet high and 11 feet wide; the centre part is 4 feet high and 27 feet wide, and the bottom part or bench is 9 feet high and 8 feet wide.

In the heading a bar 5 inches in diameter and 10 feet in length is fixed horizontally across the tunnel. Jack screws, located in each end of this bar, serve to adjust it to proper lengths, and to fix it rigidly against the walls. Three water Leyner drills are mounted on this bar, and the upper holes are first drilled. Then the bar is lowered to a point nearer to the bottom of the heading, and the lower holes are drilled.

Because of the use of these light-weight drills, which do not kick hard against their mounting, it is possible to employ this bar in place of the usual columns. Columns with arms are mainly used in America, because drills of the percussion type require a very rigid mounting. It is obvious that the use of the horizontal bar facilitates the handling of the drills, and makes it possible to set up after a blast quicker than by the use of columns. The whole thing with the drills mounted is handled readily by a gang of men, who climb up over the muck, placing the bars in position and drilling the holes, while the muckers are at work below them.

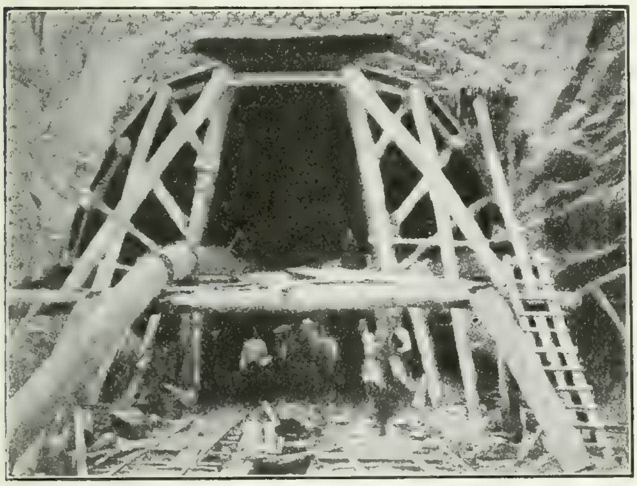


Fig. 2.—Tunnel Portal.

The centre, or cut holes, are drilled to a depth of 8 feet, all the other holes being 7 feet in depth. Blasting is done by time fuse, which is admitted nowadays to be the best practice. Gelatine is placed in the bottom of the hole next the primer, over it is placed some gelatine and then 60 per cent. dynamite. Clay is used for tamping. Where the rock is hard, from 22 to 26 holes are drilled in the heading, but in softer rock this number is reduced to 16 holes in some cases, and in others as low as 12 holes. The rock in Mt. Ikoma is granite, usually hard, especially in the east end.

Progress in this tunnel has averaged over 10 feet of heading per day. Records have been made of 20 feet in 24 hours, single heading This was on the west side where the rock is of moderate hardness. It usually requires 5 hours to drill 20 holes, 6 to 7 feet deep. The work of loading, firing and taking out the rock consumes about 3 hours, or a total shift of 8 hours. The work is done by the miners in 6-hour shifts, working day and night. One superintendent is in charge of each heading, with three drillers and three helpers.

Mine cars made of wood are used, carrying a capacity of 30 cubic feet, track 30-in. gauge, 25-lb. rail, the train of 10 cars being hauled by an electric locomotive.

For ventilation 50-h.p. Root blowers exhaust through a 20-in. stack. Ingersoll-Rand air compressors of 115-h.p. each furnish the compressed air at 100-lbs. pressure, the air being conducted to the heading through a 5-in. pipe.

The holes drilled are usually of about 2 ins. in diameter, and the progress of the drills is from 7 to 12 inches of hole per minute. Although water is fed into the bottom of the hole, the discharge of the cuttings is really effected by compressed air, which is forced in with the water, the minimum amount of water being used, and only for the purpose of laying the dust.

Power at the portals of the tunnel is transmitted electrically as a distance of 16 miles at 3,500 volts; 16-candle-power electric lamps are used for lighting.

Up to May 31, 1912, an advance was made in the east end of 2,127 feet, and in the west end 1,917 feet, or a total progress of 4,044 feet. The tunnel is to be lined with brick, about 1,000 feet being already completed.

WORKMEN'S COMPENSATION IN ONTARIO

In connection with the Royal Commission appointed by the Ontario Government to consider the question of compensation to injured workmen, the commissioner, Sir William Meredith, is visiting England and the continental countries to investigate on the ground the systems in operation in these countries.

A plan may be proposed by which all workmen sustaining personal injuries by accident, arising out of and in the course of their employment, will receive compensation, irrespective of who was to blame. A Workmen's Compensation Act of such a nature would be only similar to those adopted in the other Provinces throughout the Dominion, as well as in England.

There is a suggestion in the interim report of the Commissioner that the manufacturers of Ontario are favorable to a scheme of State insurance. The details are not disclosed, but the scheme would probably be operated on an assessment plan.

Commenting on this, Mr. Alex. MacLean, manager and secretary of the London and Lancashire Guarantee and Accident Company of Canada, says: "State insurance is a movement towards paternalism of government, more far-reaching than any economic measure heretofore proposed. The adoption of such a plan commits one to a principle, which, if carried to its logical conclusion, means that any or all commercial industries may properly be conducted by the government to the exclusion of private enterprises.

"It is for the government to decide as to what form of legislation to place on the statute books in respect to compensation to injured workmen. That is one thing, but for the government arbitrarily to fix the rates that the employer must pay for his protection is taking away the inalienable right to purchase insurance, or protection, at the lowest possible cost.

"Any legislation that will eliminate law costs and provide adequate compensation to the injured workmen will be gladly welcomed by the insurance companies. Let the government pass such an act, and if necessary see that the liability companies are subject to the closest government inspection so that no injustice will be done the employer in the fixing of rates. It will be found that there will be a better feeling between the employer and employee than if arbitrary rates are fixed by the government under a system of State insurance and injured employees are compelled to look directly to the government for compensation."

CANADIAN PACIFIC EAST-BOUND RATES AND EMPTY CAR MILEAGE

An official of the Canadian Pacific Railway, in speaking of the freight rate situation, high eastbound rates and general traffic conditions, says: "Nearly 40 per cent. of our freight trains moving westward are made up of empty cars, and it costs nearly as much to haul an empty car as it does to haul a loaded one. This empty movement is one of the largest shown by an important division of any great railroad company, and it practically means that the rates on eastbound tonnage, in order to protect the company, must be high enough to cover the eastbound haul, and also the expense of returning the empty cars to the Pacific coast.

"The bulk of this traffic," he says, "consists of lumber, and for this are used principally the ordinary box cars, which are suitable for the haulage of grain or general merchandise. It is only the long timber that is hauled on flat cars. If the cars which now return empty could be loaded with grain or merchandise, the cost of the westward trip would then fall on the latter and the burden removed from the eastbound traffic.

"In the United States, roads that show an empty car mileage of about 20 per cent. are considered expensive to operate, and in our traffic we have an empty car mileage of approximately 40 per cent." He also points out that the Canadian Pacific has probably invested more money in roadbed and equipment than any other road moving a high percentage of empty cars The line from Calgary to the coast has not yet become a profitable investment, but it was necessary to build the line in order to reach the large lumber sections and mineral deposits of British Columbia and to furnish an outlet for Canadian products to the Pacific coast.

On this division there is almost a total absence of local traffic, whereas it is on heavy local traffic that railroads principally depend for profits. The cost of road, he points out, is about $100,000 per mile, equipment included, through the Rocky Mountain section, and yet the traffic developed up to the present time is considerably less than on most roads costing not more than about $60,000.

Pacific coast extensions have proved a somewhat expensive necessity without an adequate return of profit, but it is in keeping with Canadian Pacific policy that this work is undertaken, for this road has always built far in advance of traffic demands. At present, Canadian Pacific is spending about $2,500,000 for a new station and office building at Vancouver, and also a new pier at Vancouver Island.

A large westbound traffic in wheat, which may be reasonably expected in time, will have the effect of lowering rates on eastbound freight and incidentally enable manufacturers to extend their markets in Alberta, Saskatchewan and other eastern provinces.

◆

THE UPPER ATHABASKA REGION.

The rapid linking together of the Grand Trunk Pacific [illegible] [illegible] [illegible] [illegible] central Canada [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Central [illegible] [illegible] [illegible] [illegible] and of all this there is [illegible] [illegible] [illegible] [illegible] [illegible] region [illegible] [illegible] [illegible] [illegible] of the Athabaska River and [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible] is Fitzhugh, a [illegible] [illegible] [illegible] Jasper Park, some two hundred and fifty miles west of Edmonton.

How little of this region has been actually trodden by white men is evidenced by the fact that only four short summers ago the largest sheet of water on the entire east slope of the Rockies was found in its recesses. This beautiful mountain lake, some seventeen miles in length, and lying between green wooded slopes, forms a broad expansion of the Maligne River, and resembles a Scotch tarn in its far-melting vistas of water and crag. This lake is some thirty miles south-east of Fitzhugh, and twenty miles farther south is another large lake, where the trout fishing is excellent. The latter body of water forms the chief source of the Brazeau River. To the west of it, in Alpine grandeur, lies the region of wild, lofty peaks, dominated by Mount Alberta, where enormous glaciers give birth to the Athabaska and North Saskatchewan Rivers.

This region is also a noted game country. It lies far enough north to have escaped in part, during recent years, the far-searching reach of the Stoney Indian; bears of all kinds are still fairly numerous; the sheep (and more especially the goat) hunting is good, while scattered moose, deer, and even elk, may be occasionally seen.

Meantime, the crying need of the district, for tourist and fire-ranger alike, is the need for more and better trails. Hence, to provide a good and adequate system of trails will be the first and constant effort of the Dominion Forestry Branch in carrying out its recently assumed duty of administering this region, so as to protect its forests from fire and make every auxiliary resource contribute its part to the public welfare. During the present season the rangers in charge made a good start on this work, and next year it will be again pushed with vigor. Already, between Laggan or Morley, on the Canadian Pacific Railway, and Fitzhugh, an old through trail is in existence, a trail which promises to be a very popular Alpine tourist route when improved. It traverses the Brazeau, Clearwater and Bow River, forests, and everywhere its improvement will be promptly undertaken by the Forestry Branch.

The scenery in this upper Athabaska country is varied and beautiful in its color effects, and specially so in early autumn. From the deep green carpet of pine and spruce on the valley floor the eye passes to intermingled belts of blushing gold poplar and light green lodgepole, fringed above to timber line by sombre masses of Alpine fir. Higher still, the warm reds and ochres of disintegrating ferruginous rocks form a Joseph's coat of many colors, while over all loom the background of summits wrapped in their eternal snows.

◆

THE AUSTRALIAN TRANSCONTINENTAL RAILWAY.

At Port Augusta, South Australia, on September 14th, the interesting historic ceremony of breaking the first sod in the construction of the Transcontinental Railway was performed by the Governor-General (Lord Denman). A large number of legislators and others interested in the work were present. This new line, to connect the State railway systems of South and Western Australia, will be [illegible] miles in length, and the gauge is the standard of 4 feet 8½ inches. The highest point on the line is an elevation of [illegible] feet and the steepest gradient 1 in 80. It is estimated that the work will be finished in from three to four years at a cost to the Commonwealth of, approximately, [illegible].

The completion of the railway will open direct communication (independent of the existing steamer service from Adelaide, S.A., to Fremantle, W.A.) from the eastern states with Western Australia, which is the largest state in the federation, comprising an area of [illegible] square miles, with the present limited population of about [illegible]

LIGHT COMPRESSION MEMBERS.

On March 11th, 1912, the Western Society of Engineers held a meeting at which a topical discussion of the design of light compression members was taken. The discussion is given herewith:

Horace E. Horton: I have just one thing to urge in connection with the details of compression members—not necessarily light members, but all members. The error I discover is that the principal part of our discussion turns on the radii length, while it has developed, with the built-up members universally used, that the composition of the section has more to do with its efficiency than its radii length.

Our knowledge of column design has been evolved from laboratory experiments on solid rounds and small pipe, made approximately eighty years ago. The laws of flexure for rolled sections were fairly well developed by these early tests; in fact, we have repeated examples justifying the laws of flexure as set forth in the formulae. In the evolution of things, however, we have come to build compression members that are not rolled but are composite structures, usually of plates and angles. We may use channels or we may use beams, but practically speaking, the members are built up of plates and angles. There are specifications in general use that allow a greater compressive than tensile stress per unit section of the same material. It was this error that culminated in the Quebec disaster. Compression members of forty radii were used with as great a unit stress as that allowed for tension, and in some cases a still higher unit stress was allowed on these compression members. As a matter of fact, the compression members of that structure failed with one-quarter the unit load that the material would have sustained in tension. Now, it failed how? Not by flexure, but by the wrinkling of the component elements.

Another engineering society started, some years ago, to gather all available statistics with reference to compression members. The committee of that society concluded that laboratory tests were of no value and they found, altogether, 268 recorded tests of large compression members, 184 of which were of iron and almost obsolete, except as illustrating general laws. A second group of 52 tests were made on rolled sections, namely, pipe and **H** sections. The tests of this second group undoubtedly show the maximum efficiency possible in a compression member. Each one of a third group of 32 built-up members failed by wrinkling of the parts. Not one of them yielded by flexure. In other words, none of the tests of which we have record shows a built-up member which was so designed as to reach its maximum efficiency.

We are left with the question: Suppose two, or three, or four times as many rivets had been driven through the angles and plates; or again, suppose that rivets of twice the area had been used. Would the members have sustained a greater load? Would we have obtained a greater efficiency from the material by using more or larger rivets?

What we want instead of 32 is more than 1,000 tests, varying the constituent elements such as radii length, size, and number of rivets. It happens that the members of this third group of built-up members represent about 65% efficiency, as compared with the rolled sections, at their point of failure. The loss is 35%, and it is here that experimental research can point the way to better design. We will have to have a large number of tests to give us the knowledge necessary to design to the best advantage.

Because the cost of a sufficient number of tests of full-sized members is prohibitive, I am personally inclined to think that laboratory tests are all that we can hope to get in sufficient number. Suppose we use a built-up section of two plates, 4 by ⅛ in., four angles ¾ by ¾ by ⅛ in., varying the size of the lacing and the size and number of rivets as the research advances. This section would have a gross weight of, say, 8 lb. per lineal ft., would have a radius of gyration of 1.5 and a sectional area of 1.42 sq. in. The length for 24 $\frac{l}{r}$ would be 3 ft., and for 240 $\frac{l}{r}$, would be 30 ft.

If we should make tests of five members of each of these lengths and eight intermediate lengths, we should have 100 tests which would undoubtedly point out many valuable facts. By making 1,000 tests in all, it would probably be possible to discover the spacing and size of rivets to make the material fail by flexure rather than by wrinkling.

The Pennsylvania Lines (Panhandle) not long ago made elaborate tests of six large members about 40 ft. long, each nearly 100 sq. in. in cross section. The material for these tests alone represented some 80,000 lb., or about the equivalent of the material required for the 1,000 tests suggested above.

I believe that we are safe in concluding that there is no mere mental analysis that will ever show us the required relations. Physical tests are required. We have only 32 tests of full-sized steel members in all the years that have gone. These members were all designed on the theory that they would fail by flexure. They all did fail by wrinkling. Failure by wrinkling invariably indicates a low efficiency and a poorly designed member. Sections such as I have indicated can readily be handled in our university testing machines. At the University of Illinois, as at other engineering colleges, there are ambitious professors and active students. Give them a chance. I believe that if this society would become interested in the subject, it would be possible to actually devise means whereby 1,000 such laboratory tests could be made, thereby adding more to our knowledge of the compression member than we could hope to obtain in any other way.

F. E. Davidson: In this discussion I trust some one will take up the question of a rather long compression strut with light loading, and show us how he would build an economical strut out of ordinary stock sections. That is a problem that architects and engineers have to meet constantly. The requirements of our revised building code with regard to compression members are very rigid compared to what could be done a few years ago. There are certain credits given to steel that is encased in concrete under certain conditions; that is, one can use a higher stress in certain types of columns than in other steel shapes with the same amount of concrete fireproofing.

When I was with the Illinois Steel Company I often used, in struts between roof trusses, a light channel with a plate riveted to one flange. For instance, with a 7-in. channel I would use a 7-in. plate and run the plate about three-quarters the length of the channel, simply to stiffen it sidewise. It is true I do not know of any case in which this section was used where the unit stress in the steel was over 3,000 to 4,000 lb. per sq. in. That was not economical; it was wasting steel; but it was the best we could do. I have used a 5-in. I-beam with a 4-in. channel riveted to the web. The channel has no office to perform, whatever, except to stiffen the I-beam section. The latter takes the entire loading. This section of a column is one that can be put in an ordinary 4-in. partition in an apartment building.

Recently the Lally column has come into use, which is nothing but a steam pipe filled with concrete, and it is my opinion that it might as well be filled with sand. The star-shape section, made of two angles, is very weak in one direction, on account of the very small radii.

To-day we are confronted with the proposition that we have not, nor can we build, an economical rigid section for very light loads. Take, for instance, wind bracing. It is easy enough to provide a suitable section for heavy loads, but with light loads it is a different matter. In our building designs of to-day, for instance, the columns in the top story of any building, a 5-in. **H** section would support every load, but you cannot get it and what will you use in its place? As a matter of fact, I doubt if the manufacturers of steel have kept pace with the demand for economical sections along these particular lines. I understand that the Illinois Steel Company are developing these sections, and are making rolls for a new set of beams throughout; also that they are developing some very small, light sections, and are changing the moments of inertia and the weights of standard beams from 8 to 24 in.; so that very soon we shall have a new series of steel structural shapes to figure on. This is all right for floor construction, but what I am after is something that we can use for columns and struts, which is economical; where the steel can be actually stressed up to a working limit of, say, 10,000 lb. per sq. in. Heavy column sections may be built out of a number of structural shapes, but in the light sections we are compelled to waste material, no matter what we use.

Albert Smith: I am quite unequal to suggesting any section that would be thoroughly economical in the case which Mr. Davidson mentions. We use channels, light channels, with angles at the bottom in an endeavor to make the actual fiber stress come as near as possible to that permissible in such a case. It has sometimes occurred to me that it would be possible to use a pipe section in cases of that kind. If we could get pipes 18, 20, or 24 ft. in length of thin material, and could manufacture a standard detail for the end, to be threaded onto the pipe, we might be able to carry these very light loads economically. I think we are too much afraid of doing shop work, in general; we think a little too much of the cost of coping and of blacksmith work. With us, with the very excellent machinery that we use, he cost of shop work cannot be anywhere near as great as with English manufacturers. I refer especially to the small compression members of a bridge brace—those which we now make of single angles. English designers use T-bars almost exclusively for such struts, cutting off the outstanding leg, and I think such members could be used economically as our struts. The cost of coping would not be great and we should avoid, in most cases, the gusset plate. Nine times out of ten two rivets are sufficient for a connection, and the two rivets could be driven through the remaining leg of the T-bar into the top chord.

In regard to large compression members—those to which Mr. Horton has referred—I wish that such tests could be made by the government, and that when they are made they would parallel the case of the member in the field; for instance, the vertical posts of railway bridges. It seems to me they would be better if tested in connection with the floor beams and it does not seem reasonable to get bending in that post from the floor beam attached to it. It should be [illegible] with a floor beam at the other end [illegible] [illegible] and then we might find an answer to a question which is not entirely [illegible]. What constitutes free length? I have [illegible] a set of specifications which contain three definitions: fixed at both ends, fixed at one end and free at the other, and free at both ends, [illegible] the free length [illegible] [illegible] of the [illegible] between [illegible] conditions [illegible]. I do not know what constitutes a "fixed end" [illegible] to an actual structure; it seems to me [illegible] [illegible] [illegible] the [illegible] connections [illegible] of the [illegible]. There are so many things that come into the stiffness of the member, in the connection, the yielding of the support, the rigidity of the attachment, that it seems as if a test, which would simulate actual conditions and show the actual value of the compression member under those conditions, would be very valuable. The difference in the permissive fiber stress is likely to run as high as 25% or 30%, according as you vary the free length—that is, supposing you use the ordinary formula, 16,000 minus 70 $\frac{l}{r}$, and 30% is a rather important amount in the design of your member.

I have no suggestion that bears directly upon the subject that the chairman has in mind.

Henry E. Vanderlip: In listening to Messrs. Horton and Smith, a few things have occurred to me. First, in regard to the question of wrinkling referred to by Mr. Horton. I have seen columns with that wrinkling between rivets, produced by heavy loading. There would seem to be a bulging out between the rivets, and yet the rivets had been spaced according to the so-called practice, which ordinarily is that no ¾-in. rivet—which is the standard rivet used in bridge and building construction—shall be placed at a greater distance than sixteen times the thickness of the thinnest outside piece of the member. This would mean that a ⅜-in. plate would be the minimum thickness where 6-in. spacing could be used, and a 5/16-in. plate, according to the rule, would permit not greater than 5-in. spacing. Yet, if you use that same 6-in. spacing with a ⅜-in. plate under some conditions of loading, you will get a bulging or wrinkling of the plate. According to the formula, it should not bulge. That is one of the peculiar things in the construction that nobody has ever seemed to explain.

The subject that the chairman brought up, about the advisable form of column for light loads and long lengths, is one which has not often been brought before the engineering profession. We might consider two forms: First, a post or column under four points supporting a water tank—a gravity tank—placed 25 ft. (approximately) above the roof of one of the standard warehouses as they are built in Chicago. There are all kinds of forms of columns used, and it does seem as if the engineers should agree on some standard form that seems to be the most economical for that purpose. You will see a dozen different forms to carry, say, a 25,000-gal. water tank. I have known of cast iron being used for that purpose, but personally I would not select it. I have seen two channels used so as to form, with cover plates, a box-shaped column. Then I have seen four angles with a single web plate, which we all know has unequal radii of gyration on the two axes. Then I have seen star-shaped forms, and the star may be formed by using two or four angles—two angles of sufficient area to take a light load—and increasing those two angles in thickness and in the size of the leg of the angle until we reach a point where good judgment would say you should use four angles as the load increases. I think this is a very good form of column for that purpose, for the reason that a water-tank tower is essentially a wind-braced structure. Therefore, since it is a wind-braced structure, one can arrange the position of the wind bracing horizontally and diagonally so that the question of the radius of gyration does not really enter into it. Another thing, the gusset plates can be arranged in between the angles, and the connections, from a bridge shop point of view, are about as good as can be obtained.

The other form I have in mind is a long column. Imagine a column, say, 35 ft. long, in the middle of a large and high room, with an upper floor and roof of the building carried on that long column. According to the building ordinance, if the column is to be fireproofed with tile where the tile did not aid in stiffening the column, then the radius of gyration of that column should be 1/120 of that length; or, 40 ft. being 480 in., there would be a radius of gyration of 4 in., and the engineer would select a form of column where he would have a radius of gyration of 4 in. The form is a matter of preference. Probably in a case like that the average engineer would select a box-shaped column, as it is easier and cheaper to get a radius of 4 in. with the box shape by using channels and cover plates.

J. Norman Jensen: It might be advisable for me to review some of the features of the ordinance in regard to columns. As you probably know, the ordinance formula for the allowable stress is $16{,}000-70\frac{l}{r}$, and if the column is filled with concrete, and also encased with concrete, so that there is at least 3 in. of concrete outside of the metal, there is permitted an allowable stress of $18{,}000-70\frac{l}{r}$, but not to exceed 16,000 lb. In the first formula referred to, the limiting stress is 14,000 lb. These are the highest stresses that can be used, and the limiting length of the compression member is 120 times the least radius of gyration. You will find, if you want to use an I-beam column, as is sometimes advisable, say a 6-in. I-beam, you could not use a length more than 7 ft. 2 in., and if you had an ordinary ceiling height of 10 ft., or a little more, you would have to use a 15-in. I-beam, 42 lb. per ft. This 15-in., 42-lb. I-beam would be insisted on, even for the top floor of a building where there is only a light roof load, because we have only the ordinance to go by, and that is the requirement of the ordinance. In order to meet the condition for slender columns, the Lally and the Acme columns have grown into use under the protecting wings of the ordinance. Where you would have to use, say, a 15-in. I-beam, 42-lb., you could use a Lally column or an Acme column 4½ in. in diameter, and satisfy the requirement as to length. Probably most of you know that these columns are merely pipes filled with concrete under pressure. In the city of Chicago there are two types—the older form called the Lally column, and another form called the Acme column—a recent competitor. While, of course, we cannot show any preference, we find that the details of the Acme column are considerably better.

The reason for bringing up this topic of light compression members, and the cause of this discussion about the limiting length of compression members, is that in apartment-house work in particular we want a column to fit inside of a partition. A 15-in. 42-lb. I-beam will not go inside of that partition, and so the architect and the engineer are compelled to use these round forms of columns, in order to comply with the rule in regard to limit of length. We would like to see the ordinance changed. We would like to see the limiting length increased from 120 to 150 times the least radius of gyration. This would allow the use of I-beam columns which are now practically excluded in buildings. The average round pipe column is of rather flimsy construction. There is no stiffness or rigidity about it. The use of an I-beam column for light loads will give something that is fairly stiff, and will be a section to which an I-beam can be riveted or bolted.

Tests at the Watertown arsenal, and other places, show that the radius of gyration has practically nothing to do with the strength of the column. The recent tests at Watertown arsenal show, for the lengths tested (from 25 to 175 times the least radius of gyration), that there was practically no difference in the strength. The one at 25 was just about as strong as the one at 175 times the least radius of gyration. So it seems that we are placing altogether too much emphasis on the theoretical considerations, and that we must come back to common-sense ideas and realize that in a compression member we want a good sturdy member, a member all of whose parts will work together, and not a highly theoretical member where the metal is in thin sections widely spread.

I spoke of the building ordinance and my hope that it would be changed to allow the use of I-beam columns in buildings. If such a change were made I would also suggest that the wording of the limiting length of cast-iron columns be changed. At present it reads: "The limiting length of a cast-iron compression member shall not be more than 70 times the least radius of gyration." The average layman and the person who has many other things to think about does not want to figure out the "70 times the least radius of gyration." The way that rule was obtained was this: They took the old rule of thumb of limitation of the length of a cast-iron column to 24 times its least diameter and translated it into 70 times the radius of gyration.

I do not know particularly what columns are referred to as freak columns. Sometimes we run across water-tanks carrying very heavy loads with supporting columns of single angle sections. Of course, theoretically that would seem to be all right, but it does not always look right. Outside of that I do not know of any particular instance just now.

Mr. Vanderlip: May I ask a question? Mr. Jensen remarked about the radius of gyration not having much to do with the strength; this made me think of the form of column that is used in a long boom—some of these modern long booms for derricks, 50 or 60 ft. long. They make those out of four angles, and near the ends where the blocks and pulleys are fixed they come down to possibly 8 in., back to back in both directions. Then as they go toward the centre they bow them out so that they are perhaps 16 or 18 in. wide. Would that not seem to indicate that the radius of gyration is a very important thing in there. The farther out they bow, the larger becomes the radius of gyration to take care of the bending tendency of the column.

Mr. Jensen: The point I wanted to bring out is that theoretical considerations lay large stress on the radius of gyration, but actual tests show it does not make any difference, as is shown at the Watertown arsenal—I am referring to this in particular. They took a certain type of column, and varied the ratio of $\frac{l}{r}$ from 25 to 175., and they found, so far as the load-carrying capacity of the column was concerned, that the ratio of $\frac{l}{r}$ seemed to make no difference: a long column would carry just as much as a short one. Some recent tests at the University of Illinois indicate that this radius of gyration—a thing that has troubled us ever since our student days—really has no right to trouble us. It has not much to do with the strength of the column. We have to make some allowance for it, in a way, but we should not lay as much stress on it as we do.

These tests also bring out another fact. According to the formulae for long columns, we ought to get the higher stress in the middle of the column. When the column is tested, that highest stress is not necessarily at the middle. It may be there or somewhere else.

I do not wish to discredit theoretical considerations, by any means, but to me it is more important to be guided in all these things by actual tests, and if these tests show that the radius of gyration has not much to do with the strength, we ought to throw overboard the radius of gyration.

Mr. Davidson: Mr. Jensen brought out one point that has troubled me somewhat, and that is how to make rigid connection between a floor beam and a Lally or Acme column. He also brought out in his remarks the advisability of using the I-beam. With an I-beam with floor beams riveted to it, there is rigidity to a building. In the other case there is a little steel or iron pipe filled with concrete, set up on a little cap, with no rigidity to it at all.

H. J. Burt: With reference to using I-beams for columns and also other light members, where the load is small in comparison to the section that is required on account of the rule limiting the value of $\frac{l}{r}$, I have resorted to this expedient: I have figured the radius of gyration of only the outstanding metal; that is, the flange of the I-beam. That permits one to go to a longer length for a good sized member and seems to me to be altogether permissible, provided there is enough metal in the flange to carry the load specified.

W. L. Cowles: It seems there can be no question about the cylindrical section. Probably the strongest—it must be the strongest—is the pipe section, and evidently such a form of section has been used for building construction recently, but I should imagine that it might be quite difficult to make satisfactory connections. I am not familiar with the dimensions and what the connections may be. I recall that pipe sections—in fact, actual gas pipes—were used quite extensively by the Brown Hoisting Machinery Company some years ago. The sections were prepared by putting them in the blacksmith shop and straightening out or flattening the ends. They were used in a riveted connection, and for compression members so far as they were available; also for the posts of bridges—the chords, however, being made of channels—and for lateral struts.

I have never seen this method of construction used anywhere else, and in many places it might be considered a difficult or uneconomical one as to shop work, but the Brown Company was equipped for that kind of work, and the results seemed to be very good. The pipe section certainly proved economical in construction and served the purpose very well.

I do not know whether the Brown Company is still using that section or not, but if these pipes can be utilized economically they will naturally make the best section for the [illegible]

Mr. [illegible]: It seems to me that the necessary thing to do in this matter of light column work is to take off the [illegible] length of the member. If there is [illegible] the foundation should be [illegible], it has not [illegible] that [illegible] happens there. [illegible]

[illegible]

[illegible]

portant point which is not always given the consideration that it merits. If composite members fail by wrinkling of the parts at 65% of the load that a pipe or **H** section will stand, then 35% of the maximum efficiency is lost. By spacing the rivets closer or by changing the proportion of the different parts, it may be possible to make built-up members approach nearer the strength of a solid section of equivalent area. Mr. Horton suggests that a large number of tests be made of small-sized members with variations in the relative sizes of the flange and web elements, and in the numbers and sizes of rivets. It might then be possible, from the results obtained, to recover some of the 35% lost efficiency.

Olin H. Basquin: In regard to pipe sections, I recollect that tests were made at the Watertown arsenal not long ago, perhaps within three or four years, in which Mr. Howard showed that pipe sections of moderate lengths fail practically always at their elastic limits when tested as columns. He also showed the same thing for these **H** sections, the form used by the Bethlehem Steel Company. These sections were used with square ends and were loaded very carefully. One would not expect to get such a result in actual practice because they could not be loaded as carefully in a structure as they were in the laboratory. That is one difficulty with all tests that have been made on columns, because the load which the column will stand depends very largely upon the care used in loading it, and the degree of accuracy used in getting that load at the centre of the column section.

The theory of columns is generally thought to be in a very unsatisfactory condition, but this is due to the fact that people do not pay attention to the theory that is already fairly well developed. About thirty years ago Professor S. W. Robinson, of the Ohio State University, published a paper on the strength of wrought iron bridge members, and that paper has been republished in No. 60 of Van Nostrand's Science Series. In that he gives the correct formula for maximum stress in a column, which is based on the same assumptions that are ordinarily used in the beam theory. This formula was rediscovered by Professor Marston, now of the Iowa State College, then a student at the University of Wisconsin, and was published in the Proceedings of the American Society of Civil Engineers, in connection with a paper by Dean Johnson, but Dean Johnson warned the public that this was a very dangerous theory to use in practice—for just what reason I do not know. This theory has crept into the German text-books and has been used there for a long time, but you will find it in a rather subordinate position in the better American text-books of the present time.

This theory depends upon the load on the column being a little out of centre; that is to say, it is the theory of eccentrically loaded columns and it is the true theory for ordinary columns; but in order to apply it, we must know where the load is; in the ordinary column, of course, we do not know where the load is; it may be an inch out from the axis of the column; so, in using an ordinary column formula, we are guessing how far the load is from the centre of the column. Of course, that is a short way and a convenient way of estimating columns in practice, but I want to call attention particularly to the fact that the theory of [illegible] columns are well built, is not on a particularly unsatisfactory basis. This theory was taken up by Professor [illegible], who published a book on columns and made a great many experiments on eccentrically loaded columns of rather small size. He took, particularly, a number of angles fastened together, and loaded one of the legs, and found that the deflection and failing load corresponded closely with the values which one gets from calculation.

Three or four years ago—perhaps a little longer—Mr. Buchanan published a series of tests made for one of the eastern railways—I think it was the "Panhandle." In some of those tests, which were made on the top chords of bridges loaded on the pins with a certain eccentricity, the deflections which he gives will be found to correspond almost identically with those calculated, but those columns did not fail at the maximum stress which was calculated. Why? Nearly all of them, I think all of them, failed in the details, particularly at the end plates; and I think that is true of nearly all tests of full sized columns made up of riveted shapes. They do not fail at the maximum stress figure, but they fail in the details.

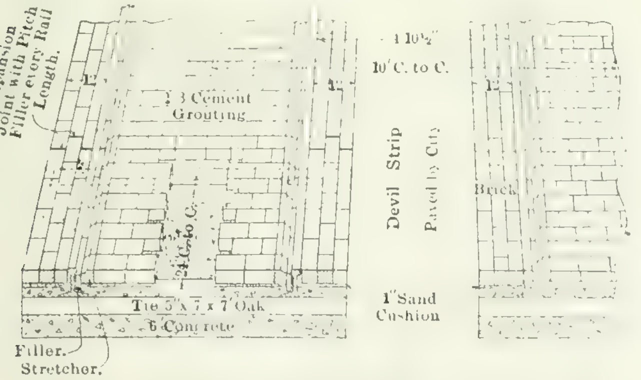
What is needed is more experiments like those recently performed at the University of Illinois, in which they were testing the strength of riveted joints. As far as the columns are concerned, it does not seem to me that there is much need of testing a great many columns in the laboratory until we know how to make the details properly, and then it is not at all certain that the tests will be of any great value, because the failure of a column depends upon how carefully it is fabricated and just how the load is applied, and to apply the load very carefully in any one position in practice is almost impossible. We cannot duplicate in practice the conditions of the laboratory, so that the results which are obtained in the laboratory will not correspond to those obtained in practice.

◆

STREET RAILWAY CONSTRUCTION.

The Des Moines (Ia.) City Railway is using for standard track construction in paved residence streets having ordinary traffic the combination of materials shown in the accompanying drawing, a description of which appeared in a recent issue of the Electric Railway Journal.

The foundation for this track consists of 6 in. of concrete below 5-in. x 7-in. x 7-ft. oak ties spaced 2-ft. centres, with 2 in. of concrete above the ties and a 1-in. sand cushion for the paving. The rails, which are the Lorain 80-335 section, 7 in. high, with 6-in. base, 2¼-in. tread and 7/16-in. web, are connected every 6 ft. by 5/16-in. x 2-in. tie rods. The interesting feature of the paving is the use of the Nelsonville (Ohio) Brick Company's filler and stretcher blocks in connection with the T-rail. The filler blocks are 2 in. x 5 in. x 9 in. and the stretcher blocks 3¼ in. x 4 in. x 9 in. in size. Pitch filler is used for the joints between them. The other paving used on the street is of cement-grouted brick, 4 in. deep, as shown in the illustration.



T-Rail with Filler and Stretcher Block, as Laid in Des Moines, Ia.

NEW WESTMINSTER'S HARBOR

Seeing that a bill will shortly come before parliament to make New Westminster a national port; that most extensive plans for the development of this port have been drawn up and the first work is being carried out; and that the development of the Pacific Coast ports is of importance to the whole of Canada, the following authoritative facts concerning New Westminster and the Fraser River, which can be relied on, are of much interest:

New Westminster is situated on the Fraser River, 18 miles from the sea.

The harbor extends from the head of Douglas Island (about 28 miles from Sandheads Lightship) down the north arm to salt water, south to the international boundary and up the south arm to Douglas Island. The length of the main deep-water channel (or south arm) is 28 miles, and 14 miles is the length of north arm for log towing and small vessels. The depth is 14 feet at low-water, and 26 feet O.S. high-water at Sandheads. When the Dominion government's work at the Sandheads is finished these depths will be 25 feet at low water and 37 feet at high-water. Along 1.7 miles of municipal waterfront there is an average depth of 40 feet.

There is 12 feet of tide at the Sandheads and 5 feet at New Westminster. Marine growth dies and falls off in the river water in ten days or so. The water is good for boilers.

Pilotage fees are $1.00 per foot of vessels' draught and 1 cent per registered ton each way, half charges if no pilot is employed.

Harbor dues are chargeable as follows on vessels of

	50	tons and under		$ .50
over	50	tons and not over	100	1.00
"	100	" "	200	1.50
"	200	" "	300	2.00
"	300	" "	400	2.50
"	400	" "	500	3.00
"	500	" "	700	4.00
	700			5.00

Dock dues are not charged; wharfage amounts to 50 cents a ton. The railway makes no charges on freight delivered from or to their own trains. One dollar a day berthage is charged where any charge at all is made.

The principal wharves are those of the Canadian Pacific Railway, 340 feet long; Canadian Pacific Navigation, 700 feet long; British Columbia Transport, 600 feet long; British Columbia Electric Railway; Great Northern Railway, and that of the Canadian Northern Railway at Port Mann, 1,000 feet long, and many other privately leased wharves. The railways, the Canadian Pacific Railway, Great Northern Railway and British Columbia Electric Railway, parallel the waterfront and run on to the wharves. The land and waterfront lend themselves to unlimited development along these lines.

Towage is unnecessary except for sailing vessels, when charge is a matter of bargain. Large vessels coal at Vancouver Island points, as they do when calling at any British Columbia port. Small supplies of coal are to be had locally. Locks are unnecessary on the river.

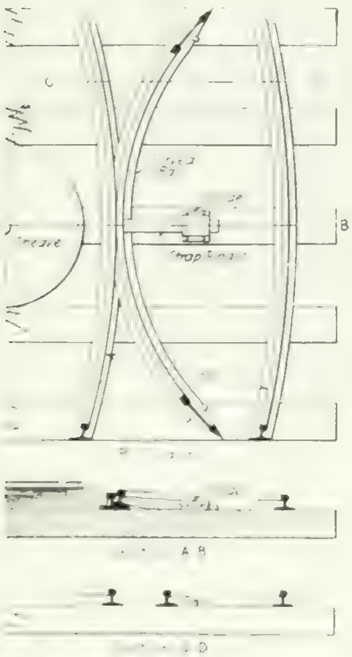
There are good machine shops and boiler works in New Westminster, capable of carrying out any repairs. The Dominion Government dredge "Fruhling" is at work at Sandheads, King Edward, on north arm. The municipal dredge will soon be at work improving the city waterfront by filling Front Street and carrying the harbor line further out to an unbroken quay over a mile in length.

The Dominion government's contract for the first 6,900 feet of three-mile jetty will be completed by April 1st, 1913, and forms part of LeBaron scheme, which will give 25 feet at low-water from the Pitt River to the Gulf of Georgia.

◆

GUIDING ROPES ON CURVES.

A rope incline which contains many curves sometimes occasions trouble by the rope catching under the rail head, when rounding the curve, and thus being thrown off the sheave. Joseph Daniels proposes an ingenious method of avoiding this trouble in Coal Age, August 24, 1912. It is as follows:



Sketch of Guide Arrangement for Use on Curves.

A section of rail, usual weight 30 lb., has its ends tapered to a wedge and is bent into a curve having a middle ordinate of 5 in. in a chord of 6 ft. This rail is placed so that its centre touches the main rail at one point and its ends are then spiked to the ties, leaving this middle point free to move. A piece of strap iron is fastened to the rail flange at the middle point and slides in a guide which is also spiked to the tie as shown.

The action of this arrangement is as follows: The cars going up or down the incline spring the curved rail away from the point of contact, thus permitting the trip to pass and immediately coming back to place after the last wheel flange has passed.

The rope at the time is approximately in the middle of the track, but its tendency will be to side over toward the [illegible] of the adjacent [illegible]. [illegible] from the middle of the track over the centre point of the curved rail [illegible]. In this way the rope is prevented from getting underneath the head of the main-track rail.

◆

TOWN-PLANNING FROM AN ENGINEERING ASPECT.

A paper on [illegible] was read by Mr. [illegible] [illegible] a subsidiary street less substantial than that in a wider street. He deprecated the practice of putting in heavy kerbing and flagged footways in residential districts, and thought that grass margins and asphalt footways not only effected a saving of cost, but presented a more rural and pleasing appearance. He thought that the road requirements of our by-laws were unreasonable, and resulted in houses being built with a narrow frontage and deep back, instead of a wider frontage and shallow back, which he considered much preferable. Open spaces should be left for parks, tennis courts, bowling greens, children's playgrounds, garden enclosures, sites for public buildings, &c. The sewerage scheme and sewage disposal were also very important matters. In a manufacturing area town-planning was different from that of a residential area, some of the points to be considered being:—(1) The position of the proposed industrial area, (2) its proximity to railway sidings. (3) the facilities for vehicular traffic to and from the area; (4) the necessity for constructing any new roads leading to this area in a substantial manner, so that they would carry the heavy traffic likely to come upon them; (5) the area to be occupied by workmen's dwellings; and (6) the supply of electrical energy for power and lighting purposes. In addition to these there would be questions of water and gas supply to be considered, and the disposal of sewage, storm-water, &c.

◆

OIL FUEL BURNERS.

At the October meeting of the New York Railroad Club a paper on the subject of liquid fuel was presented by W. N. Best. Mr. Best stated that one of the greatest abuses of liquid fuel is the fact that it is often used with burners that do not thoroughly atomize the oil and evenly distribute the heat throughout the firebox or the charging space of the furnace. A burner should really form a flame to fit the length and width of a furnace as evenly as a blanket covers a bed. It should be capable of atomizing any gravity of fuel procurable in the open market without either clogging or carbonizing, no matter whether it be fuel oil of very light gravity or crude oil, oil tar or coal tar. A burner is not worthy of consideration unless it enables the operator to burn any gravity of liquid fuel, for no manufacturer should be limited to the purchase of one particular kind of fuel oil.

A burner wherein the base of the fuel carbonizes over the fuel passage is absolutely worthless. A burner should be of such construction that it can be filed to make a long, narrow flame or a broad, fan-shaped blaze, and each burner should be thoroughly tested, so that when it leaves the shop where it is made the manufacturer will know that it will fill the requirements for which it is being furnished. A burner having the oil orifice below the atomizer orifice and independent of it renders efficient service because of there being no liability of the oil solidifying or carbonizing over the atomizer slot at the base of the burner.

A combustion chamber of adequate proportions for the uniting of the air requisite for perfect combustion with the atomized fuel before it reaches the furnace proper should be used on furnaces. This prevents oxidization of the metal charged in the furnace. It also aids in forming a blanket of flame to cover the entire charging space, thus insuring the even distribution of the flame and heat. Steam or compressed air should be used to atomize the oil and distribute the heat in the furnace, the pressure varying in proportion to the size of the furnace. Air at from [illegible] oz. to [illegible] oz. pressure admitted independently below the burner will aid in furnishing the oxygen requisite for perfect combustion.

COAST TO COAST.

Regina, Sask.—The building permits issued in this city for the month of October last have a total value of $462,725. This is over $200,000 less than the total value issued in the same month last year.

Vancouver, B.C.—Mr. P. Welch, who recently secured the contract for the construction of the Pacific and Great Eastern Railway, is making arrangements for the transportation of his supplies and equipment into the country over snow roads that are to be kept open all winter.

River St. Lawrence.—The Admiralty Court of London, England, reversed the recent judgment on the placing of the responsibility for the collision between the Canadian Pacific Railway liner "Empress of Britain" and the collier "Helvetia." By their decision the owners of the smaller vessel must assume seven-twelfths of the damage.

Toronto, Ont.—A general survey of Ontario, dealing particularly with water supply, sewage and drainage of every city, town and village except in centres of over 50,000 population is to be made by the provincial authorities through the district health officers. The latter have practically completed their preparatory work in Toronto and will start the survey about November 15th.

Moose Jaw, Sask.—Word comes from this point to the effect that contractors are experiencing considerable difficulty with workmen in their employ who claim the various Balkan States as their native land. It is thought that the return of these men to take up arms against the common enemy will be a serious drag on the completion of several contracts now being rushed.

Ottawa, Ont.—D. H. Ross, Canadian trade agent in Australia, advises the Trade and Commerce Department that though a special effort was made to interest Canadian rolling mills in regard to the supply of 146,000 tons of steel rails and fish plates for the new transcontinental railway in the Commonwealth, no tender was received. The strong domestic demand precluded Canadians from submitting offers.

Ottawa, Ont.—At a meeting of the International Joint Waterways Commission to be held in Washington on November 18th, the matters to be dealt with will include the questions of the level of the Lake of the Woods and the pollution of international waters. It is expected that both these important problems will be advanced a stage. It will be some time later, however, before either matter reaches a finality.

Big Sandy Island, Man.—A barge in tow of the tug Minerva, became waterlogged and sank at this point, which is 200 miles north of Selkirk. The cargo consisted of two cars of dynamite and one car of black powder and is a total loss. It was the property of Macmillan Bros., sub-contractors on the Hudson Bay Railway, and was to be used in the construction of the railway. High winds had prevailed for several days on the lake.

Ottawa, Ont.—An order-in-council has been passed providing that in future school lands in the three prairie provinces may be leased for the purpose of extracting fire clay therefrom. These leases will be for an annual rental of one dollar per acre, but shall not apply to school lands within a city, town or village, unless specially provided for. The term of the leases will be for 21 years, and they will be renewed for a second term of a similar period.

Wallace Harbor, N.S.—The Livingstone bridge, the longest bridge in Nova Scotia, which spans Wallace Harbor, was formally opened for traffic recently. The bridge consists of seven spans, having a total length of the steel work, with the abutments, of 771 feet. In addition to this the approaches are 2,200 feet long, making a grand total of 2,971 feet for the length of the bridge. The cost of the bridge, which was built by the local Government, was $65,000.

St. Lawrence River.—Everything is in readiness for the floating in of the first of the four huge spans which will complete the building of the double-track bridge over the St. Lawrence River at Highlands, a work which is costing the Canadian Pacific Railway $3,000,000. It will be another twelve months before the work is finally completed, despite the fact that only four of the spans have to be swung. Each of these four spans are four hundred and eight feet long.

Springfield, Man.—Henry Hudson, Pine Ridge, Springfield, has discovered an immense bed of cement rock on his 240 acre farm. The deposit is 140 feet beneath the ground surface and extends to a depth of 250 feet, the quantity being almost unlimited. The material has been tested by local experts, whose report shows it to be an excellent ingredient for the manufacture of Portland cement. Above the deposit is also an immense bed of valuable clay for brick and tile making.

Montreal, Que.—The drydock "Duke of Connaught," recently described in *The Canadian Engineer*, arrived at its final resting place in Maissoneuve Friday morning, November 1st, after a rough journey across the Atlantic. During the trip the hawsers by which it was being towed broke several times, and a great storm nearly threw the dock on the rocky shores of Cape Breton. The dock was escorted to its position by a string of tugs, bearing representatives of the Harbor Commission and the cities of Maissoneuve and Montreal.

British Columbia.—That lumbering should properly be regarded as a science and as a profession is the substance of resolutions recently adopted by the British Columbia Lumber and Shingle Manufacturers' Association and by the Canadian Forestry Association, favoring the establishment of a course in logging engineering at the new University of British Columbia. The success which has attended the agricultural colleges of Canada and the United States in equipping the farmers' sons with a scientific knowledge of husbandry, is evidence of what might be expected from similar courses devoted to logging engineering.

Ottawa, Ont.—The construction of a $200,000 bridge over the Richelieu River, in Ottawa division of the G.T.R., has just been completed. It will connect Coteau with St. Alban's, Vt., and will result in the elimination of a number of light engines now used on the local division and the substitution of heavier ones. The old Richelieu bridge was of wooden construction and could therefore not be used by heavy locomotives, which were sent around by Montreal. The new structure, however, is of steel with concrete piers and is 1,100 feet in length. It will be formally opened for traffic on November 10th.

Toronto, Ont.—Three hundred and fifty-six new members were received by the board of directors of the Ontario Motor League at their regular monthly meeting on October 31st at the National Club, Toronto. This is the largest number of members ever enrolled in one month by the association. The total membership is now considerably over the two thousand mark. The movement for good roads will continue to be furthered vigorously by the league. The directors will personally inspect the roads in the vicinity of Toronto, and they will hold a special meeting shortly for the purpose of discussing road problems and will invite as guests, W. A. Maclean, provincial highway engineer; E. A. James, York highway engineer; Mayor Hocken, and a representative from the Board of Trade. The board decided to co-operate with the Canadian Motorcyclists' Association in all matters affecting the common interests of both bodies.

St. Catharines, Ont.—A serious accident and break in the Welland Canal occurred about two o'clock November 1st, when the steamer "Samuel Marshall," owned by the Central Canada Coal Company, of Brockville, carried away the four gates of lock 13, and badly damaged the bridge crossing the canal a short distance below the lock. The Marshall was bound up, light, and on entering the lock rammed the two head gates, throwing them apart and letting the waters of the upper level rush through, tearing the upper and lower gates from their sockets and forcing the steamer back against the bridge which crosses the canal. The working gear of the bridge was badly wrecked and the bridge thrown out of position, blocking all travel along the road. Fortunately the level above is a short one, and there was comparatively little damage to the canal banks or surrounding country. The steamer escaped without any serious damage. The pontoon, with new gates, from Port Dalhousie, was at once hurried up to the break. There has been an unusual number of accidents this season on the canal, this being the fifth time gates have been carried away. It is said the high wind was partly responsible for the latest accident.

Grand Trunk Railway.—In regard to the block signal system at present being installed on some portions of the Grand Trunk Railway System for the additional safety and control of train morements, it has been decided by the company to place all construction work incident thereto, as well as the after maintenance of such, under the direct charge of one official, known as the signal engineer, who will report to the chief engineer. The signal engineer will also have similar charge of the signal and interlocking plants, on the lines of the Grand Trunk System. In a circular issued recently by the chief engineer, Mr. Charles A. Dunham is appointed to the office of signal engineer. Mr. Dunham was born in Hamilton, Ont., 46 years ago, and has had a long experience with the various systems of block signalling in use by the larger trunk lines in the United States. To meet the needs brought about by the great development of its train service in general, the Grand Trunk has been extending the use of such safety appliances on some of its lines, and it has in view the substantial increasing of such use, in order to keep pace with the needs of its general development.

SEPTEMBER RAILWAY EARNINGS.

The net earnings of the Canadian Pacific Railway in September, according to the monthly statement, showed an increase of $332,857 as compared with the same month last year. The increase while smaller than that reported in either July or August of the current year compares with a gain of only $[illegible] in the same month last year over September, [illegible]. The yield at par for the month was equal to [illegible] per cent., and net earnings for the three months show an increase of nearly 15 per cent. The September statement follows:—

	September, 1912	July 1st, to Sept. 30, 1912
Gross earnings	$[illegible]	$[illegible]
Working expenses	[illegible]	[illegible]
Net profits	$[illegible]	$[illegible]

In September, 1911, the net profits were $[illegible], and from July 1st to September 30th, 1911, there was a net profit of $[illegible]. The gain in net profits over the same period last year is therefore, for September $332,857.05, and from July 1st to September 30th $1,[illegible].

Canadian Northern gross earnings for September were $1,671,500, an increase of $95,100 over the corresponding month in 1911. The net earnings showed an increase of $4,100 for the same period, making those for 1912 to date $193,200 in excess of last year.

The Grand Trunk September statement shows net profit as follows:—Grand Trunk proper, increase, £21,550 sterling; Canada Atlantic net profit, decrease, £3,400; Grand Trunk Western net profit, increase, £4,250; Grand Haven net profit, decrease, £4,900; total net profit, whole system, increase, £17,500; one working day less.

◆

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended September 21st:—

	1911.	1912.	Increase or Decrease.
C.P.R.	$2,218,000	$2,549,000	+ $331,000
G.T.R.	1,018,506	1,101,588	+ 83,082
C.N.R.	373,600	390,200	+ 16,600
T. & N.O.R.	44,592	28,146	— 16,446

The following are the railroad earnings for the week ended September 30th:—

	1911.	1912.	Increase or Decrease.
C.P.R.	$3,061,000	$3,457,000	+ $396,000
G.T.R.	1,330,952	1,464,732	+ 133,771
C.N.R.	506,000	526,600	+ 20,600
T. & N.O.R.	58,381	36,650	— 21,731

The following are the railroad earnings for the week ending October 7th:—

	1911.	1912.	Increase or Decrease.
C.P.R.	$2,396,000	$2,765,000	+ $369,000
G.T.R.	985,730	1,058,587	+ 72,857
C.N.R.	460,500	471,700	+ 11,200
T. & N.O.R.	42,582	25,019	— 17,563

The following are the railroad earnings for the week ended October 14th:—

	1911.	1912.	Increase or Decrease.
C.P.R.	$2,510,000	$2,957,000	+ $447,000
G.T.R.	995,600	1,063,161	+ 67,561
C.N.R.	480,900	523,700	+ 42,800
T. & N.O.R.	49,402	33,170	— 16,362

Aggregate traffic receipts of the Grand Trunk Railway Company for July, August and September were £2,952,240, against £2,701,975 in the same three months last year, an increase of £250,265.

◆

NEW FOREST RESERVE RECOMMENDED IN PRINCE ALBERT DISTRICT, SASKATCHEWAN.

The Forestry Branch of the Department of the Interior has again, during the past summer, had parties out examining the timber on some of the regions still in the hands of the Dominion Government, with a view to reserving from settlement lands more suitable for forest growth than for farming. Some of these parties have finished the work assigned them and have made their reports.

Mr. C. H. Morse made an examination of a district north-west from Prince Albert lying between the Shellbrook branch of the Canadian Northern Railway (on the west) and the third Dominion meridian (longitude 106 degrees), and recommends that the tract between the meridian on the east and the Sturgeon River on the west should be made a forest reserve. This land is not pure sand, but has some stretches of sand among lands of better quality; none of it, however, can be classed as good agricultural land. At the present time this tract carries, in places, a good stand of spruce, as good a stand as will be found anywhere in the country. The reproduction of the forest is good, and this should make one of the most valuable forest tracts in the west. The rate of growth is good. As it is calculated that the present stand of timber, which is held under license, will be cut out in ten years, it will be seen that the necessity for looking for a future supply is close at hand.

◆

RAILWAY AND OCEAN TERMINALS FOR HALIFAX.

The Dominion government will build new railway and ocean terminals nearly two miles south of the present terminals at Halifax.

The new docks are to extend for one and a half miles from the Lumber Yard to Point Pleasant Park, and will consist of six piers, 1,250 feet long and 300 feet in width, with capacity sufficient to dock at least thirty ships. There will be one bulkhead loading pier, 2,000 feet in length, at which the ocean greyhounds will land. This pier will be equipped with immigration buildings, sheds and a grain elevator.

A new union passenger station will be erected at the end of Hollis Street, just north of the docks mentioned, which will be of ample size and suitable architecture.

The new terminals will be approached by a double-tracked railroad, which will branch off the main line at the Three Mile House and extend southerly through the low divide between Bedford Basin and the head of the northwest arm. It will then skirt the arm in such location as will do the least damage to property in that vicinity, avoiding all level crossings, and for the most part passing through deep cuttings so as not to mar the beauty of that district, and finally reaching the terminals by passing under the lower end of Young Avenue. The streets in the residential district where the railway is submerged will be carried over the cutting on artistic bridges in keeping with the present surroundings.

◆

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

Professor C. H. McLeod, secretary of the Canadian Society of Civil Engineers, has sent out the list of nominees for officers and members of the council for the year 1913, as submitted by the Nominating Committee of the Society. It will be observed that with the exception of the nomination for president, two members are proposed for each office. There are three vacancies in District No. 1, and one in each of the other districts. The extra vacancy in No. 1 is caused by the resignation of Mr. Phelps Johnson, who has been nominated for the office of president.

FOR PRESIDENT—Phelps Johnson.

FOR VICE-PRESIDENT—H. G. Kelley, F. C. Gamble.

FOR COUNCILLORS—

District No. 1—R. J. Durley, J. M. R. Fairbairn, W. J. Francis, Geo. Janin, F. H. Pitcher, J. M. Robertson.

District No. 2—F. A. Bowman, T. C. Burpee.

District No. 3—A. R. Decary, W. D. Baillairge.

District No. 4—S. J. Chapleau, A. A. Dion.

District No. 5—H. E. T. Haultain, C. H. Mitchell.

District No. 6—E. P. Fetherstonhaugh, W. A. Duff

District No. 7—H. E. C. Carry, T. H. White.

PERSONAL.

MR. R. J. FULLER, B.A.Sc., has been appointed to the staff of the city architect's department in Toronto.

MR. T. AIRD MURRAY, consulting engineer, has returned to Toronto after an extended trip through the West

MR. W. J. ELMENDORF is in charge of the property of the Portland Canal Tunnels, Limited, in the Portland Canal district, British Columbia, as general manager.

MR. ROBERT D. HEDLEY, formerly manager for the Canadian Mining Operators, Limited, Vancouver, B.C., has opened an office in Vancouver as consulting engineer.

PROFESSOR WALLACE P. COHOE gave an address on "The Function of the Chemist in the Industrial Development of Canada," before the Society of Chemical Industry in Toronto on October 31st.

PROFESSOR R. J. DURLEY, M.Inst.C.E., of McGill University, Montreal, Que., has been awarded the Crampton prize of the Institution of Civil Engineers of Great Britain for a paper presented during the 1911-1912 session.

MR. D. H. McDOUGALL, assistant general manager of the Dominion Coal Company, has been appointed to the general managership of that company, which position has been rendered vacant by the resignation of Mr. J. Butler.

MR. H. P. BELL, late of London, England, has opened an office in Toronto as consulting chemical engineer, with temporary quarters at 409 Kent Building. Mr. Bell will undertake inspections and reports on industrial processes and plants.

MR. F. A. DALLYN, B.A.Sc., of the Ontario Board of Health, is at present taking samples of water from Lake Huron, the River St. Clair and Lake St. Clair. It is understood that the results of the analyses will be used before the International Joint Commission when the Provincial Board of Health present their arguments regarding lake pollution.

MR. HARRY DIX, for the past two years in charge of the heating and ventilating department of the Douglas Milligan Co., Limited, has severed his connection with that firm to join the engineering staff of the Canadian Domestic Engineering Co., Limited. Mr. Dix is a Boston man who came to Canada for permanent residence several years ago and has a number of friends in and around Montreal. He is well fitted for the responsibility of his new position and the connection should prove mutually beneficial.

MR. C. A. DUNHAM, who has been appointed signal engineer for the Grand Trunk Railway System, received his earlier education in Hamilton, Ont., which was supplemented by educational work at Scranton, Pa., and Chicago, Ill. He entered the railway service in 1884, since which time and up to 1886 he was with the mechanical department Chicago, Burlington and Quincy Railroad, at Chicago; April, 1886 to 1887 in bridge department, New York, Chicago and St. Louis Railroad; in 1887 he was for several months with the U.S. Rolling Stock Company at Hegeswich, Ill., following which he became connected with Grand Bros., railroad contractors, serving in this capacity until January, 1890. From January, 1890, to September, 1892, was in the operating department of the Chicago, Burlington and Quincy Railway. September, 1892, to March, 1896, with the Union Switch and Signal Company, and the National Switch and Signal Company; March, 1896, to March, 1901, inspector of signals, Illinois Central Railroad; March, 1901, to June, 1905, signal engineer same road; June, 1905, to date, signal engineer, Great Northern Railway.

OBITUARY.

PETER H. HUME, C.E., one of the best-known structural engineers in America, and business associate of Michael Connolly, of Ontario, died at St. John, N.B., on November 3rd last after a long illness during which he had kept at work. He had supervised the construction of great docks at Hong-Kong, Buenos Ayres, New York and the subway in Philadelphia. His widow and one daughter, Mrs. C. E. Duggan, of St. David's, Ont., survive.

◆

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Monthly Meeting will be held in the Rooms of the Society, 413 Dorchester Street West, Montreal. November 7th. Paper on "The Protection of the Foreshore at Dallas Road, Victoria, B.C.", by Mr. G. N. Duncan, Jr., C.S.C.E. will be read. Discussion on the effect of sea water on Portland Cement Concrete Structures will follow the reading of the paper. Chairman, Henry Holgate.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annua Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary A. P. Folwell, 50 Union Square, New York.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—7th Annual Convention, November 14th, 1912, City Hall, Toronto. Secretary, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lecture, Nov. 23rd, at 8 o'clock. "The Prevention of Sewage Pollution relative to Water Supply," by T. Aird Murray, C. E., Toronto. Secretary, J. Patterson.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. Tye; Secretary, Professor C. H. McLeod.

[illegible] BRANCH— [illegible], Secretary, [illegible]

OTTAWA BRANCH—

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

MUNICIPAL ASSOCIATIONS

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, [illegible]

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, [illegible]

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, [illegible] Farewell, Whitby, Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—[illegible]

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—[illegible]

REGINA ENGINEERING SOCIETY.—[illegible]

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, [illegible]

ROYAL ASTRONOMICAL SOCIETY.—[illegible]

SOCIETY OF CHEMICAL INDUSTRY.—[illegible], Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—[illegible]

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan [illegible]

WESTERN CANADA RAILWAY CLUB.—President, [illegible], Secretary, [illegible], Winnipeg, Man. Second Monday, except [illegible]

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
10-24	—Construction of about 7¾ miles of Combined Sewers, New Westminster, B.C. ....(P. & S.)	10-10
1. 24	—Supply of 10,400 ft. reinforced concrete pipe, New Westminster, B.C. ....(P. & S.)	10-10
10-24	—Supply of 1,660 ft. of 48″ steel pipe, bends and specials, New Westminster, B.C. ...(P. & S.)	10-10

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Albert, N.B., wharf with approach and bed	Nov. 18.	Oct. 31.	65
Bassano, Alta., waterworks....	Nov. 18.	Oct. 31.	74
Cap-a-l'Aigle, P.Q., extension to wharf	Nov. 11.	Oct. 17.	65
Dunnville, Ont., steel elevated tank	Nov. 11.	Oct. 31.	74
Isle aux Coudres, P.Q., extension to wharf	Nov. 5.	Oct. 17.	65
Kamloops, B.C., intake, dam and flume system...	Nov. 14	Oct. 31.	65
London, Ont., bridge over Thames River	Nov. 13.	Oct. 17.	74
Midland, Ont., public building.	Nov. 5	Oct. 24.	65
Ottawa, Ont., re-erection of Lobinz rock-breaker	Nov. 11	Oct. 31.	65
Ottawa, Ont., conveyance of H.M. mails	Nov. 20	Oct. 24.	74
Point Grey, B.C., steel pipes..	Dec. 2.	Oct. 17.	74
Quebec, P.Q., grain elevator...	Nov. 30.	Oct. 17.	76
Rimouski, Que., wharves and dredging	Nov. 1[illegible].	Oct. 31.	76
St. Boniface, Man., motor and pump	Nov. 8	Oct. 17.	76
St. Victoire, Que., wharf	Nov. 11	Oct. 24.	65
Toronto, Ont., engines and boilers	Dec. 1[illegible]	Oct. 31.	74
Toronto, Ont., gradings, concrete walks, etc.	Nov. 5	Oct. 31	65
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., Fire Department apparatus	Nov. 1[illegible]	Oct. 17.	66
Winnipeg, Man., extension of water works	Nov. 15	Oct. 24.	74
Winnipeg, Man., supply of valves	Nov. 8.	Oct. 31.	65
Yorkton, Sask., auto fire truck.	Nov 12.	Oct. 24.	74

◆

TENDERS.

Calgary, Alta. Tenders for the construction of an examining warehouse will be received until November 15th, 1912, by R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at the offices of Mr. H. E. Matthews, Superintending Architect of the Dominion Public Buildings in the Province of Manitoba, Winnipeg, Man.; Mr. W. T. Mollard, Clerk of Works, Regina, Sask.; at the post-office, Calgary, Alta., and at the Department of Public Works, Ottawa.

Dunnville, Ont.—Tenders for a turbine pump installation for domestic and fire purposes will be received until November 18th, 1912, addressed to B. L. Edgecombe, chairman of the Water Commission for the town of Dunnville. Alan Mair Jackson, Superintendent. (See advertisement in Canadian Engineer.)

Edmonds, B.C.—Tenders for the construction of a concrete covered reservoir for the municipality of Burnaby, will be received until November 11, 1912, by W. Griffiths, comptroller, Edmonds. Particulars may be obtained at the office of the engineers, Cleveland and Cameron, 1,001 Rogers' Building.

Fernie, B.C.—Tenders will be received by the Director of Contracts, Department of Militia and Defence, Ottawa, until November 21st, for the construction of a new drill hall at Fernie, B.C. Specifications, etc., at the office of the officer commanding military district No. 11, Victoria, B.C., and the City Clerk, Fernie, B.C., and the Director of Engineer Services, headquarters, Ottawa.

Fredericton, N.B.—Tenders will be received until noon of December 2nd, 1912, for the construction of the substructure of the Reversible Falls Bridge, St. John, N.B. Plans, etc., at the Provincial Government Rooms, St. John, N.B., and at the Provincial Public Works Department, Fredericton, N.B. John Morrissy, Chief Commissioner of Public Works. (See advertisement in Canadian Engineer.)

Montreal, P.Q.—Tenders shall be received by the sectary of the Municipality of Amqui, Que., until November 11th, 1912, on the sale of a Worthington centrifugal pump to raise 700 gallons per minute at a total dynamic head of 185 feet. Pump shall be directly connected on a 60 horsepower triphased motor, 60 cycles, 550 volts. An automatic current cutter shall also be furnished; this cutter to work by means of a contact when the reservoir is full. For further information apply to J. Emile Gill, C.E., Room 43, 20 St. James Street, Montreal.

Ottawa, Ont.—Tenders addressed to the Postmaster-General will be received at Ottawa until noon of December 13th, 1912, for the conveyance of His Majesty's mails on a proposed contract for four years, six round trips per week over Aurora rural mail route. Particulars may be obtained at the post-offices of Aurora, Vandorf, Newmarket, White Rose, and at office of Post-office Gormley, Pleasantville, Bethesda. (See advertisement in Canadian Engineer.)

Ottawa, Ont.—J. D. McLean, Assistant Deputy and Secretary, Department of Indian Affairs, will receive tenders until November 12th, 1912, for 28,000 cedar railway ties, one-half of this number No. 1 and the remainder No. 2; also 8,500 cedar posts and 250 cords soft wood.

Ottawa, Ont.—Tenders addressed to G. J. Desbarats, Deputy Minister of the Naval Service, Department of the Naval Service, Ottawa, will be received until November 12th, 1912, for the following descriptions of timber: Birch, cedar, spruce, pine, oak, fir, teak, all being for delivery at H.M.C. dockyards at Halifax, N.S., and Esquimalt, B.C.

Regina, Sask.—Tenders for the erection of a telephone building on lots 21, 22 and 23 in block 309, Regina, will be received until November 14, 1912. Plans, etc., at the office of Messrs. Storey and VanEgmond, architects, Regina. D. C. McNab, Deputy Minister, Railways, Telegraphs and Telephones.

Three Rivers, Que.—Tenders for the construction of a public building will be received until November 25th, 1912, by R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., can be obtained at the offices of Mr. Charles Lafond, architect, Three Rivers, Que.; R. L. Deschamps, Esq., 103 St. Francois Xavier Street, Montreal, and at the Department of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received by Messrs. Darling & Pearson, architects, 2 Leader Lane, Toronto, up till noon, November [illegible]th, 1912, for all the various trades in the erection and completion of a two-story bank building on the north-east corner of College and Bathurst Streets, Toronto, for the Metropolitan Bank. Plans, etc., may be obtained at the office of the architects.

Vancouver, B.C.—Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, will be received until November 18, 1912, for electric elevators for the Customs examining warehouse, Vancouver, B.C. Plans and specifications to be seen on application to Mr. E. E. McGregor, clerk of works, Vancouver, examining warehouse; Mr. H. E. Matthews, supervising architect, Winnipeg, Man.; and at the Department of Public Works, Ottawa.

Victoria, B.C.—Tenders for the erection of a school at Campbell River will be received up to noon of Wednesday, November 13th. Tenders for the erection of a lockup at Enderby will also be received until the same date.

Victoria, B.C.—Tenders will be received by W. Galt, purchasing agent, city hall, Victoria, until November 25th, 1912, for 12,000 ft. or more, 10-pair No. 16 cable; 2,000 ft. or more No. 16 duplex cable. Specifications can be seen at the purchasing agent's office. C. H. Rust, city engineer.

Wallaceburg, Ont.—Tenders for the construction of a public building will be received until November 20th, 1912, at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans, etc., at the post-office, London, Ont.; post-office, Wallaceburg, Ont., and at the Department of Public Works, Ottawa.

Winnipeg, Man.—Tenders for the manufacture, delivery and installation of one horizontal boiler at the high-pressure pumping station, James Avenue, will be received until November 15th, 1912, addressed to the chairman, Board of Control. Specifications, etc., at the office of the City Engineer, 223 James Street; M. Peterson, Secretary, Board of Control office, Winnipeg.

Winnipeg, Man.—Tenders for the manufacture and delivery, f.o.b. cars, Winnipeg, of 22,000 ft. of lead covered rubber insulated cable, will be received until noon of Friday, November 15th, 1912. Particulars may be obtained at the office of the City Light and Power Department, 54 King Street. M. Peterson, secretary, Board of Control office, Winnipeg.

◆

CONTRACTS AWARDED.

Harriston, Ont.—The Harriston town council have awarded contracts for the instalment of the new electric light plant, which is expected to be in operation by December 15th, as follows: Engine, Messrs. Leonard & Sons, London; generator and all electric outfit but street lamps, the Westinghouse Co., Limited, Hamilton; street lights, the Philadelphia Electric Manufacturing Co., through Winter & Joyner, St. Catharines. The total estimated cost of the new system is $[illegible].

New Westminster, B.C.—The Shaake Machine Works have received an order for the construction of a [illegible] dredge to be used in gold dredging operations on the Fraser River, near Hope. The dredge will cost about $[illegible], and will be ready by the first of April.

Ottawa, Ont.—A contract has been awarded to the [illegible] Dredging Company for dredging work at Port [illegible], to cost $[illegible].

Regina, Sask.—The contract for the erection of the new [illegible] has been awarded to the [illegible] Construction Company, who will [illegible] for the sum of $[illegible]. The Regina Plumbing and Heating Company will install the lighting, heating and power systems.

Vancouver, B.C.—The Norton Griffiths Steel Construction Company, Limited, have been awarded the contract and have already commenced work on the Merchants' Ice and Cold Storage Company's warehouse. The building will be [illegible] feet long, [illegible] feet wide and [illegible] in height, and will have a [illegible] basement. Reinforced concrete will be used in construction throughout. It will be fitted with rolling doors and patent sprinkler system, and will be entirely [illegible] in every respect. The cost will be $[illegible]. Mr. [illegible] is the architect. Messrs. Norton Griffiths have been awarded the contract for a new machine shop for the [illegible] Naval Dockyard, to be erected at a cost of $[illegible]. Mr. [illegible] is the engineer.

RAILWAYS—STEAM AND ELECTRIC.

Edmonton, Alta.—It was announced in this section of the Canadian Engineer some months ago that a company financed by French capital were negotiating for a charter to erect and operate a railway to be known as the Peace River Great Western Railway. Word has been received to the effect that the management have secured their charter and are making all arrangements for an early start on the construction. The first section will run north-west from Edmonton The original charter was granted Robert Alfred Grant, Robert Henry Percival and other Winnipeg men. The capital stock of the company is $2,500,000 and bonding powers of $20,000 a mile are granted.

◆

LIGHT, HEAT AND POWER.

Esquimalt, B.C.—The municipal council will call tenders for the installation of an electric lighting system. The council, on the receipt of tenders, will obtain the advice of a solicitor and an engineer.

Niagara Falls, Ont.—The Canadian Niagara Power Company will spend a million and a quarter dollars to construct a new forebay at its power-house in Queen Victoria Park. The company plans to have the enlarged forebay completed in 1915.

Peterboro, Ont.—Arrangements are being made to have the ratepayers vote on a hydro-electric by-law calling for the expenditure of $118,000. The voting will be done in January next.

Regina, Sask.—The ratepayers will be asked to sanction a by-law calling for the erection of ornamental lighting standards in the business section at a cost of $80,000. A. E. Chivers, city clerk.

Regina, Sask.—Commissioner Thornton has proposed a scheme calling for the erection of a new power house to cost $500,000. The routine expenditure for electric light and power house extension for next year, if the old plant is retained, will be as follows:

One complete 1,500 unit and equipment	$40,000
Additional boilers, to furnish power for the new unit	28,500
Poles and wiring	75,000
Extension of street lighting	20,000
Meters	20,000

Regina, Sask.—The following is a list of expenditures in the estimates of the fire chief for the year 1913:—

One auto pumping fire engine	$9,000
One auto double tank chemical engine	4,500
One chief's auto	2,200
2,000 feet high pressure hose at $1.60	3,300
One Hart cellar pipe	135
1,000 feet fire hose at $1.10	1,100
One Bowder life net	200
One life gun	25
Three hose holders	300
Three Cooper hose jackets	120
Two smoke protectors	200
Ten fire alarm boxes	625
One hose sleigh	225
One [illegible] fire hall	10,000
Sundries	500
Gong and equipment	150

A. E. Chivers, city clerk.

Township of Louth, Ont.—A large meeting of ratepayers, after hearing addresses from officials of the Hydro-Electric Commission, requested that body to prepare an estimate of costs regarding the installation of this utility into the neighborhood. Messrs. J. H. Broderick, L. Haynes and A. C. Gregory were appointed a committee to represent the ratepayers.

◆

GARBAGE, SEWAGE AND WATER.

Galt, Ont.—The municipal council have decided to install additional hydrants on some of the streets. C. D. Campbell, town engineer.

Halifax, N.S.—Mr. F. W. W. Doane, city engineer, states all is in readiness for the commencement of the temporary sedimentation tanks to be erected in this city.

Barrett Specification Roofs

Shove Mills, Fall River, Mass. Roofed along lines of the Barrett Specification in 1876.

Low Cost—Long Service

METAL roofs require painting every few years; most ready roofings require coating regularly, but with Barrett Specification Roofs *there is no maintenance expense.*

Barrett Specification Roofs are roofs of coal tar pitch and tarred felt, with a top surface of slag, gravel or tile, *laid according to the Barrett Specification.*

This specification is simply the standard formula for building a first-class roof of this character.

It is possible, of course, to make an inferior roof of these materials either by poor workmanship or by using insufficient and poor goods. But if the Barrett Specification *is followed absolutely and the materials called for are used,* you are certain of getting the best value in roof coverings.

Such roofs usually last twenty years and over without leaks or repairs.

Barrett Specification Roofs are almost universally used on factories and buildings of large roof areas and where costs are carefully figured. They are equally good for city dwellings, warehouses, railroad buildings, etc.

Copy of the Barrett Specification, with diagrams, mailed free on request to nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Victoria, B.C.—The Provincial Government has agreed to make a grant of $20,000 for the construction of the bridge at Brilliant, which will connect the Doukhobor settlement at that place with the transcontinental highway.

Winnipeg, Man.—The site for the new 20,000,000 gallon reservoir in connection with the extension of the city well system, has been definitely chosen by the board of control in the old triangular park in the rear of the main pumping station and power sub-station at the corner of Logan and McPhillips. The reservoir will be close to the pumping station.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Berlin, Ont.—The directors of the Economical Fire Insurance Company will erect an office building in this city at a cost of several thousand dollars. W. H. Schmalz is the manager of this concern

Brockville, Ont.—Frank Donnelly, of the Donnelly Wrecking Company, Kingston, will start laying out for the contractors the cribs for the new wall to replace the concrete wall of the breakwater that collapsed a year ago. McCool & Moffatt, of Pembroke, Ont., secured the contract at $15,000. The wall will be built of timbers.

Camrose, Alta.—The Public School Board of this municipality will spend ten thousand dollars on the equipment of rooms for instruction of household arts, manual training, on an assembly hall. R. D. Fleming, Town Clerk.

Kingston, Ont.—The Kingston Automobile Company, under the management of Norris & Wafer, have purchased the Salvation Army barracks, on Queen Street, and it is their purpose to turn the premises into a first-class garage.

Medicine Hat, Alta.—Messrs. T. F. Dawson & Co., real estate brokers, have recently completed negotiations whereby a firm of New York financial men will erect a new hotel and a theatre in this city.

Montreal, P.Q.—The management of the Atlas Glass Plant have made extensive land purchases in the vicinity of this city, and will commence the erection of a factory for the manufacture of their products. It is expected that the new [illegible] by April 1st next and will employ about 700 men at the commencement.

Montreal, P.Q.—The management of the Imperial Tobacco Company will erect a two-story fire-proof factory in St. [illegible]

Nelson, B.C.—Owing to the increased interest in platinum mining in this district it is probable that one or two experimental plants for the commercial treatment of the ore will be erected. Mr. R. J. Elliot is interested in the project.

Port Arthur, Ont.—The Alberta Land Co., H. J. Powers, engineer, will erect a 2-story store and office building, [illegible] Bay and N[illegible] [illegible], $40,000.

Port Mann, B.C.—Arrangements have been made by the Canadian Northern Railway with an eastern Canadian car company to establish car works at Port Mann, B.C., one of the Pacific terminals of the C.N.R. system. The plant will have a capacity of at least [illegible] a day. It is expected that tenders will be called in a short time for this and other [illegible] at this point.

Regina, Sask.—[illegible]

Sudbury, Ont.—[illegible]

Toronto, Ont.—[illegible]

Vancouver, B.C.—[illegible]

Winnipeg, Man.—[illegible]

Welland, Ont.—The high school board have requested the council to furnish the sum of $1,700 to be used in an extension to the building. Geo. R. Boyd, town clerk.

◆

BRIDGES, ROADS AND PAVEMENTS.

St. Catharines, Ont.—Mr. N. W. Gowan, inventor of the canal lock safety device, has been awarded the first contract on the newer Welland Canal. He will put down test-holes 800 feet deep at the location of each of the locks. Work will be begun as soon as possible at the new harbor on Lake Ontario.

◆

FIRES.

Montreal, P.Q.—Fifteen thousand dollars is the estimated damage caused to the premises of the Elite Hat Works, Nos. 8 and 10 Bleury Street.

Montreal, P.Q.—The plant and premises of the Consumers' Cordage Company was destroyed by fire. Loss, $300,000.

◆

CURRENT NEWS.

Galt, Ont.—The ratepayers endorsed a by-law that will grant a loan of $15,000 to the management of the Galt Shoe Company.

Hamilton, Ont.—It is reported that the Doherty interests of Pittsburg will assume control of the Manufacturers' Natural Gas Company. It is further reported that $650,000 is the consideration paid to the stockholders.

Montreal, P.Q.—The great dry dock, which was successfully towed across the Atlantic, was safely docked in the harbor of this city early in the morning of November 1st. The three Dutch tugs which did the towing are said to be marvels as seagoing tractors.

Montreal, P.Q.—The new jail, one of the largest on the continent, is now ready for occupancy, and the first of the prisoners to be lodged there will be transferred in the course of a day or so. The construction of the building gives the appearance of an immense cross with a dome rising from the central portion.

Moose Jaw, Sask.—Industrial Commissioner C. E. Brown announces that three new industries will locate in this city in the near future. The first of these is that of the Railway Accessories Company, the second the Soap Lake Soap Company, and the third is the Alberta Glass Bottle Company.

Nelson, B.C.—The members of the grand jury have framed a resolution which, if carried into effect, will call for the erection of a new jail. Mr. Justice Gregory has the matter in hand for the present.

Province of Nova Scotia.—It is reported that the owner of certain extensive coal fields in this province is in negotiation with the Metropolitan Gas Company, of London, England, in regard to the supply of that corporation with gas coal.

Peterboro', Ont.—The Militia Department of the Federal Government have recently purchased 500 acres of land near this point and will erect a rifle range on the same.

Peterboro', Ont.—The ratepayers voted in favor of extending a bonus to the management of the Delaval Dairy Supply Company as an inducement to locate a plant at this point.

Peterboro, Ont.—Several townships adjoining this municipality have [illegible] a writ against the council for alleged pollution of the [illegible] River with sewage matter.

St. Catharines, Ont.—Another serious accident was caused in the Welland Canal by a ship striking and breaking a lock gate.

Sault Ste. Marie, Ont.—Certain property owners in the vicinity of the steel works have held a meeting and arranged a scheme calling for the erection of a model village. It is expected that Mr. H. E. M[illegible] will plan the work.

Welland, Ont.—Building permits for month of October this year are $[illegible]. Building permits for month of October last year were $[illegible]. Total for year to end of above month is $[illegible].

Windsor, Ont.—The ratepayers voted in favor of spending the sum of $[illegible] for [illegible] fire engine. M. E. [illegible], city engineer.

48 in CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

CONTINUOUS STAVE PIPE

RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

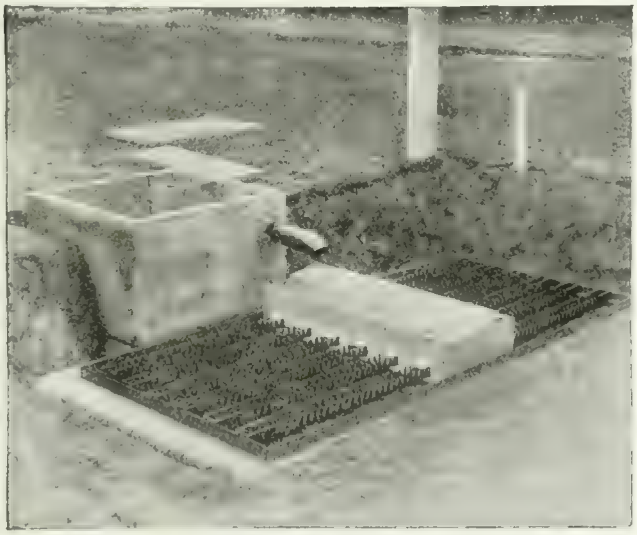
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory: 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

THE "SEMI-SEPTIC" SEWAGE PLANT

THE BEST SYSTEM OF PURIFYING SEWAGE, FOR COUNTRY HOUSES, OR ANY ISOLATED BUILDINGS



FROM J. M. GORHAM, ESQ. DROVE HOUSE, SINGLETON, SUSSEX

September, 1911.

Dear Sirs,

"I am very pleased with the system you have put in for me. It is really as good as it possibly can be, and I cannot understand anyone going on with the old cesspool system.

I have never seen purer effluent from any Septic System, and there is not the slightest smell in the fields."

Penhale Semi-Septic Installation.

Truro, May 10th, 1912.

Dear Sirs,

In further reply to your letter of the 2nd inst., we beg to say that we yesterday made a careful inspection of this Plant and the working thereof, and have now the pleasure to enclose our final certificate.

We find that the Installation has worked for the last six months without a single hitch or complaint of any sort, and is in perfect order and most satisfactory in every way

We beg to congratulate you on your success.

Yours faithfully,
HENDERSON & SON
(ARCHITECTS)

TUKE & BELL, LTD.

69 LEADENHALL ST., LONDON, E.C.

AGENTS FOR CANADA: LAURIE & LAMB

211 BOARD OF TRADE BUILDINGS, MONTREAL

CONSUMERS' GAS COMPANY'S REPORT.

The gross receipts of the Consumers' Gas Company, Toronto, for the year ended October 1st, 1912, were as follows:—

Gas sales	$2,058,140 63
Coke sales	253,709 97
Tar sales	32,415 12
Ammoniacal liquor	41,007 60
Consumers' Supplies and maintenance.	78,370 18
Office rents	724 96
	$2,464,368 46

The net earnings were $718,134 as contrasted with net earnings for 1911 of $697,006.

Income from other sources brought the total to $821,096.05. After paying dividends of $438,309, the sum of $382,786 has been transferred to plant and buildings renewal fund, the total amount at the credit of that account being $978,759, against $851,477 a year ago.

The output of gas for the year ended September 3rd has amounted to 3,119,748,000 cubic feet, an increase over the output of the previous year of 276,707,000 cubic feet. Gas rental for the year was $2,058,140, compared with $1,857,071 the previous year, an increase of $201,069.

President Austin, in his report, states that this is the first complete year during which gas has been sold at the present reduced price, and the reduction of five cents per 1,000 cubic feet has amounted on the output of gas for the year to about $151,000.

The following is the statement for the past, as compared with the preceding year:—

	Meters.	Gas Rental.
1912	82,022	$2,058,140.63
1911	72,544	1,857,071.01
Showing an increase of	9,478	$ 201,069.62

The current expenses total $2,464,368 and the total liabilities are shown as $8,756,749.

The company's assets are as follows:—

Works, plant and general outlay	$8,070,327.48
Main pipes, specials and lead	61,376.88
Service pipes, fittings, etc	14,729.28
Consumers' supplies	57,646.12
Coal	118,396.09
Gas oil	6,880.61
Coke	10,589.85
Tar	5,961.12
Oxide of Iron	10,656.00
Cement	183.04
Fireclay, etc.	4,130.37
Cash	334.07
Debentures	216,233.28
Gas accounts receivable	116,559.13
Sundry accounts receivable	52,746.19
	$8,756,749.51

At the annual meeting of the company on Tuesday, the president, Mr. A. W. Austin, presented the sixty-fourth annual report, together with the financial statements, as outlined above, which were adopted.

The following gentlemen were re-elected directors for the ensuing year:—Messrs. A. W. Austin, A. H. Campbell, Wellington Francis, K.C., F. LeM. Grasett, M.D., John Hoskin, K.C., LL.D., D.C.L., Herbert Langlois, and Thomas Long, Sir Edmund Osler, M.P., and Sir Wm. Mortimer Clark, K.C., LL.D. At a meeting of the board held subsequently, Mr. A. W. Austin and Mr. Wellington Francis, K.C., were re-elected president and vice-president respectively.

◆

TO MANUFACTURERS.

[illegible]

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending October 21st, 1912:—

A Scottish firm manufacturing cast-iron soil pipe desire to appoint agents in Western Canada.

An engineer at Manchester is open to act as buying agent for Canadian importers of electrical goods.

A London firm are anxious to secure supplies of a waste product of the wood pulp industry, and would like to be placed in communication with manufacturers in Canada.

A Danish firm make inquiry for the names of Canadian millers wishing to ship flour to Scandinavia. They would also like to import other Canadian products for which they could develop a market.

A firm of match manufacturers in the Netherlands require supplies of Canadian pine, and would like to receive correspondence from shippers in the Dominion.

A Vancouver firm manufacturing chemical specialities are desirous of taking up agencies for lines which could be worked in conjunction with their own business.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:—

A Midlands firm manufacturing bicycle and motor spokes and nipples for building wheels are open to appoint suitable Canadian resident agents.

◆

VOLTA'S ELECTRICAL APPARATUS.

A discovery of particular interest to electrical engineers was recently made by Sir Henry Norman, M.P. (English), while enjoying an automobile tour in Italy. The party stopped at a small shop situated in one of the back streets if a little Italian village, and, while other members examined the quaint wares offered for sale, Sir Henry Norman commenced the examination of a cupboard in the rear of the premises. There he came across what he believes to be many of the apparatus and material used by Volta in his experiments which resulted in the discovery of "voltaic" electricity. further examination revealed the fact that the cupboard contained a number of personal articles at one time the property of the scientist, together with a number of his letters, books, papers and pictures.

He photographed what appeared to be the original "Crown of Cups," as Volta named his first one fluid primary battery, and made a severe examination of all the other apparatus.

The keeper of the little shop informed him that an uncle of his grandfather's was for thirty years Volta's cook and man servant, and upon the death of the scientist the apparatus was left to him, and they have since been passed on from father to son, the present possessor being an old man in frail health.

Sir Henry Norman, in an article to the London Times, suggests that, should the genuineness of the objects be established beyond dispute, it would be a gracious act for some wealthy man of scientific tasts to purchase the collection and present it to the Royal Institution, where it could find a permanent resting place at the side of Faraday's original apparatus.

◆

NEW INCORPORATIONS

Armstrong, B.C.—Okanagan Hardware Co., $35,000.

Invermere, B.C.—Invermere Contracting Co., $50,000.

New Westminster, B.C.—Westminster Arena Co., [illegible]

Medicine Hat, Alta.—Excelsior Oil and Gas Co., [illegible]

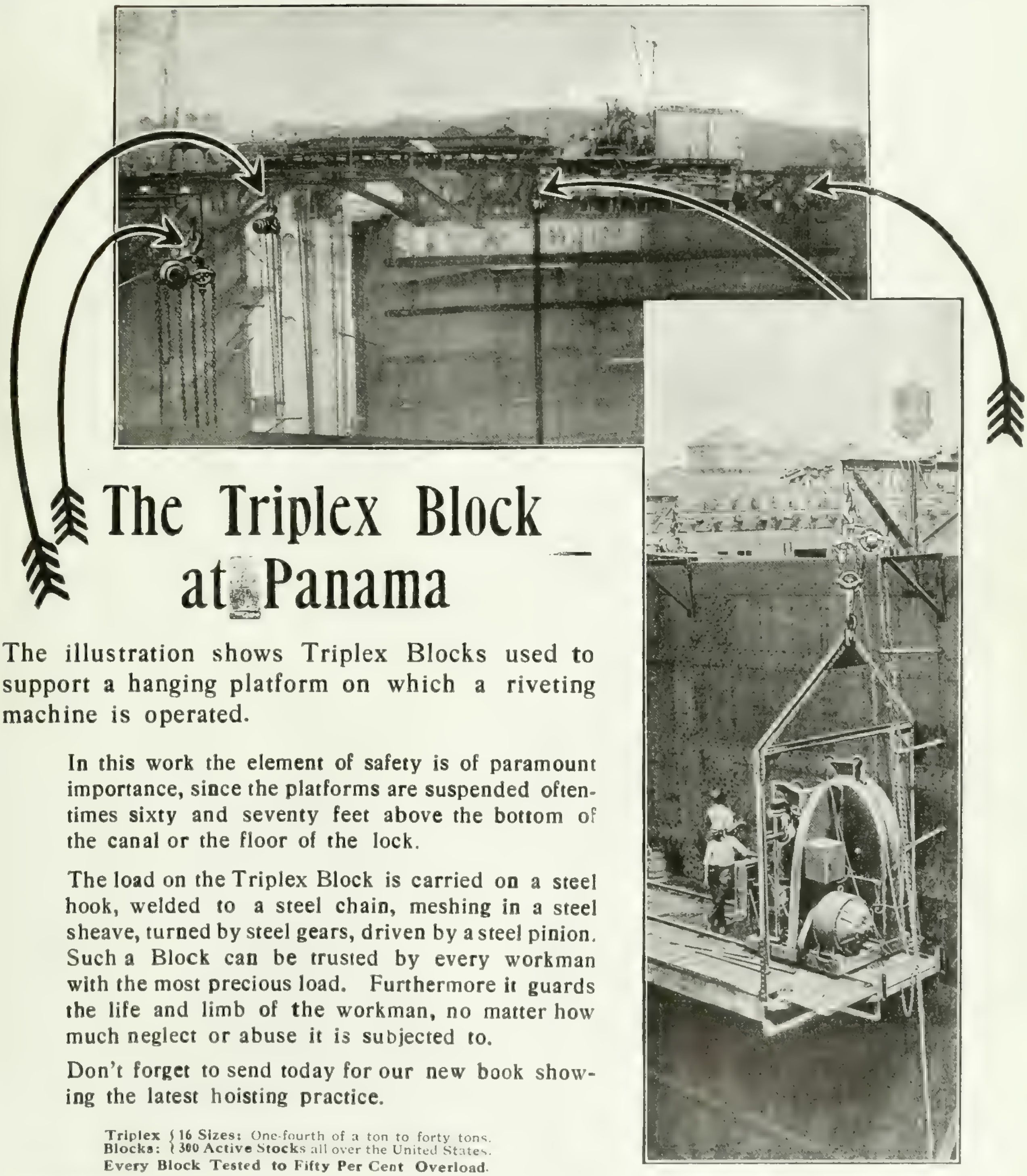
Redcliff, Alta.—Redcliff Rolling Mill and Bolt Co., [illegible]

Prince Rupert, B.C.—New Hazelton Bridge and Power Co., [illegible]

Forest, Ont.—Forest Basket Co., [illegible] W. [illegible], [illegible]

Victoria, B.C.—Leechtown Mining Co., $500,000. [illegible]

THE TRIPLEX BLOCK



The Triplex Block at Panama

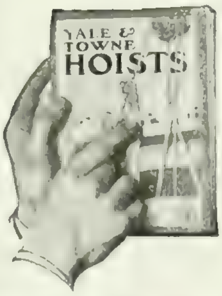
The illustration shows Triplex Blocks used to support a hanging platform on which a riveting machine is operated.

In this work the element of safety is of paramount importance, since the platforms are suspended oftentimes sixty and seventy feet above the bottom of the canal or the floor of the lock.

The load on the Triplex Block is carried on a steel hook, welded to a steel chain, meshing in a steel sheave, turned by steel gears, driven by a steel pinion. Such a Block can be trusted by every workman with the most precious load. Furthermore it guards the life and limb of the workman, no matter how much neglect or abuse it is subjected to.

Don't forget to send today for our new book showing the latest hoisting practice.

Triplex Blocks: { 16 Sizes: One-fourth of a ton to forty tons.
{ 300 Active Stocks all over the United States.
Every Block Tested to Fifty Per Cent Overload.



THE CANADIAN FAIRBANKS-MORSE CO., Limited

SOLE AGENTS FOR CANADA

MONTREAL ST. JOHN OTTAWA TORONTO WINNIPEG
CALGARY SASKATOON VANCOUVER VICTORIA

Hamilton, Ont.—Sunshine Laundry Co., $40,000. J. M Duff, F. R[illegible], W. G. Hann[illegible]

Galt, Ont.—Plested Construction Co., $150,000. G. A. Dobbie, F. S. Scott, C. Turnbull.

Brantford, Ont.—Ideal Brick and Tile Co., $60,000. G. [illegible], H. J. [illegible], T. L. Wood

Hamilton, Ont.—Blue-Glass Chemicals, $40,000. J. B. [illegible], B. [illegible], J. W. [illegible]

Montreal, Que.—Canada Grip Nut Co., $250,000. E. M. McDougall, G. S. Stairs, P. F. Casgrain.

Ottawa, Ont.—Capital Roofing and Cornice Co., $40,000. H. Fisher, L. P. Sherwood, J. J. Lyons.

Vancouver, B.C.—East Coast Logging Co., $50,000. Sechelt Gravel and Construction Co., $170,000.

Fort William, Ont.—McKellar Bedding Co., $200,000. H. D. McKellar, E. W. Clement, W. P. Clement.

Roxton Falls, Que.—Poirier Chairs and Caskets, $95,000. W. Poirier, J. B. Lamarche, J. H. Provost.

Brandon, Man.—Great West Coal Co., $20,000. C. H. Lamontagne, S. C. Lamontagne, R. E. Unicume.

Edmonton, Alta.—Park Lumber and Planing Mills, $75,000. Crown Plumbing and Heating Co., $10,000.

St. Malachie, Que.—Bois Gilbert Manufacturing Co., $49,900. J. A. Lacasse, H. H. Henderson, J. Maheux.

London, Ont.—Perfect Automatic Wrapping Machine Co., $40,000. W. W. Gammage, H. E. Short, G. Kelly.

Weston, Ont.—Reliable Bedding Co., $60,000. J. F. Holliss, T. H. Wilson, Toronto; W. Gauvreau, Ottawa.

Sayabec, Que.—Simard Lumber Co., $2,000. J. Simard, [illegible], T. L. [illegible], J. A. Cast[illegible], Sayabec

Vancouver, B.C.—Canadian Engineering Corporation $250,000. J. F. Wineland Building and Engineering Co., $[illegible]

Walkerville, Ont.—Agnew Electric Welder Co., $40,000. R. F. Agnew, Detroit, Mich.; C. Fleming, Ingersoll; H. Crouchman, Walkerville.

Sault Ste. Marie, Ont.—Pratt Mining Co. of Ontario, $50,000. S. B. Somers, Minneapolis; J. A. McPhail, D. W. Lewis, Sault Ste. Marie.

Montmagny, Que.—Usines Generales de Chars et de Machineries, $500,000. A. N. Normand, Montmagny; C. A. Paquet, J. H. Paquet, Quebec.

Calgary, Alta.—Alberta Optical Co., $25,000. Alberta-Saskatchewan Paper and Straw Board Products Co., $300,000. [illegible] $[illegible]

Steelton, Ont.—Algoma Hardwood Flooring and Lumber Manufacturing Co., $40,000. W. Wilks, W. Stringer, Steelton; W. K. Miller, Sault Ste. Marie.

Montreal, Que.—General Manufacturers' Agencies, $50,000. J. W. Cook, A. A. Magee, E. G. Trevor Penny. Nova Scotia Development Co., $1,000,000. A. H. Elder, P. [illegible], S. L. [illegible]

Notre Dame du Bon Conseil, Que.—[illegible] Compagnie [illegible] St. Bonaventure.

Winnipeg, Man.—[illegible] Co., $80,000. I. Lesk, J. Cherniack, A. Cherniack. Fisher River Lumber Co., $100,000. D. Silver, H. Tremert, G. A. [illegible]

Toronto.—[illegible] Co., $[illegible]000. S. Hill, Birmingham; W. L. Clark, H. R. Turner, [illegible] Mines, $1,[illegible]. S. Cuddy, J. Y. Murdock, W. H. Clip[illegible]

Toronto.—C. G. Anderson Lumber Co., $40,000. C. G. [illegible]

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

[illegible]—October [illegible]—Authorizing G.T.R. to construct siding and spur therefrom for the Shortreed Lumber Co., at Kearney, Ont.

[illegible]—October 22—Authorizing G.T.R. to construct siding for the Canadian Rumley Co., Ltd., Toronto, Ontario.

17838—October 23—Authorizing G.T.P. Branch Lines Co. to construct Prince Albert Branch across highway between Secs. 6 and 7, Tp. 46, R. [illegible], W. [illegible] M., mileage [illegible], Dist. Sask., Sask.

17839—October 23—Authorizing G.T.P. Branch Lines Co. to construct Calgary-Boundary Branch over Diamond Coal Co.'s spur in N.E. ¼ Sec. [illegible], Tp. [illegible], R. [illegible], W. 4 M., by overhead structure.

17840—October 14—Authorizing city of Vancouver, B.C., to construct Hastings St., Pender St., Keefer St., and Harris St., across Vancouver, Victoria and Eastern Ry. & Nav. Co., by means of overhead bridges.

17841—October 1—Approving revised location C.N.O.R. through unsurveyed territory, Dist, Algoma, mileage 280.5 to mileage 290.6.

17842—October 23—Relieving C.P.R. from providing further protection at Main Street crossing, village of Chesterville.

17843—October 24—Authorizing C.P.R. to construct across twelve (12) highways in Manitoba and Saskatchewan, mileage 31.27 to mileage 65.3.

17844—October 24—Authorizing C.L.O. & W. (C.P.R.) to construct bridge across highway at mileage 95.25, Tp. Brighton, Ont.

17845—October 24—Authorizing C.L.O. & W. (C.P.R.) to construct proposed bridge across road between Lots 28 and 29, Con. 2, Tp. Whitby, Co. Ontario, Ont., mileage 164.42, station 1018.35.

17846—October 23—Approving plan of structural work of C.N.R. proposed bridge over C.P.R. Co.'s Secondary Canal "B," in Sec. 9, Tp. 25, R. [illegible], W. 4 M., Alberta.

17847—October 24—Extending, until July 1st, 1913, the time within which the C.P.R. may operate its Manitou Lake Branch from a point on its Pheasant Hills Branch, in Sec. 6, Tp. 40, R. 19, W. 3 M., to a point in Sec. 32, Tp. 43, R. 21, W. 3 M., mileage 0 to mileage 27.8, between Wilkie and Cutknife, Saskatchewan.

17848—October 23—Requiring the Esquimalt & Nanaimo Ry. Co. to appoint and continue a permanent agent at Cowichan, B.C.

17849—October 24—Authorizing C.P.R. to construct third track, south of its present tracks, across tracks of Jacques-Cartier Union Ry. Co., on Lot Cadastral No. [illegible], Parish of Lachine, Co. Jacques Cartier, Que.

17850—October 24—Authorizing G.T.P. Branch Lines Co., temporarily, to carry traffic over its Biggar-Calgary Branch from Biggar to No One Siding, distance of 7.1 miles.

17851—October 24—Authorizing C.P.R. to construct spur for the John Irwin Co., Ltd., Calgary, Alta.

17852—October 25—Authorizing C.P.R. to carry freight, temporarily, on its Lacombe Easterly Branch from Coronation to Consort, a distance of thirty-two miles.

17853—October 24—Authorizing C.P.R. to construct industrial spur for Canadian Milk Products, Ltd., and crossing road allowance between Lots 16 and 17, Con. 15, Tp. Yarmouth, Co. Elgin, Ontario, near Belmont Station.

17854—October 25—Authorizing C.P.R. to cross, for construction purposes only, the tracks of Grand Trunk and Toronto Street Railway Companies, and John Street, city of Toronto, Ont., crossings, when in operation, to be protected by watchman.

17855—October 25—Authorizing C.P.R. to construct subway No. 100.5 at the east end of Coquitlam Yard, on Cascade Subdivision, British Columbia Division, in Province of British Columbia.

17856—October 25—Authorizing C.L.O. & W. (C.P.R.) to construct bridge [illegible], Tp. of Camden, Co. Lennox and Addington, Ont.

17857—October 25—Authorizing G.T.R. to construct siding for J. John[illegible] on Lot [illegible], Tp. [illegible], Co. Simcoe, and Province of Ontario.

[illegible] Authorizing G.T.P. Branch Lines Co. to operate [illegible] over Pheasant Hill[illegible] C.P.R. [illegible], R. [illegible], W. [illegible] M., Dist. Saska[illegible]

17859—October 22—Approving location C.N.O.R. station grounds at [illegible], Tp. [illegible], Ont.

[illegible] Pointe aux Trembles, Que., [illegible] Ry.

[illegible] to construct farm crossing [illegible], R. [illegible], W. [illegible] M.

[illegible] C.N.O.R. to construct across Sault and [illegible] overhead structure.

[illegible] C.P.R. to construct spur for the St. Lawrence Bridge Co., Ltd., crossing main spur and connecting with another spur of G.T.R., on Lot Cadastral, No. 915, Parish Lachine, Co. [illegible]

[illegible] C.L.O. & W. (C.P.R.) to construct [illegible], Co. Durham, Ont.

[illegible] C.L.O. & W. (C.P.R.) to construct [illegible]

[illegible] Order directing [illegible]

[illegible] B.C., [illegible] platform at that point [illegible]

[illegible] C.P.R. [illegible] to construct spur [illegible]

Volume 23. Toronto, Nov. 14, 1912 Contents of this issue on page 739

The Canadian Engineer

An Engineering Weekly

THE BROOKLYN GRADE CROSSING COMMISSION.

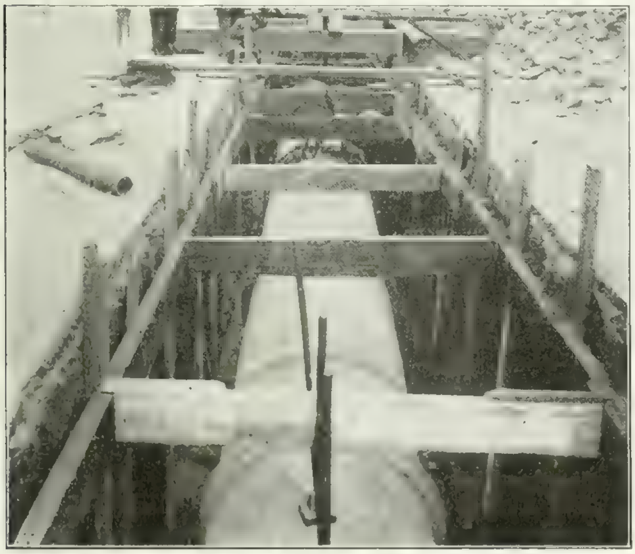
Pipe Raising at East New York, Brooklyn, N.Y.

By WM. C. SAMPLE.

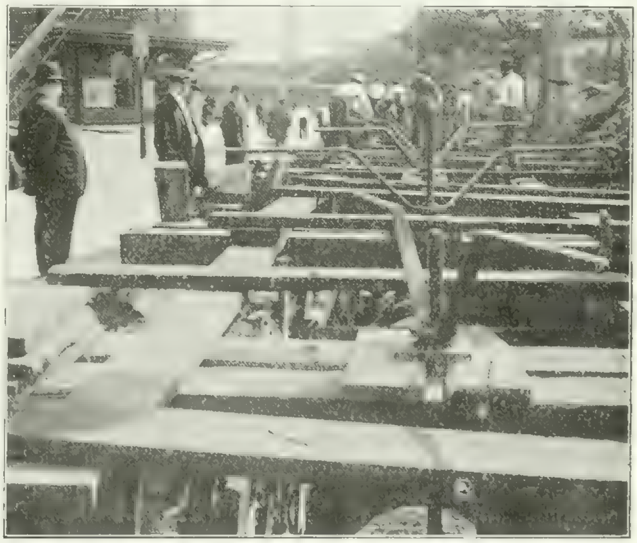
Mr. Sample was in the employ of The Brooklyn Grade Crossing Commission for upwards of five years. For four years of this period he occupied the position of designer and estimator to the Bay Ridge Improvement. Quite recently Mr. Sample was engaged to fill a position at Fort William, Ont., with the Barnett, McQueen Co., Engineers and Contractors, Minneapolis and Fort William, who have the contract for the design and construction of the three million bushel addition to the Canadian Northern Elevator at Fort William.

During the past eight years the Brooklyn Grade Crossing Commission has been engaged upon the largest scheme of grade crossing elimination ever carried out in the United States.

The commission was created by an Act of the New York State Legislature, which became a law on May 9th, 1903, entitled as follows: Chap. 507, an Act to abolish certain grade crossings of highways and railroads in the borough of Brooklyn in the city of New York and county of Kings, and providing for necessary changes in the grades of highways, streets and avenues, and of portions of the railroad and right-of-way of the New York, Brooklyn and Manhattan Beach Railway Company, leased to the Long Island Railroad Company, and of the Brooklyn Union Elevated Railroad Company, leased to the Brooklyn Heights Railroad Company, so as to abolish present, and avoid future crossings at grade, and providing means for the payment for such alterations or changes.



View of Fort Hamilton Main Before Raising.



View Showing Screw Jack in Position, Fort Hamilton Main.

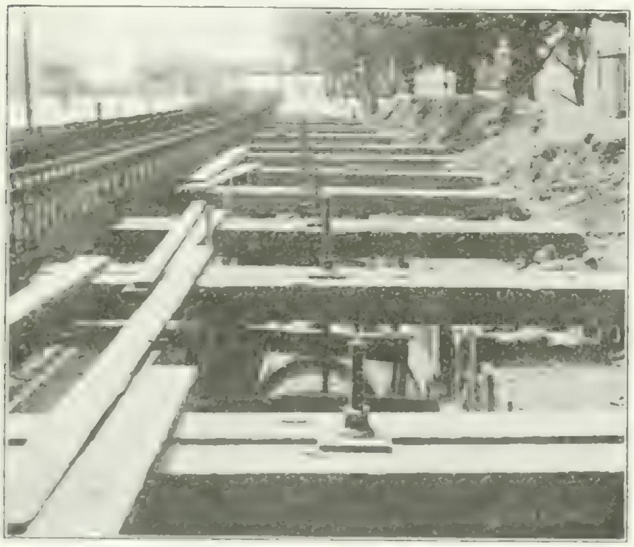
The Act authorized the mayor of the city of New York (Hon. Seth Low) to appoint a commission of five, three of whom should represent the city, one to represent the Long Island Railroad Company, and one to represent the Brooklyn Heights Railroad Company, for the purpose of carrying out the provisions of the Act above referred to.

Changes have from time to time been made in the personnel of the commission, and the membership as at present constituted, is as follows: Frank U. Brooks, president; John S. Griffith, secretary; Edwin C. Swezey, general superintendent, representing the city of New York; Ralph Peters, president of the Long Island Railroad, representing the Long Island Railroad Company; and John L. Wells, representing the Brooklyn Heights Railroad Company.

Under the terms of the original Act of the New York State Legislature, the city of New York was required to pay one-half the cost of the work and this was provisionally fixed at $750,000, subsequently increased by amendment to $1,000,000 for the Brighton Beach improvement (Brooklyn Heights Railroad), and $2,500,000 for the Bay Ridge improvement (Long Island Railroad), with the provision that any additional cost in excess of the joint expense of $5,000,000 should be borne by the railroad company alone, except where additional bridges were built at streets not actually opened or travelled, so as to provide for future crossings. In such cases the cost to the city was to be increased so as to cover one-half of the expense of such additional bridges.

The Brighton Beach improvement is now completed, but the Bay Ridge improvement, although in an advanced stage of construction, will take about twelve months longer to complete. The work already done on this last mentioned improvement embraces the raising and depressing of about twelve miles of double track, the construction of railroad and highway bridges with reinforced concrete floors; plain and reinforced concrete retaining walls and bridge abutments, station buildings, freight and storage yards, new streets, etc. The contract for the final section of the work was recently let for a figure approximating $1,250,000, and when complete will bring the total amount expended on the Bay Ridge improvement to about $8,000,000.

The principal item on this final section of the improvement consists of a four-tube reinforced concrete tunnel, 3,500 feet in length, the building of which, in open cut, through the busy East New York section of Brooklyn, [illegible] which the improvement engineers will be called upon to solve. The tunnel will cut through many of the busiest streets in East New York, and [illegible] etc., have been diverted, and this article is intended to deal [illegible]



The Atlantic Avenue Main.

A large amount of work was necessary before the actual raising of the pipes could be undertaken. Detailed drawings showing the existing elevations and location of the water mains in relation to the proposed tunnel were prepared and submitted to the Brooklyn Department of Water Supply, who have jurisdiction over all mains laid in the borough of Brooklyn. This department in turn drew up a large scale plan, embodying a general scheme of the method to be pursued in the carrying out of the work.

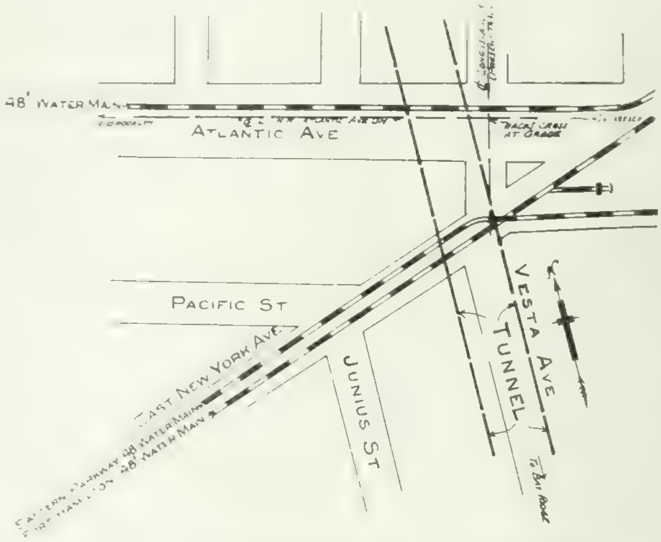


Fig. 1.—Sketch Showing Location of Water Mains.

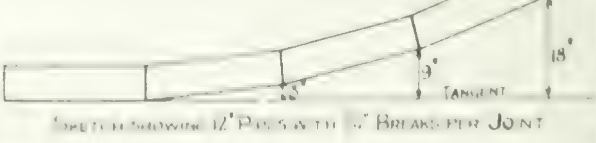
In Fort Hamilton and the Eastern Parkway water mains, or rather the portions of them which required raising, pass underneath the existing Long Island tracks and provision had to be made for the carrying on of the railroad traffic during the progress of the work. The portion of the Atlantic Avenue main raised did not interfere with the railroad, the end adjoining [illegible] quite close to the tracks.

Table I.

Dia of Pipe in Inches	Break in Inches per Joint	OFFSET IN INCHES FOR Nº OF LENGTHS									
		1	2	3	4	5	6	7	8	9	10
12	¼	3	9	18	30	45	63	84	108	135	165
	⅜	4½	13½	27	45	67½	94½	126	162	202½	247½
	½	6	18	36	60	90	126	168	216	270	330
	⅝	7½	22½	45	75	112½	157½	210	270	337½	412½
16	¼	2½	7½	15	25	37½	52½	70	90	112½	137½
	⅜	3⅜	10⅛	20¼	33¾	50⅝	70⅞	94½	121½	151⅞	185⅝
	½	4½	13½	27	45	67½	94½	126	162	202½	247½
	⅝	5⅝	16⅞	33¾	56¼	84⅜	118⅛	157½	202½	253⅛	309⅜
20	¼	1⅘	5⅖	10⅘	18	27	37⅘	50⅖	64⅘	81	99
	⅜	2⅗	8⅕	16⅕	27	40½	56⅗	75⅗	97⅕	121½	148½
	½	3⅗	10⅘	21⅗	36	54	75⅗	100⅘	129⅗	162	198
	⅝	4½	13½	27	45	67½	94½	126	162	202½	247½
30	¼	1⅕	3⅗	7⅕	12	18	25⅕	33⅗	43⅕	54	66
	⅜	1⅘	5⅖	10⅘	18	27	37⅘	50⅖	64⅘	81	99
	½	2⅖	7⅕	14⅖	24	36	50⅖	67⅕	86⅖	108	132
	⅝	3	9	18	30	45	63	84	108	135	165
48	¼	¾	2¼	4½	7½	11¼	15¾	21	27	33¾	41¼
	⅜	1⅛	3⅜	6¾	11¼	16⅞	23⅝	31½	40½	50⅝	61⅞
	½	1½	4½	9	15	22½	31½	42	54	67½	82½
	⅝	1⅞	5⅝	11¼	18¾	28⅛	39⅜	52½	67½	84⅜	103⅛

$$\text{Constant for any Break in Joint} = \text{Break in Joint in Inches} \times \frac{144}{\text{Dia of Pipe in Inches}}$$

$$\text{Offset from Tangent at any Pipe Length} = \text{Number of Pipes} \times \left(\frac{\text{Number}+1}{2}\right) \times \text{Constant}$$



Sketch showing 12" Pipes with ¼" Break per Joint

Bents were designed as shown in Fig. 2, and these were placed under the tracks to support them over the excavated pipe trenches. This work was carried out in the early hours of Sunday, when traffic was practically at a standstill.

The plan drawn up by the Brooklyn Department of Water Supply showed that it would be necessary to raise 21 pipes in the Eastern Parkway main; 19 pipes in the Fort William main, and 17 pipes in the Atlantic Avenue main, and the heights to which the mains were to be raised above their original levels were: Eastern Parkway, 2.75 feet (2 ft. 9 in.); Fort William, 2.17 feet (2 ft. 2 in.), and Atlantic Avenue, 2.25 feet (2 ft. 3 in.). To achieve this object the Bay Ridge engineers calculated the break to be given per point from the formula given in Table I.—the formula is self-explanatory. Everything was now in readiness for the contractor, Mr. Frank J. Gallagher, of Brooklyn, to make a start and it was decided that the Eastern Parkway main would be the first to be raised, with the Fort Hamilton and Atlantic Avenue mains to follow in the order mentioned. The methods adopted by the contractor in raising the mains were similar in each case, and it will be necessary, therefore, to detail the work on one of the mains only, as typical of the others. For this purpose the Atlantic Avenue main is selected. It was much the older main of the three, having been laid about forty years ago, and it was anticipated that a great amount of trouble would be met with in raising it. Happily, however, this did not prove to be the case. The pipe joints, when bared, were found to be in excellent condition, and bear eloquent testimony to the splendid manner in which the original contractor had carried out his work. Water main laying is the one branch of contracting that the grafting contractor should avoid. He may be able to pull off some of his old tricks in practically every other grade of contracting, but never with water pipes. Water has a little peculiarity of finding out any weaknesses at the joints.

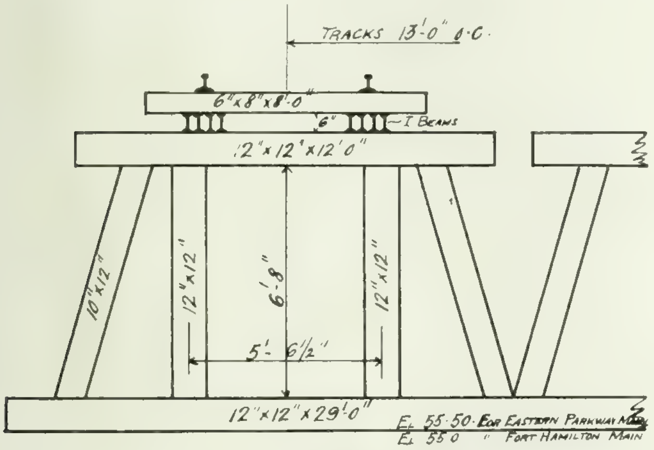


Fig. 2.—Details of Bents.

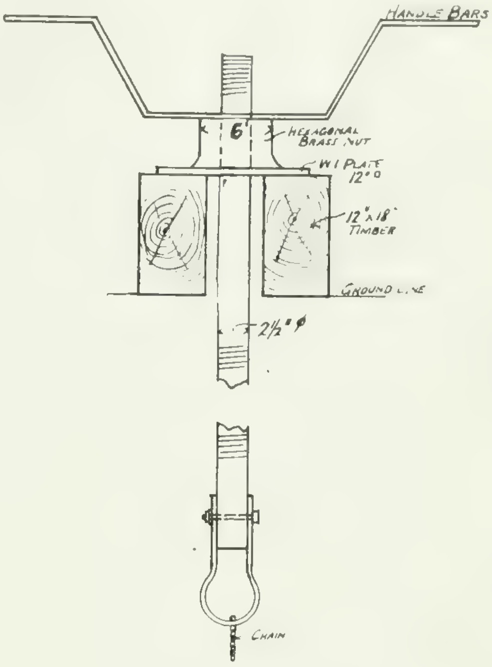


Fig. 3.

In raising the mains twelve screw jacks were used. A sketch of this type of jack is shown in Fig. 3. This sketch, it should be stated, is from memory, as the writer has not any details of it before him, and the dimensions given are therefore only approximate. The jacks are the property of the Brooklyn Department of Water Supply, and were hired from the department by the contractor. It will be noticed that the jack passes through a large brass nut, this in turn rests on two balks of timber placed just sufficiently

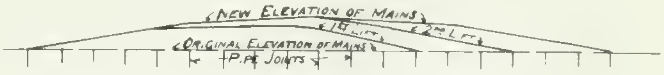


Fig. 4.

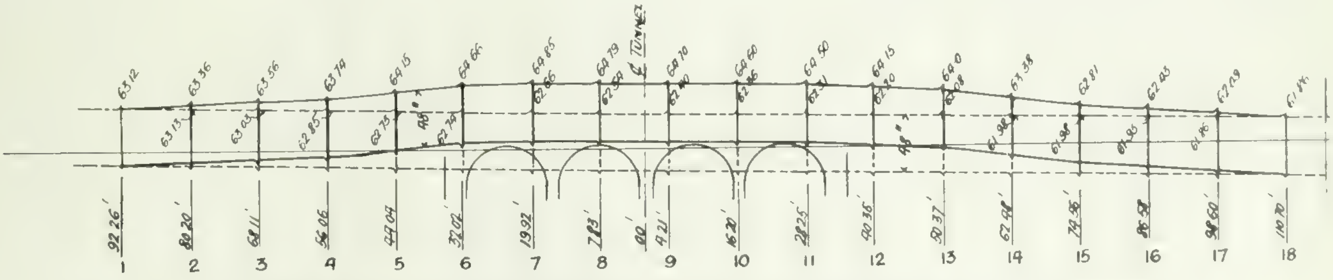


Fig. 5.

SECTION SHOWING ORIGINAL AND NEW LOCATION OF 48" WATER MAIN ATLANTIC AVENUE

ORIGINAL LOCATION SHOWN THUS - - - - - - -

NEW " " ———

TABLE OF ELEVATIONS TAKEN DURING PIPE RAISING OPERATIONS

DATE & TIME OF TAKING ELEVATIONS		JOINTS																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	ORIGINAL ELEVATIONS	63 12	63 13	63 03	62 85	62 75	62 74	62 66	62 54	62 40	62 36	62 31	62 20	62 08	61 98	61 98	61 95	61 86	61 86
	NEW ELEVATIONS	63 12	63 36	63 56	63 74	64 15	64 66	64 85	64 79	64 70	64 60	64 50	64 15	[illegible]	63 38	62 81	62 45	62 09	61 86
9 50am June 21st	"	63 12	63 20	63 21	63 16	63 18	63 22	63 14	62 98	62 77	[illegible]	[illegible]	62 30	62 14	[illegible]	[illegible]			
4pm June 21st	"	63 14	63 33	63 53	63 72	63 98	64 50	64 55	64 72	64 71	64 70	[illegible]	[illegible]	[illegible]	[illegible]	62 89	62 49	62 07	61 85
8am " 22nd	"				63 87	64 27	64 60	64 85	64 92	64 96	64 88	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
8 30am "	"	63 14	63 34	63 65	63 93	64 29	64 69	64 95	65 06	64 99	64 95	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62 50	62 07	61 88
11am " "	"	63 14	63 34	63 65	63 90	64 23	64 67	64 88	65 01	64 88	[illegible]	[illegible]	64 16	[illegible]	[illegible]	62 88	62 48	62 07	61 88
12 15pm "	"	63 14	63 34	63 63	63 90	64 23	64 61	64 88	65 01	64 95	64 88	[illegible]	64 15	[illegible]	[illegible]	62 88	62 47	62 07	61 88
8 30am " 24th	"		63 32	63 60	63 86	64 19	64 57	64 84	64 97	64 97	64 83	[illegible]	64 10	63 70	63 21	62 83	62 43	62 04	61 86

apart to allow the jack to pass between them. The balks of timber were given a good bearing on each side of the trench and thus distributed the pressure over a large area. Attached to the jack, as will be seen, was a large powerful hook and this in turn was hooked up with a steel link chain which was passed round the pipes near the bell. Twelve jacks, as already stated, were used, worked by hand power, and these gradually raised the pipes, as shown in Fig. 4, and denoted "First Lift." An engineering corps in charge of Mr. J. P. Patterson, assistant engineer of the Long Island Railroad, was in constant attendance taking elevations of the pipes, and as the first few were brought to grade they were blocked up and the jacks taken to the further end of what might be termed the jack line.

Raising was then commenced as denoted "Second Lift" in Fig. 4, and thus by successive lifts the water main was brought to the desired elevations. The pipes were carefully blocked up, and it speaks well for the manner in which the work was carried out that elevations taken on the pipes many hours after they had been raised and blocked up showed that they had sunk in a few cases only a mere fraction of an inch. The jacks used in the work are capable of raising 25 tons whilst the pipes raised were twelve feet long and weighed about four tons each, or full of water, as they were, nine tons each. The pipes, it should be mentioned, were under a pressure of 40 lbs. to the square inch. A section of the pipe is shown in Fig. 5. As previously stated, the pipe joints on the Atlantic Avenue main were found to be in excellent condition, but naturally the bed blocks were not found in a similar state of excellent preservation, and many of them had to be replaced when the pipes were raised. It should be stated that the contractor had a number of caulkers in constant attendance, and whenever any weakness in the joints became apparent, it was speedily attended to. Fig. 5 shows a section giving the original and new locations of the water main under review, and appended to it is a table giving the original and new elevations, together with elevations taken on the pipes during the progress of the work. A perusal of these will be found interesting and will in part explain the "Lifts" shown in Fig. 4.

The Eastern Parkway main was subject to a pressure of 40 lbs. to the square inch, and the Fort William main to a pressure of 80 lbs. to the square inch. With regard to the Fort William main it should be mentioned that part only of it was raised under full pressure. It is syphoned under the Eastern Parkway main, and owing to an extra bend having to be added to it, the water was turned off [illegible].

The whole of the work was carried out under the direct supervision of Mr. L. V. Morris, the chief engineer of the [illegible]

[illegible]

◆

[illegible]

LIGHT COMPRESSION MEMBERS.

(Concluded from last issue).

Mr. Horton: I am disposed to suggest that the difficulty with the details was that they wrinkled, and have suggested that a thousand tests be made in the laboratory to discover how to lessen the wrinkling.

Chas. K. Mohler: I wish to call attention to some points which may be of interest, in connection with the distortion and partial failure of some trestle columns under conditions where they should not have failed, if the bent, of which they formed a part, had been properly designed. The distortion was made possible on account of the omission of diagonal bracing between the columns. Briefly, the bent was located at an angle in the north approach to a bridge over the Monongahela River at Pittsburg. The columns carried the east end of the riveted pony truss, which made an angle of about 35° or 40° at this point with the main approach. A timber trestle was built at right angles in the opposite direction. Through expansion and contraction, or the tilting of the bents of the timber trestle, or both, the spans, together with the tops of the columns, were carried at right angles to the trestle. The columns were bent fixed at both ends, and as a result both columns were bent in double flexure or reverse curves. The lacing bars in compression were badly buckled. The columns were not over 20 ft. high. There would have been no failure from any strain that comes upon the bent if it had been supplied with the necessary diagonal bracing. The omission of the diagonals was inexcusably bad design. There were many other instances of bad detail in this particular structure, but they do not relate to this discussion.

This simply shows that many times failure of a structure is caused by some of the members having to take care of loads and stresses which they were not designed to carry.

F. G. Vent: Mr. Jensen made a remark about not worrying too much over the proportion of the length to the radius of gyration. I think when you get over 200 you have to begin to look out. A short time ago a certain manufacturer submitted a design for a roof truss, which I had occasion to check. It was what is called a skimp design, and in figuring it over I found that the sections had a large ratio of $\frac{l}{r}$. One of his excuses for this was that we had a structure which was built where the $\frac{l}{r}$ was somewhere around [illegible], built by George S. Morison. In referring to the plans for that truss I found that by taking the section of the compression member and figuring only the outstand[illegible] the $\frac{l}{r}$ to about [illegible], and the design was well proportioned. The de[illegible] was somewhere [illegible] $\frac{l}{r}$ in every member. This shows that if we [illegible] we will sometimes find that the $\frac{l}{r}$ is [illegible] just the outstanding flange we will [illegible] $\frac{l}{r}$ [illegible] low.

Mr. Horton: I understand, Mr. Jensen, that the $\frac{l}{r}$ is of much less significance than is frequently ascribed to it, and the tests of full-sized members certainly show this fact. Tests have been made, up to 175 $\frac{l}{r}$ on large pipe and **H** sections, and the ability to stand loads is not much lessened at that length (about 20% less than the strength at 35 $\frac{l}{r}$). No column of over 120 $\frac{l}{r}$ can be used in Chicago, whereas tests of rolled sections show a loss of only about 16% between 35 $\frac{l}{r}$ and 120 $\frac{l}{r}$. With the straight line formula $16{,}000-70\frac{l}{r}$, to limit the radii length is absurd.

Lewis McDonald: There has been considerable talk about the relation of the radius of gyration to the length, and because some experiments have seemed to show that this did not have the significance which we have usually attributed to it, it seems that some would do away with it altogether in their designs. I do not think that we should forget our early training in this respect and we should still consider the relation of the radius of gyration to the length. But there are other things which enter into the design of a column which perhaps we have overlooked in the past and which recent failures have brought more particularly to our attention, and while we should not omit to take this into consideration, we should give other things, such as wrinkling, thickness of material, etc., their proper consideration. I do not think it is the intention of any one to say that we should design our columns up to 300 or 400 $\frac{l}{r}$. Probably the original formula which was worked out was all right, and so long as we had homogeneous material, that probably would be the only consideration which we would need to give. But in built-up members it certainly is necessary that we consider the shop work and the effect of driving more or less rivets and other things which we have heard discussed.

Mr. Horton: Referring to Mr. Vanderlip's remarks, we can scarcely imagine a boom built of four angles which would not be very satisfactory as regards $\frac{l}{r}$. I am reminded of a boom 100 ft. long, 24 in. square in the centre, built of four 1½ by 1½ by ¼-in. angles, laced on four sides with 1¼ by 1¼ by 3/16-in. angles in 2-ft. panels. This boom was entirely satisfactory as regards $\frac{l}{r}$, but the other question came up as to its sufficiency as a beam. Could it be handled as a beam, that is lifted at the centre or at the ends? Calculations showed that it could. Experiments made later showed that the actual corresponded with the calculated deflections. This is interesting, as a ratio of length to depth of 50 to 1 is an unusual proportion.

J. W. Bradford: It is quite a problem to know just how light we can make many of these struts, but we are called on at times to furnish some which are not so light. I know of instances where we have been called on to make struts 2 ft. or more in width, and laced with angles, which makes a very heavy and costly member. The ordinary strut made with four angles laced makes a very good strut but it runs up in weight, and where the four angles are turned in and laced, the cost of shop work is very great. In many cases the strut made of two channels with lacing between them makes a very light strut and one with which it is very easy to get a good end connection.

Arthur N. Talbot: The compression member is a fruitful topic for discussion, and the remarks made on this topic are interesting and bring out many different views. As the column is used under such diverse conditions, it is not strange that such a variety of views exist. Our knowledge of the action of the column is incomplete, so much so that its properties offer a very promising field for investigation. In fact, one of the great needs in the line of structural engineering lies in experimentation on the action of compression members. However, it should not be lost sight of that a great deal of information on column action is available and that certain things have been established. A reader might gain wrong impressions from some of the statements in the discussion, impressions which the speakers doubtless did not intend to convey. Possibly a few general statements will serve to clear up some ambiguities.

(a) Long columns do fail by flexure, very much as indicated by Euler's analysis. Simple laboratory experiments show this. A very good collection of the results of these tests which have been made on columns may be found in the Proceedings of the American Society of Civil Engineers for December, 1911, pages 1290-98, and these tests bring out very well the effect of flexural action in long columns. If the modulus of elasticity of the column is known, and the section is such that the column will not collapse or distort laterally, the maximum load which will be carried by very long columns may be fairly definitely stated if the end condition of the column is known. For mild steel, long column action may be expected in columns having a length, say, of more than 125 $\frac{l}{r}$ for columns with round ends, and of more than 250 $\frac{l}{r}$ for columns with fixed ends. However, it is known that the stiffness of the built-up column is much less than that of a solid section, as is shown by tests in flexure, and therefore a lower value of the modulus of elasticity must be used in Euler's formula than will obtain for solid material.

(b) What constitutes a round end and what a fixed end, cannot be stated very satisfactorily. It seems evident that a pin-ended connection will offer little end restraint and may be considered to be a round-ended column in one plane. A flat-ended column may act as fixed-ended, especially if it has an enlarged base resting on a firm bearing. Between the extremes of round ends and fixed ends there is a wide range of conditions, and the method of holding the ends, the tightness of the riveting, and the fixedness of the supports are elements which give uncertainty. There is a lack of information on the actual end restraint to be found in building construction.

(c) For very short mild steel columns, of other than solid section, failure is generally by a crinkling or wrinkling action. This action starts at some point where the local stress exceeds the yield point, and this critical load should be considered the strength of the compression member, even though in some forms of section the ultimate load for columns of very short lengths may be such as to give an average stress well beyond the yield point of the material. Just how far this critical load is below the load which would give an average stress equal to the yield point of the material, will depend upon such matters as the imperfection of parts, like crookedness, eccentricity of bearing, eccentricity of rivet bearing, and the movements of the structural elements upon each other. For such short members the strength depends very much upon the form of section and the method of fabrication.

(d) For compression members having a length intermediate between that of the very long column and the very short compression member, the slenderness ratio $\left(\frac{l}{r}\right)$ does affect the strength of the column. Just why this is true is not clear. It is evident that the reasoning about the effect of the length used in the derivation of Rankine's formula is not entirely tenable. It might even be thought that as the column of intermediate length does not deflect laterally to an extent which will explain failure, the strength of a column will remain nearly constant from the very short column to the vicinity of Euler's curve. However, the tests of columns show a gradual reduction in strength with increase in length, though the reduction is of a different character and generally less in amount than that given by Rankine's formula. In fact, tests show that a straight line inclined to the axis represents the results of tests of compression members of intermediate length very well—better than the Rankine formula. Failure in such columns may be by crinkling or wrinkling, the yield point being exceeded at places not necessarily at the centre of the length, and no special bowing or lateral deflection occurring in the amount which would be necessary to explain the failure, such as is seen in the failures of very long columns. In other words, failure seems to be due more to local causes than to general curvature along the whole length as is assumed in most column analyses. As has been indicated, reduction in strength in this intermediate field may be said to be directly proportional to the length of the column, though just why this is has not been determined.

(e) The extent to which length affects the strength, for columns of this intermediate length, seems to depend upon the shape of the section, the thickness of parts, and the method of making up the section, as whether the structural elements are riveted together, as in the case of built-up columns, or whether the piece is an integral rolled section. The tests of rolled **H**-sections made at Watertown arsenal [illegible] may be expressed by the formula $\frac{P}{A}$ = [illegible] $\frac{l}{r}$ for ultimate strength, up to the [illegible] $\frac{l}{r}$ [illegible] $\frac{P}{A}$ = [illegible] $\frac{l}{r}$ for the elastic limit of the columns. The tests of lap welded [illegible] may be expressed by the formula $\frac{P}{A}$ = [illegible] $\frac{l}{r}$ for ultimate strength, the graphs up to the point of $\frac{l}{r}$ [illegible] the tests [illegible] $\frac{l}{r}$ [illegible] strength by $\frac{P}{A}$ = [illegible] $\frac{l}{r}$. These equations [illegible] strength [illegible] of the longest length tested. The formulas for ultimate strength [illegible] [illegible] [illegible] (Bulletin No. 60) made at the University of Illinois are expressed by the equation $\frac{P}{A} = 36,500 - 155\frac{l}{r}$. It is evident that in this form of column, length has a much larger effect than in the two other forms. The general forms of column sections may be expected to have strength equations lying between this equation and the preceding two. An interesting fact brought out in the tests of the Gray columns (see Bulletin No. 56 of the Illinois Engineering Experiment Station) is that at small deformations the effect of length of column is very much less than at the higher deformations, and in this may be found a suggestion bearing upon the explanation of column action. It should also be noted here that in tests of built-up columns the load-deformation diagrams have a considerable curvature even at low loads, while in the tests of the rolled columns the low load-deformation diagram is nearly straight up to the yield point of the columns.

(f) The amount of the effect of the slenderness ratio $\left(\frac{l}{r}\right)$ through this range of intermediate lengths depends also upon the end condition of the column. The equations given in the preceding paragraph are for columns tested with flat ends which acted in the tests as fixed ends. The diagrams giving the results of tests of free-ended columns show a greater slope. Just what explanation best fits the existence of this greater slope, if general flexure is not the only cause of decrease of strength, cannot now be told. It must be understood, however, that end condition does affect the strength reduction for columns of intermediate length, and that a statement of the end condition assumed may well go with the formula.

It may be observed, too, that a single formula for all forms of sections and for different end conditions may not be expected to express the actual column strength.

Some very interesting questions have been raised in the discussion on compression members. One of these is, why not remove the limit of $\frac{l}{r}$. Why was this limit inserted in the ordinance? Possibly because it was felt that there is too much uncertainty in the action of the column beyond the length of 120 $\frac{l}{r}$. Possibly it was done because it was appreciated that the end condition—whether round or fixed—so largely affects the strength of very long columns, and it was not expected that the brief statement in the ordinance could provide for the variations in condition likely to be found in practice. Besides, it has been thought possible by some that in a column formula for homogeneous columns the line which represents the strengths of columns of intermediate length may intersect Euler's curve instead of being tangent to it as commonly assumed.

Enough has been said to justify the remark that more experimental knowledge of column action is needed, for the variety of [illegible] of section, of bearing, of length, and of [illegible]. The view expressed by Mr. Horton, that a large number of laboratory tests are essential to give us an adequate understanding of column strength, has much to support it. The effect of form of section, of thinness of parts, of [illegible], of end condition, of length and slenderness [illegible] different end conditions and different [illegible], of form of [illegible] and its spacing, of lateral supports, of the effect of [illegible] of the effect of the [illegible] with rivets, of the [illegible] Mr. Horton's [illegible]. As Mr. Horton says, "No more mental analysis will ever show us the required relations. Physical tests are required."

And why may not such tests be made? Not all that may be suggested, but a large number along specified lines selected with a view of advancing knowledge on many disputed and unsettled questions. And why should not the Bridge and Structural Section of the Western Society of Engineers take an active part in promoting a movement for such experimental work, in outlining the most profitable lines of research, and in other ways contributing toward the advancement of knowledge in this important matter? Surely a means of co-operation in so promising and fruitful a field may be found.

◆

BRITISH INVESTIGATION OF RAIL CORRUGATION.

The Municipal Tramways Association of Great Britain has been conducting an elaborate study into the causes of rail corrugation and the possible remedies of it, and a report of its committee on this subject was presented at the convention of the association at West Ham, Sept. 25-27. The committee consisted of twenty members, of whom fourteen were railway men and six were outside engineers. The committee has been engaged upon its investigations for a number of years and has been in special activity since February, 1911.

A feature of the work of the committee was a series of extensive experiments to determine the movement of the cars on track and other facts which might have a bearing upon the general subject. Some of these tests were conducted by the committee and others by individual members of the committee. An account follows:

In one experiment a jet of white liquid was discharged from a nozzle fixed at the front end of the truck of a single-truck car, and a jet of red liquid was discharged from a nozzle fixed at the rear end of the truck. A measurement of the records left on the pavement by these jets gave information as to the movement of the truck, wheels and axles relative to the truck. The records thus obtained appeared in the report and their significance was discussed by the committee.

In another experiment a pad of felt to which a supply of white oil-paint was fed was pressed lightly against each rear wheel. In this way a film was left on the track, and it was possible in many cases to produce artificial corrugations in the paint film apparently identical in every respect with actual corrugation marks produced under working conditions. In some cases, however, there were corrugation marks in the paint where there were none in the rail.

In another experiment a single rubber stud was set into each wheel tire and, as it made contact with an ink or paint pad, each revolution of each wheel was marked on the track. On other roads a hard steel sharpened stud to mark the rail was used instead of the rubber stud. The records thus obtained with each wheel of the car were compared to determine the extent of slip and skid of wheels on straight track and curved track, with power and without power etc. Records thus obtained are shown in the report and proved in the opinion of the committee that slip and skid are taking place continually on all wheels under all conditions, even on a car in which an especial effort has been made to have all four wheels brought to the same diameter and where the car is being driven on a straight track. In one test of this kind carried out in Glasgow, where one wheel was 1/16 in. less in circumference than the other three, it was found that at no time, while the car was being driven by its own motor, did any of the wheels cover a distance equal to their circumference, although when the car was being hauled as a trailer the smallest wheel of the four covered the required distance almost exactly. The committee concludes, therefore, that there is always a certain slip going on between the wheels and the rails even under very best of conditions as regards mating of wheels.

In another test two small hard steel studs were placed in the curve of each rail at exactly right angles on straight track or exactly radial on curves. These studs were depressed by the wheel flanges and completed an electric circuit, making a record on a traveling sheet of paper. By this device the position of the axles in regard to the track would be recorded as each car passed the studs. The apparatus for this test was not completed in time for the committee to give results.

Another test was to loosen a section of rail on a curve and one on straight track to ascertain the effect of a loose rail. Another was to remove the lip of a section of rail on straight track and on a curve. Neither of these showed any apparent effect as regards corrugation, except that in Manchester the removal of the lip on the outside rail on a curve seemed to increase the corrugation.

A test made by allowing cars to coast over specified lengths of curved and straight track which was already corrugated was found to reduce the corrugation on the straight track but did not seem to have any definite result on curved track. In another test the gauge of the track in sections of corrugated track was tightened and loosened, in each case ½ in. In the case of the tight gauge the effect was marked, particularly on curves, where the outer rail became more corrugated and the corrugations changed their form, being at right angles to the gauge edge instead of sloping backward from the gauge edge. On the widened section of track the corrugations seemed at first to grow less but afterward became more pronounced.

Another interesting experiment, which was conducted on the lines of the London County Council Tramways, was that of making oblique cuts across the tread of the corrugated rail. These cuts were ⅛ in. wide, 1/16 in. deep and 3 in. pitch, and they sloped at an angle of 60 deg. in the direction of traffic. Two 45-ft. rails were treated in this way, and before they were cut one rail was ground free from all corrugations while the other was left corrugated. The rails were closely watched, but no effect was apparent. In the rail which was ground before being cut the corrugations reappeared after two months, and in the other rail the corrugations became slightly less.

In another test a car was driven along some new track by means of the rear motor alone, and the wheel brakes were applied to the front wheels. Very distinct markings, which bore a decided resemblance to corrugation, were left on the rails.

Tests were also conducted upon the character of the metal at the crests and the hollows of corrugated rails. Strips of metal cut vertically from the tread of the corrugated rail showed in the internal portions of the head an average of twenty-eight points on the scleroscope, while on the surface of the crests the average was thirty-five and at the hollows thirty-three. This indicated that the surface was harder than the body of the rail and that the crests were slightly harder than the hollows. Acid tests on the surface of the corrugated rail also showed that the surface of the crests was harder than the surface of the hollows, but this condition did not exist to a greater depth than ⅛ in.

As the result of its investigations, the committee arrived at the following interim findings:

"Corrugation occurs very widely on systems with electrically self-propelled rolling stock, the construction of which necessitates a relatively low centre of gravity, also on cable systems and to a relatively small extent on steam railways.

"The check or guard is not a necessary factor in the production of corrugation.

"On almost every system it occurs abundantly at places where the break is very seldom applied and is not any more frequent or pronounced at places where the brakes are regularly applied, as at stopping places. It may be concluded that the great bulk of corrugation is not due to any action of the brake.

"The occurrence of corrugation is not dependent on the number of cars which have passed over the rails.

"It is not necessary that the track or the rolling stock or the wheel profiles should be in a worn or defective condition in order to produce corrugation. With all these factors in excellent condition, a car traveling with power under ordinary conditions will readily produce corrugation.

"Corrugation appears on the rails independently of whether the wheels are being actively driven by the motors or not. The committee is of opinion that the explanation of this may be the slip and skid taking place owing to the different diameters of the wheels, which difference largely results from the unequal wear produced by the relative difference in speed of the two motors.

"Corrugation produced by one set of cars may be entirely removed by another set of cars running in place of the first. It may also be caused and removed by the same set of cars under apparently the same conditions.

"The pitch of corrugation is independent of the speed of the cars producing the same.

"Corrugation does not exist on tramway rails as received from the rolling mills.

"Corrugation has been produced by every known type of electric car, and the pitch and characteristics are independent of the type of such car producing the corrugation.

"It is suggested that the brightness of the crests of corrugation, as compared with the comparative dullness of the hollows, is due to a purely rolling action under increased pressure over the crests, and that other portions of the rail are not subjected to a purely rolling motion but to the action of slipping or skidding, alternating with the roll- [illegible]

Suggested Measures for the Mitigation of Corrugation.—"The committee considers that its investigations have produced ample evidence that the force or forces responsible for the reaction between the wheels and rails which results in rail corrugation are external to the rail. It is realized, however, that while rails rolled to any known specification [illegible]

"The committee, therefore, [illegible] a rail steel of such physical character as to resist the ten- [illegible]

"From evidence collected, coupled with the actual ex- [illegible]

[illegible] found that a rail steel which has merely an increased carbon content is not sufficiently durable for this purpose; it is necessary that the rail should be both hard and tough.

"The steel for this purpose should be relatively high in manganese, carbon and silicon, and should be capable of passing the following physical tests: Tensile test, not less than 50 tons per square inch; elongation, 12 per cent. on 2 in. tup test, with rails similar to B. S. section, No. 4, 1 ton falling 15-ft. deflection not more than 1½ in. Brinnel impression test, 50 tons on ball 19-mm. diameter, impression not to exceed 3.5 mm. Curving test, rails to withstand a test curve of 20-ft. radius, either inward or outward, without fracture."

Further Experiments Recommended and Information Required.—The committee suggests further experiments and additional information as follows:

Tests to be made of the amount and period of torsion on the axles of cars.

Tests to be made of the amount and period of the torsion in the wheel.

The vibration on the rail and foundations to be analyzed.

Continue Experiment No. 4, already described. In this it is proposed to place two small steel studs in the groove of each rail exactly at right angles on the straight or radially on a curve. These are depressed by the wheel flanges and each one makes a separate record electrically on a revolving sheet of paper, thus establishing the relative position of the axles with regard to the track. The speed will also be recorded on each sheet.

Tests to be made of the relative speeds of the two motors on a car and the manner in which any difference is compensated for or adjusted under service conditions.

The effect of altering the centre of gravity of the car to be investigated.

Further experiments to be made on the lines of the Leeds and Glasgow tests with retarded wheels.

Records to be kept of the profiles and diameters of successive sets of worn wheels on a car in relation to the position of the two motors on that car.

Information to be obtained as to what effect the springs of the car have on the production of corrugation.

That the advisability of acquiring a complete set of instruments which will record all car movements simultaneously be considered. Such apparatus could be passed on from one system to another. The records could be readily compared and they could be all obtained by one operator.

In view of the considerable use now being made of micro-photography in the investigation of the minute physical structure of metals, the committee advises that the fullest advantage be taken of this science in the further investigation of the corrugation phenomena.

The report contains as an appendix a bibliography of the subject and also a large number of charts and halftone illustrations showing the results of the tests conducted.

* * *

WEIGHT OF CONCRETE.

The average weight of concrete per cubic foot when [illegible] into beams for flexure tests, and into cubes and cylinders for compression tests, is given by the U. S. Bureau of Standards as follows:

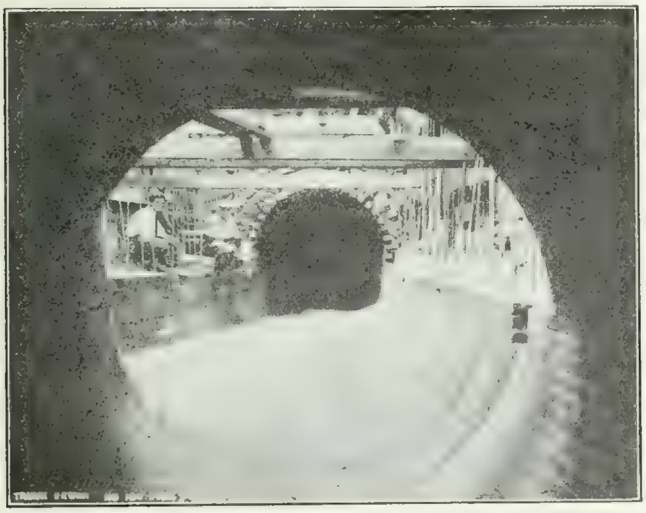
Kind of concrete.	Beams lbs.	Cylinders lbs.	Cubes lbs.
Granite concrete	148	148.6	[illegible]
Limestone concrete	[illegible]	[illegible]	[illegible]
Gravel concrete	144.1	144.8	144
Cinder concrete	[illegible]	[illegible]	118.1

MAIN DRAINAGE SYSTEM OF THE CITY OF TORONTO.

In the issue of October 12th, 1911, of *The Canadian Engineer* we published an article dealing with the main drainage system of Toronto. The annual report of the city engineer of Toronto, for 1911, has just been published and we herewith present an abstract of the report of Mr. A. B. Garrow, assistant engineer, in charge of main drainage works.

High Level Interceptor.—That portion of the high level interceptor, for the construction of which contracts have been let, and which is now all but complete, lies between the Garrison Creek on the west and the sewage disposal works on the east, and might be termed the high level interceptor proper. The high level extension, which is at present being designed, is the continuation of the above sewer westerly to Springhurst Avenue, with a possible further extension to Roncesvalles Avenue.

The past year having, as has been noted, been one of gratifying results, has also witnessed the first, and what is hoped will be the only, misfortune in connection with the construction of the system, namely, the failure of that portion of Section No. 2, located on the east bank of the Don River. This is a circular section, 8 feet 9 inches in diameter, built of reinforced concrete and supported on concrete piers, the construction of which was commenced in September, 1910. For a distance of 300 feet, between the east end of the Don syphon and the old bank of the Don River, the sewage had to be constructed on a filled-in portion of the river bed. The shallow excavation—8 feet at the most—showed a fairly good clay, which, it was estimated, would sustain the weight of the piers upon which the sewer was to be built, and the construction was carried on accordingly. A considerable portion of the invert had already been constructed before it was noticed that the whole 300 feet of sewer was sinking. Observation showed that all the ground in the immediate vicinity was undergoing a similar charge in elevation, and it was realized that any attempt to prevent the sinking of the sewer would have to be postponed till the stability of the ground was restored, and in the meantime the construction was proceeded with. After a study of the conditions it was determined that this peculiar occurrence was due to a combination of circumstances, namely, the placing of the approach of the Wilton Avenue bridge simultaneously with the construction of the Don syphon across the river. The enormous pressure exerted by the former was forcing the soft underlying ground to seek an outlet into the syphon trench, with the result that the surface layer was forced to settle.



Bellmouth.
High Level Interceptor, Section No. 6—Garrison Creek,

The first crack appeared in the invert of the sewer, about midway between the west end and the bank. This quickly widened, and with the appearance of others, destroyed the continuity of the work. The back filling, which was proceeded with, increased the settlement that already had occurred, which resulted finally in a maximum of three feet.

Reconstruction was commenced on August 15th, 1911, and the work put into the hands of the J. H. McKnight Construction Co., who were the original contractors for the section. It was decided to leave in place and underpin a 100-foot section upon which the maximum settlement was 16 inches, and to tear out and reconstruct the remaining 200 feet. Piles were driven close to the interceptor on both sides at 4-foot centres, the centres of the two piles of each bent being 12 feet 9 inches apart. The process of underpinning was to cut off the piles 22 inches below the bottom of the sewer and on them to construct a concrete cradle, reinforced at the bottom with 5, 1-in. diameter, round rods. This cradle was 18 inches wide, and extended up to the springing-line of the sewer. When the concrete had set, the forms were removed and the backfilling replaced, great care being exercised with the latter. The task of tearing out the remaining 200 feet of the sewer was a laborious one, due principally to the presence of the steel reinforcement, which consisted of ⅝-inch square rods. Trouble was also occasioned by the proximity of the approach to the Wilton Avenue bridge on the north side of the excavation, which the rain had made very soft, and for the protection of which a row of anchor-piles had to be driven. When the old concrete and brick invert had been removed down to grade a third pile was added at the centre of each bent, and all were cut off 13 inches below the bottom of the new work. These were capped with a concrete beam 15 inches by 18 inches, reinforced with 5 ⅞-inch diameter round rods. In this instance the invert up to the springing-line and cradle were poured together, and vertical dowels were left protruding at the haunch for bonding the arch. The single ring of brick on the invert was omitted in order to simplify the construction. The new work was set to the original grade and connection made with the under-pinned section (the grade of which was not corrected) in one 25-foot length. The concrete work was completed on December 27th, and after a sufficient interval the backfilling was proceeded with.

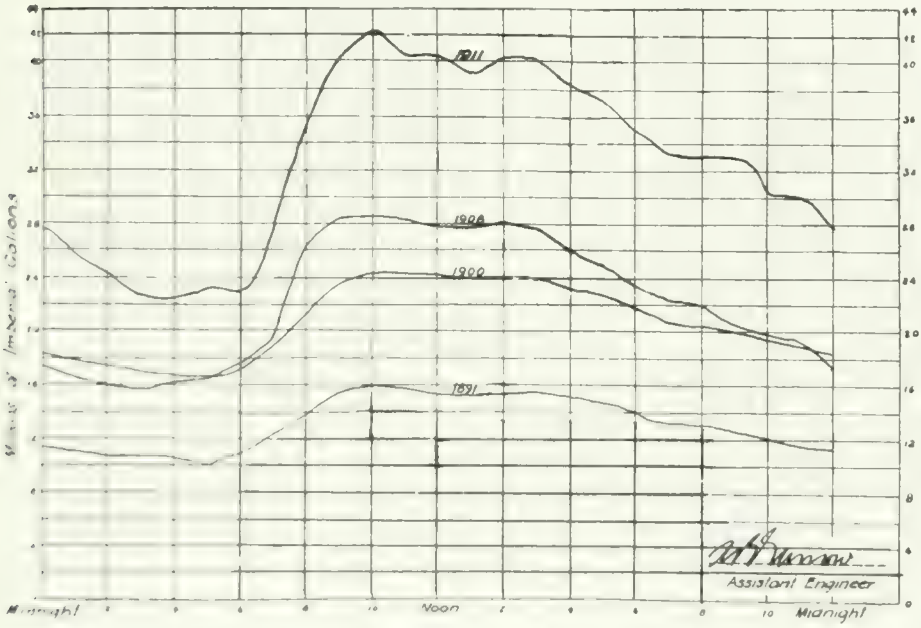
The work necessitated, approximately, the following quantities:

Excavation	1,220 cub.. yds.	
Piles	10,700 lin. feet.	
Concrete, 1, 2, 4	1,210 cub. yds.	(tearing out and replacing)
" "	200 "	(placing only)
Steel	16.75 tons.	

and the total cost, including contractors' 15 per cent., amounted to $14,712.07.

The Rosedale Creek connection, comprising Sections Nos. 14 and 15, has been designed and the contract for the construction of a portion of it awarded this year. The point of interception is located about 3,000 feet west of the Don River, on the Rosedale Ravine Drive, and the pipe required to connect it with the high level interceptor at the corner of River and Mark Streets is 6,600 feet long. It is divided into two sections for the reason that the upper length of 5,700 feet (Section No. 15) is to be in the form of an inverted syphon, for the construction of which 42-inch reinforced concrete pressure pipe are to be used, and the lower 900 feet (Section No. 14) is to be a 3-ft. x 4-ft. 6-in. egg-shape brick gravity sewer. The contract for the pipe for Section No. 15 was awarded this year, and all the pipe manufactured and delivered, although a number have still to be accepted subject to test. The contract for Section No. 14 was also awarded this year, and it is expected that construction will be commenced within a month.

A departure was made in designing the pipe to be laid on curves for the syphon. Since the operation of the syphon would practically depend on the tightness of the joints between the pipes, a special bend was made to be used at the beginning and end of each curve. The standard bend for the curve is made from the straight pipe by depressing one side of the top plate of the mould a sufficient distance to compensate for the difference in distance of the two walls of the pipe from the centre of the curve. To form a true curve with tight joints it will be seen, however, that in making the pipe for the beginning and end of the curve the mould should be depressed only half the distance used on the standard bend. In this way every bend on the curve makes a tight joint with its neighbor, and, with the use of [illegible] in addition, a [illegible] watertight job is [illegible]ted.



Intensity of the Dry Weather Flow. Imperial Gallons per Day for the Years 1891, 1900, 1908, 1911.

Low Level Interceptor.—Very satisfactory progress has been made on the construction of the low level interceptor. Apart from making the plans for Sections Nos. 1, 2 and 3, the entire sewer has been designed, contracts on all the sections awarded, and 16,000 lineal feet, or two-thirds of the total length, constructed within the year. At the present rate of progress it is [illegible] the middle of next year.

The first four sections, reaching from [illegible] Street to Parliament Street, on Front Street, are constructed of brick, [illegible] diameter [illegible] brick sewer. [illegible] the Don section. [illegible] concrete pipe [illegible] the Don River [illegible] pipe which are connected to the interceptor on both sides of the [illegible] is regulated.

Of the brick sections, three were awarded to the Godson Contracting Co., and the fourth, awarded first to the city engineer, was taken over by Messrs. Donnelly & Graham. The work was carried on in tunnel on account of its central location, and the material encountered was blue clay of much the same quality as that found on the line of the high level interceptor, although in some places it was encumbered with fairly large boulders. In one place, between Simcoe and Bathurst Streets, shale and rock outcropped on the invert, reaching a maximum depth of two feet and extending over a length of 500 feet. This reduced the daily progress in each heading from 8 to 4½ lineal feet, and seriously retarded the progress of the section, which had, during one week, averaged over 50 lineal feet a day.

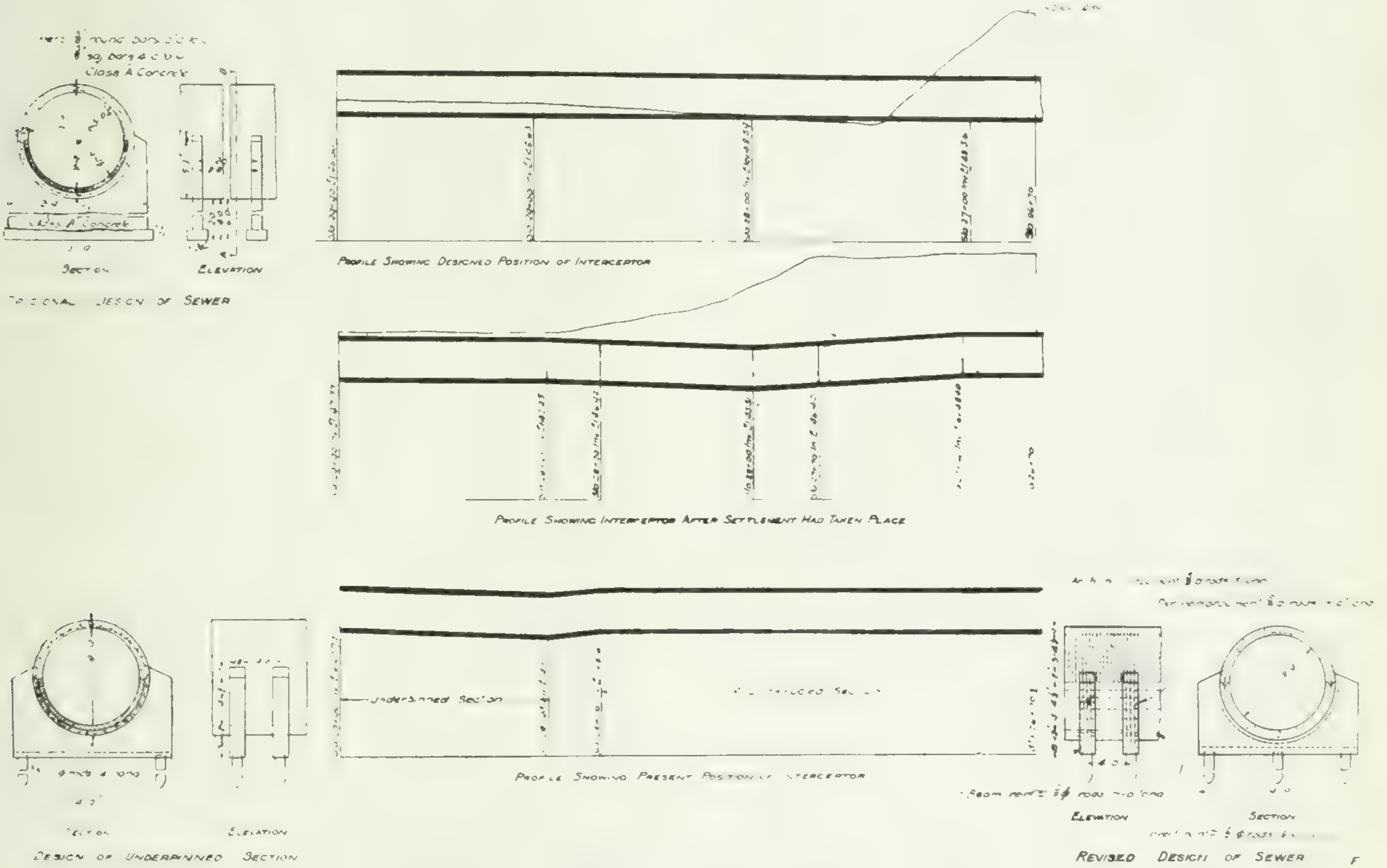
The 5-ft. diameter section and one of the three 5-ft. 6-in. diameter sections were obtained by Messrs. Lehmann, Nicholson & Jerou, and the remaining two 5-ft. 6-in. diameter sections by the J. H. McKnight Construction Co. The former contractor employed a Potter machine on each section. These did not prove very satisfactory, in that they necessitated twice handling the surplus material removed from the trench, were unwieldy on the curves and made pipe handling difficult. A progress of 150 lineal feet a week was the maximum reached by either of these machines. The two clam-shell derricks used by the J. H. McKnight Construction Co., however, proved more suited to the work. One move of the machine of 36 feet representing 200 cubic yards, could be excavated in one day. The pipe-laying, which was done by the same machine, handicapped the work, however, and a progress of 188 lineal feet per week was the maximum obtained.

The contract for the construction of the Don syphon was awarded to Messrs. Miller, Cumming & Robertson. The method proposed by them is to construct the two chambers in the dry, setting the exit and entry pipes in each case, and to connect these across the bed of the river in the wet.

Some important changes have been made in the interception of certain sewers in the west end of the city, which have resulted in a considerable saving in the cost of construction, and an annual saving in the cost of pumping, by reducing the amount of sewage entering the low level interceptor.

The only sewage reaching the Garrison Creek sewer below the high level interceptor is that from King Street on the west, Niagara Street between Defoe and Wellington Streets, Walnut Street and Wellington Street between Walnut and Tecumseth Streets. The flow of sanitary sewage coming from the last three sewers is very small, and its presence in the Bay will create no nuisance until some means have been devised to handle it. By turning the smaller sewers and taking the King Street sewer into the high level extension, it is no longer necessary for the low level interceptor to intercept the Garrison Creek sewer, and a [illegible] at the corner of Bathurst and Front Streets. This plan has been adopted and has resulted in a reduction in the flow entering the low level interceptor of [illegible] gallons per day, and saving the construction of 2,450 lineal feet of sewer, the contract price of which was $13.10 per foot. A further reduction in the amount of sewage reaching the low level interceptor has been accomplished by, where possible, moving the points of interception of the existing sewers along the line of the high level interceptor as far south as the difference in elevation between the existing sewers and the interceptor will permit. In this way it has been found feasible, in the case of Bathurst Street, Spadina Avenue and Peter Street, to move the point of interception from Adelaide Street south to King Street. The total reduction in the amount of sewage reaching the low level sewer due to these two changes amounts to 1,400,000 gallons per day.

The Sewage Disposal Works.—The same expediency exhibited in the construction of the trunk sewers during the year has been evidenced in the construction of, and the ultimate completion of, the sedimentation tanks. Of the total 24 units, 16 have been completed this year, the cast iron and timber penstocks are in place, and the whole has been back-filled and graded. The storm overflow from the tanks, for which plans were made, tenders received and the contract awarded during the year, has been constructed. This consists of a line of 5-foot concrete pipe (of the same design as those laid for the outfall sewer) laid on pile bents and extending south from the southwest corner of the tanks for a distance of 318 feet to Ashbridge's Bay.


Section
Elevation
Original Design of Sewer
Profile Showing Designed Position of Interceptor
Profile Showing Interceptor After Settlement Had Taken Place
Underpinned Section
Profile Showing Present Position of Interceptor
Design of Underpinned Section
Elevation
Section
Revised Design of Sewer

High Level Interceptor. Original and Revised Design of Reinforced Concrete Section.

The substructure of the pumping station, with the exception of the sludge well, was commenced and completed this year. This work was carried on by the department and was completed in time to allow the contractors for the superstructure to get well under way before the cold weather set in. This latter work is being carried on under the supervision of the city architect, and the brick work is already practically complete.

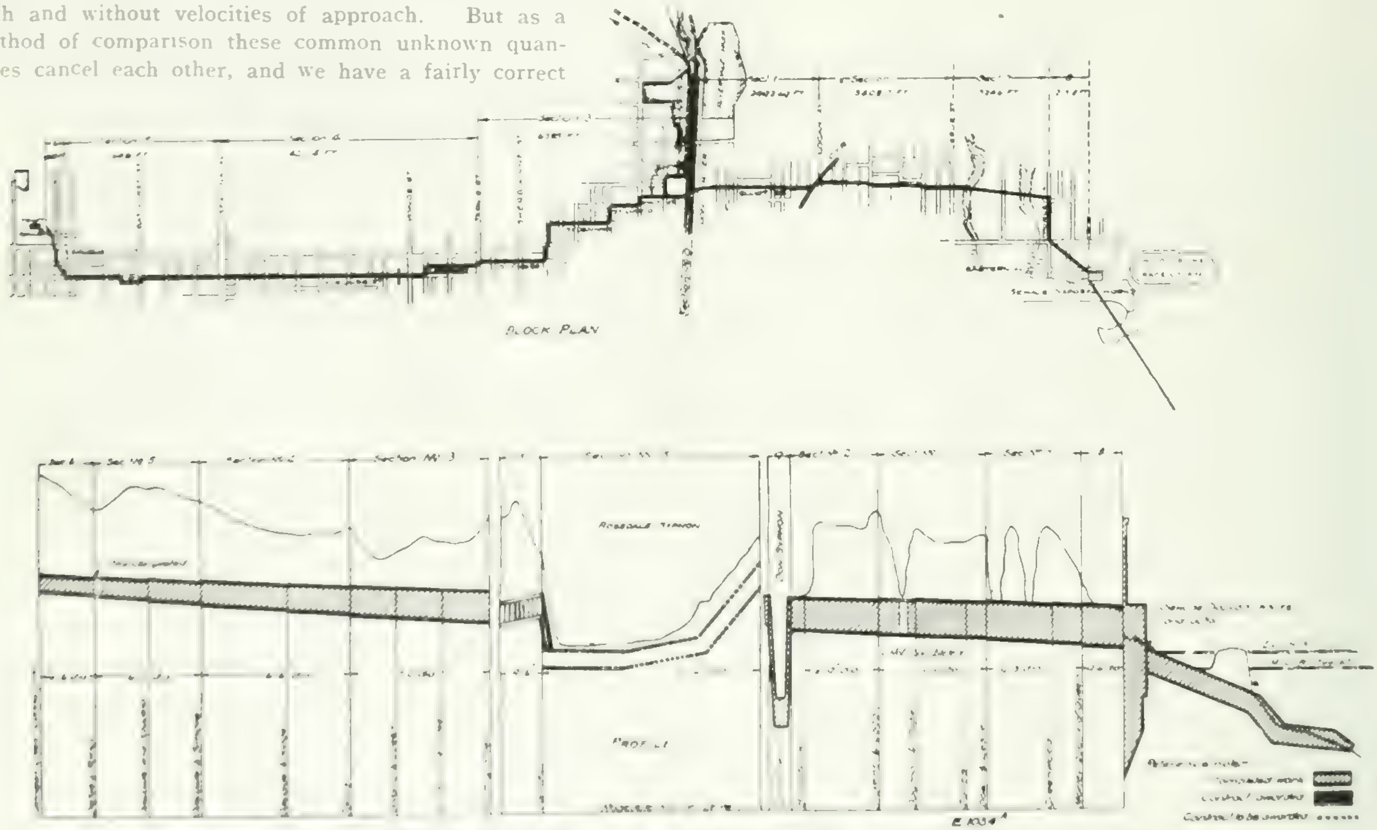
The four high level venturi meters connecting the pumping station with the tanks have been constructed this year. They consist of concrete barrels 38 feet long, 56 inches diameter at the entry and 28 inches in diameter at the throat, substituted at the above two points by iron castings which were manufactured by the Builders' Iron Foundry. Plans were made and manufacture all but completed of the screening and elevating machinery also. It is expected that this apparatus will be in hand early in the next year, when its erection will be carried on. The contract for the supply of cranes, made in 1910, has been revised, and the cranes have been manufactured and delivered. The contract for pumps and electrical equipment suffered some delay owing to the fact that motors called for were unsuited to the current provided by the Hydro-Electric System, which is to supply the power for their operation, and tenders were accordingly cancelled. The manufacture of the pumps has, however, been proceeded with, and will be complete well on time. The revised specification for the motors is under way, and it is hoped tenders will be received early in the new year.

Provision for disposing of the sludge has been under consideration and the method advised in the preliminary report of employing it with the addition of refuse for filling the low-lying ground in the vicinity of the work, partially adopted. It is proposed to sheet pile the south, and portions of the east and west boundaries of the sewage disposal works site, which extend some 300 feet into Ashbridge's Bay, thus providing sufficient space for at least two years' sludge.

Storm Overflow Sewers.—Work on a system of storm overflow sewers was authorized, under By-law No. 5628, which was passed early in the year, providing for an expenditure of $800,000. The work was put in the hands of this department, and the preliminary estimates and surveys were commenced forthwith. Much time was spent in collecting data regarding the locality of floodings throughout the city, the intensity and duration of storms, and other information necessary for planning an efficient system of relief sewers. By September the 6th (on which date the work was handed over to the sewer department), considerable progress had been made, including the construction of 100 lineal feet of Wilton Section No. 1, from the Don to Yonge Street, the completion of the preliminary work on Wilton Section No. 2, and a portion of the preliminary work on the Sorauren, Manchester, and St. Clair relief sewers.

Gauging the Sewers.—Almost the first move in the design of the main drainage system was the gauging of the flow in the existing sewers, which was done in the fall of 1908. In order to check the increase in the flow during the past three years, and to get an idea of what might be expected when the tanks were thrown into operation, it was demed advisable to undertake a second gauging, and this was accordingly commenced in October of this year. The results are, of course, only approximate, due partly to the more or less rough construction of the apparatus employed, and also to the fact that the formula used in the calculation is an approximation between those for flow over weirs with and without velocities of approach. But as a method of comparison these common unknown quantities cancel each other, and we have a fairly correct idea of the increase in flow corresponding to the increase in population.

[illegible]



Progress Profile of the High Level Interceptor, Main Drainage Works, Toronto.

GARBAGE DISPOSAL IN HALIFAX.

The sanitary disposal of the garbage of the city of Halifax is the subject of part of the annual report of City Engineer F. W. Doane, from which we have abstracted the following:

The method of disposition in vogue up to the present is to gather all garbage which would create a nuisance and be a menace to health at the individual residences and haul it to one spot where it is dumped, as a rule, the garbage is dumped at the Exhibition Grounds, but for a month during the exhibition, we are obliged to dump it wherever we can find a hollow in which we can place the material without serious objection from property owners residing in the neighborhood.

The number of places in which the garbage can be deposited is very limited. The hollow at the Exhibition Grounds is rapidly becoming smaller and within a very short time,, will be filled up entirely. If the city does not take steps in the near future to provide for some other place or method of disposal, we shall be forced to deposit it on city property where it will be most offensive and a serious menace to the health of the community.

The disposal of garbage and refuse in a manner conforming to sanitary law, is becoming a matter of vital importance and should receive the immediate attention which so important a matter in the welfare of the city deserves. It is most essential that adequate means be provided for the sanitary disposal of all decomposing refuse, including dead animals and night soil. Sanitary authorities agree that the complete destruction of garbage or a complete change in its characteristics is the only solution that will satisfy sanitary requirements.

A visit to a garbage dump will show it to be a breeding place for flies and rats, and offensive and unwholesome odors are carried from it by the wind for long distances. Flies from such places cannot fail to carry disease into any residence they may enter. The danger to public health is further increased by the sorting over of the garbage by men and women who find articles which they consider of value. The fact that these articles have been in contact for hours, perhaps days, with the garbage, together with the fact that the articles are not likely to be free from filth themselves, emphasizes the risk of conveying these cullings back to the city as carriers of dirt and disease germs.

There are only three methods of disposal which give any measure of efficiency: Dumping at sea; the reduction method, and incineration.

Dumping at sea is not only fully as expensive as burning, but where practiced, is found to be very objectionable even when the garbage is carried twenty miles out to sea, and is being abandoned by all progressive cities where it has been in use.

The reduction method, which consists of passing the garbage only, through a digestive process and taking out its oils and grease, is not popular for the following reasons, namely, that it is expensive to install, it is practically impossible to carry on the process without causing a nuisance by offensive odors, it deals only with the garbage and some other means must be provided for disposing of the remaining rubbish and refuse.

In the cremation method, two systems are followed, one the low temperature furnace, and two, the high temperature furnace.

In the low temperature furnace, the heat is not sufficient to completely destroy all the organic matter in the mass, and noxious, unburnt gases are produceed. In the attempt to overcome this difficulty, coal or other fuel is burned. While the first cost is lower, the annual cost is about the same as in the high temperature furnace.

The city has authority now to borrow $12,000 to install a crematory, but that would not be sufficient even to install a low temperature furnace. The most satisfactory and up-to-date furnace is the high temperature incinerator. It is generally arranged in the modern plants so that the heat produced may be utilized for steam raising and consequently, power can be obtained for the operation of machinery. The operation is carried on without offence from odors, smoke, dust, or noxious fumes and the plant can be located in the neighborhood of residences. Such a plant is in operation in the city of Westmount, Quebec. With Alderman Martin, your engineer inspected that plant in September last.

A careful study has been made of the latest practice and the incinerator at Westmount seems to be the most up-to-date. They raise steam in water tube boilers with the heat produced by the burning of the garbage. They use no fuel in the furnace except the garbage itself and the surplus power obtained is used to assist the operation of an electric lighting plant. In Halifax, the power produced could be used for lighting, running the stone and clinker crusher and for similar purposes.

It is probable that the installation of such a plant as that Westmount with a capacity of fifty tons in twenty-four hours, would cost $40,000, but the time is near when the city must grapple with this problem, and I would respectfully recommend that early action be taken to obtain plans, specifications and tenders for the installation of a modern garbage incinerator so that the necessary legislation may be obtained and some more sanitary method of disposal provided by the time the hollow at the Exhibition Grounds is filled.

Improvements in the method of street sprinkling and street cleaning are almost solely a question of cost. It means an increase of the annual appropriation of not a few dollars only, but thousands, to enable the Works Department to do this work as the Civic Improvement League desires. The sprinkling in the suburbs of the city is done by contract, with the exception of one district which is covered by a Works Department cart. These carts are covering as many miles of street as it is possible to water in half a day, but horses could not stand the work if the length of the district were increased. The remainder of the city, including all the business and oldest residential districts, is covered by fire department carts. The Board of Fire Commissioners limit the distance which the horses are allowed to go from the fire stations and consequently the length of streets sprinkled by the fire carts cannot be increased. The appropriation for this work is limited, therefore the number of hired teams employed cannot be increased.

Street cleaning at night has been suggested as an improvement on the present system. Outside the paved streets, the work could not be as well done in the night; it would cost more and no good, practical reason has been suggested for doing it at night instead of in the day time. Under certain conditions, it is better to clean paved streets at night instead of in the day time, but such conditions do not exist in Halifax. In large cities, it is a practical impossibility to clean thoroughly, paved streets on which there is heavy traffic, during the day time. It is the practice on such streets to remove the dirt roughly during the day and give the streets a thorough cleaning at night, when there is no traffic on them. The night cleaning is adopted, however, from necessity, and not from choice. In such streets the roadway is dirty all day long. In Halifax, the paved streets are kept clean during the day, which is the time when cleanliness is needed, and not at night.

The cleaning of the unpaved streets is quite as unsatisfactory to the Works Department as to the citizens who are complaining. If there were money enough in the appropriation to clean them twice or more, the streets should be cleaned in a short time, at the first of the season, but as there is money enough to clean the unpaved streets once only, it becomes necessary to leave those streets on which there are no permanent gutters, until June or later, because if they are cleaned earlier the grass grows in the gutters after the cleaning is done and remains there until the next year, which makes these streets very unsightly. It is, therefore, the practice to do the cleaning after the grass has grown or begun to grow, so that the streets, when cleaned once, may be more sightly during the tourist season.

On those streets which are most important, and which are cleaned first, the work is begun as soon as the season opens. This year the season was very late and no allowance is made by the critics for this obstacle to early cleaning. The cleaning cannot be pushed until the frost is out of the dirt. The sun is shining brightly in some years in the month of February, but the frost is in the dirt for weeks after that date. Cleaning has been commenced as early as the 11th of March, whilst this year it did not begin until late in April.

If the money were provided, the unpaved streets would be kept as satisfactory to the public as the paved streets, but $1,000 a mile is expended annually in cleaning the paved streets, while the expenditure in cleaning the unpaved streets is only $74.00 a mile. It is impossible to organize and maintain a $1,000 service with $74.00.

◆

RIDING ON PILOTS OF RAILWAY ENGINES.

The Board of Railway Commisisoners have issued an order following a tabulation of accidents resulting from persons riding on railway engine pilots, according to this order the practice must be discontinued in all classes except switching.

COST OF DRIVING STEEL SHEET PILING.

Very little data is available as to the cost of driving steel sheet piling. The Carnegie Steel Company has recently issued a little booklet entitled "Steel Sheet Piling." In this is listed a number of steel sheet piling jobs for which the cost of driving has been obtained by the company. The following figures are abstracted from the booklet:

The cost of driving steel sheet piling depends on a number of very variable factors, such as the kind of piling, the character and size of the structure, the character of the material to be encountered, depth of penetration, type of pile driver, kind and weight of hammer, experience of the crew, etc. The items which make up the driving expense are likewise variable, such as the pro rata cost of the pile driving equipment, including the driver, hammer, hoisting engine, tackle, etc., with proper allowance for depreciation, etc., if owned by the contractor, or its rental and maintenance cost if leased for the occasion; the daily expense in operation for labor, superintendence, etc.; cost of handling piles from the siding or boat to the driver, the cost of fuel, water, oil, waste, etc.; the cost of insurance on equipment, labor and material, etc.

The sum total expense for pile driving crew and regular equipment does not vary very greatly and may usually be put down at $50.00 a day or somewhat less, but this is complicated by the introduction of steam hammers which can be used suspended from derrick booms and for that class of work which does not need a power hammer. In view of these variable factors in driving, cost figures must, in the nature of the case, be only approximate. Such figures, however, may be of some service in estimating the probable cost of complete installations, and we, therefore, append from our records Table I., which gives a selection of the costs of driving various quantities and kinds of piling to different depths of penetration on jobs of the ordinary size and character.

The actual cost of driving 19,654 lineal feet of 12-inch 40-pound United States steel sheet piling (413 tons) in one installation per day of ten hours, was as follows:

1 foreman, per day	$ 5.00
1 engineer, per day	4.00
1 fireman, per day	3.00
6 workmen, per day	10.50
Cost of maintenance and operation	7.00
Total cost of driving crew per day	$ 35.50
Total cost of crew for 21 days	$745.50
Handling and incidental expenses	60.00
Total for job	$805.50
Total cost per foot of penetration	4.1 cents
Total cost per ton	$ 1.95

Piling driven in lengths of from 40 to 60 feet through sand and clay.

COST OF DRIVING STEEL SHEET PILING.

		Width, ins.	Weight, lbs.	Net tons	Length, ft.	Penetration, ft.	No. driven per day Max.	No. driven per day Min.	Type of Hammer	Cost, cents per ft.	Material	Remarks
1	Mt. Carmel, Ill.	12	35	366	28	22	32	20	Drop	2.75	Sand, fine gravel	
2	[illegible]	12	35	96	20	15	9	4	Drop	10.60	Stiff clay silt	Slow hammer, handling included
3	Glen, Ohio	12	35	67	16	10	35	15	Drop	6.00	Riprap, sand and gravel	
4	[illegible]	12	25	38	22	22	16	11	Drop	3.00	Filled earth, clay, sand	
5	[illegible]	12	35	85	26	16	40	35	Drop	5.00	Clay, gravel	
6	[illegible]	12	35	154	35	30	30	13	Drop	4.50	Clay, hardpan	
7	[illegible]	12	35	61	18	18	35	20	Drop	12.00	....	Labor, fuel, oil, etc.
8	[illegible]	12	35	72	14	11	...	.	Drop	11.90	Sand, gravel	Labor and equipment
9	[illegible]	12	35	113	30	21	100	80	Drop	5.00	Silt, sand	
10	[illegible]	12	35	28	12	12			Drop	6.64	Sand, course gravel	Labor and equipment
11	[illegible]	12	35	512	20	[illegible]	30	3	Steam	12.50	Sand, blue clay	Price paid contractor
12	[illegible]	12	35	18	10	10			Maul	29.00	Quicksand	Labor and equipment
13	[illegible]	12	35	[illegible]	26	10	11	6	Drop	10.00	Clean sand	
14	[illegible]	12	35	[illegible]	30	28	40	35	Steam	3.50	Course sand, gravel	
15	[illegible]	12	35	140	[illegible]	23	20		Steam	11.50	Gravel, sand, hardpan	
16	[illegible]	12	35	35	20	12	26	2	Drop	8.00	Sand	
17	[illegible]	12	35	[illegible]	[illegible]	31	[illegible]		Drop	21.00	Sand, clay, gravel	
18	[illegible]	12	35	46	20	18	15	3	Drop	17.00	....	Much time lost, labor and equipment
19	[illegible]	12	35	[illegible]	14	14	16	13	Steam	7.00	Sand, gravel, boulders	
20	[illegible]	12	[illegible]	21	30	30	30	12	Drop	7.90	Clay, quicksand, gravel	
21	[illegible]	12	35	[illegible]	35	29	34	13	Steam	7.40	Sand, gravel	Labor and equipment
22	[illegible]	12	35	105	20	19	86	10	Drop	0.63	Clay, loam, sand	
23	[illegible]	12	35	[illegible]	10	10			Drop	4.00	Clay, quicksand	
24	[illegible]	12	[illegible]	[illegible]	25	24	6	1	Drop	63.00	Marl	Driven under water—divers
25	[illegible]	12	35	134	24	[illegible]	105	20	Drop	5.00	River mud, silt	
26	[illegible]	12	40	130	24	20	28	[illegible]	Drop	9.00	....	
27	[illegible]	12	40	[illegible]	20	20	31	26	Drop	5.00	Close packed sand	
28	[illegible]	12	40	[illegible]	20	17	31	26	Drop	10.00	Close packed sand	
29	[illegible]	12	40	176	34	30	[illegible]	3	Drop	10.00	Sand	Driving, handling
30	[illegible]	12	40	[illegible]	20	20	20	8	Drop	10.00	Sand, gravel	Inexperienced crew
31	[illegible]	12	40	400	Sp	50	33	[illegible]	Drop	14.80	Heavy clay	Price paid contractor
32	[illegible]	12	40	[illegible]	[illegible]	20	60	8	Drop	3.90	Sand, clay, hardpan	
33	[illegible]	12	40	77	[illegible]	14	20	[illegible]	Drop	15.00	Sand, clay, hardpan	Labor, equipment, etc.
34	[illegible], Ill.	12	40	17	14	10	10	6	Drop	11.40	Sand, gravel, hard clay	Handling cost, 13.6 cts.
35	[illegible]	15	54	810	65	9			[illegible]	10.00	Silt clay	
36	[illegible]	15	44	85	30	14	[illegible]	10	Drop	6.50	Slag, quicksand	
37	[illegible]	12	[illegible]	[illegible]	[illegible]	16	[illegible]	2	Drop	16.00	6 ft. into sandstone	Price paid contractor
38	[illegible]	12	33	[illegible]	[illegible]	[illegible]	25	1	Drop	30.00	Mud, clay, gravel	Difficult job
39	Berrien Springs, Mich.	15	44	[illegible]	30	30	[illegible]	14	[illegible]	11.00	Mud, sand, clay	Labor, handling
40	[illegible]	15	44	[illegible]	17	16	15	[illegible]	Drop	14.50	Gravel, hardpan	
41	New York, N. Y.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			Drop	20.00	Earth, sand, gravel	Price paid contractor
42	[illegible]	[illegible]	[illegible]	[illegible]	40	34	[illegible]	[illegible]	Drop	[illegible]	Decayed vegetation, clay	
43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Drop	[illegible]	[illegible]	
44	Tomahawk, Wis.	[illegible]	[illegible]	[illegible]	[illegible]	16	16	[illegible]	Drop	20.00	Very hard driving	

[illegible]

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: **62 Church Street, and Court Street, Toronto, Ont.** Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."
Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum, Editorial Representative, Phone Main 8436.
Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.
London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, NOVEMBER 14, 1912. No. 20

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Use of Fuel Oil on the British Columbia Coast 739
Supervision of Sewage Works 740
The Shipment of Cement . . . 740

Leading Articles:

The Brooklyn Grade Crossing Commission 725
Light Compression Members 728
British Investigation of Rail Corrugation 731
Main Drainage System of the City of Toronto... 733
Garbage Disposal at Halifax 736
Cost of Driving Steel Sheet Piling 738
Canadian Draughtsmen and Engineers 741
Report of Committee on Sewerage and Sanitation 742
Lateral Pressure in Clay from Superimposed Loads 743
A Small Sewage Plant 744
The Building and Ornamental Stones of the Maritime Provinces 745
Repairing of Unarmored Cables in Wet Shafts.... 746
Reinforced Concrete Slab Bridge 748
The Development and Status of the Wood Preserving Industry in America 749
Gas as a Means of House Heating............... 751
Coast to Coast 753
Personals 755
Coming Meetings 756
Engineering Societies 756
Market Conditions 24-26
Construction News 65
Railway Orders 72

THE USE OF FUEL OIL ON THE BRITISH COLUMBIA COAST.

The use of fuel oil on the British Columbia Coast has many advantages over the use of coal. The quantity required to perform the same service is less both in weight and the space occupied, with a proportionate decrease in fuel bills. On the larger boats, the reduction in firemen and trimmers by its use has been as 67 per cent., with the consequent lowering in pay-roll and the cost of subsistence. Such expenses as renewing of grate-bars, stoke-hold floor plates, slice-bars, rakes, etc., are done away with.

Owing to the uniform temperature of the fires, boiler repairs have disappeared. With the use of fuel oil there is no constant opening of furnace doors for firing up, no cleaning of fires, with the consequent inrush of cold air, and the resulting lowering of temperature, which has a serious effect on joints and rivets because of contraction. The experience on one of the large boats running out of Vancouver in this respect is that one boiler in a battery of six was constantly under repair when coal was in use. Since oil has been in use there have been no repairs necessary.

Because of the absence of smoke, cinders and coal dust, oil-burning ships are not only cleaner, but the supplies required for scrubbing and painting are much less. There are no dirty bilges and no corrosion to the bottom boiler plates as a result of absence of ashes.

In point of efficiency the advantages are quite as marked. The calorific values of oil far exceeds that of coal, after deducting the percentage of moisture and ash from coal, the latter from experience being found to run as high as 20 to 25 per cent. The average run of coal will be found to represent 7,000 to 9,500 B.T.U., whereas oil will give as high as 18,500 B.T.U. Owing to incomplete combustion when firing with coal the stack temperatures are very high; with oil, combustion is practically complete, and stack temperatures of 400 degrees to 450 degrees are obtainable. In the case of one large coast steamer the reduction in stack temperature was 950 degrees; the temperature with coal being 1,400 degrees, with oil 450 degrees.

With fuel oil there is perfect control of the fire. When the engines are stopped fires may be completely extinguished, if desired, in the course of a minute. There is no lost time in filling the coal bunkers. The oil tanks can be filled in several hours, fuel enough being taken on to last in some cases twice as long as when using coal.

The efficiency of the plant, and, to a large extent the economy to be obtained, depends on the system of burners adopted. As is well known, there are three methods of atomizing fuel oil employed, viz., by air, by steam, or by mechanical process. The first entails considerable initial expense for compressors, etc., and the cost of operation. The second, while not so costly to install, uses a large amount of live steam, which is unreclaimed, and a consequent drain on the fresh water supply. In addition, the roaring of the burners is disagreeable and a nuisance. The third, or mechanical system, consists of heating the oil to a high temperature and putting it under pressure, from which, when escaping at the burner, it bursts into a vapor and readily ignites.

A large number of vessels, also a number of stationary plants, have been equipped with the mechanical system. Its adoption as being the cheapest to operate and most efficient, was only after careful consideration of the various systems. It is practically noiseless, and consists of a pump, heater and burner. In practice, two pumps and two heaters are fitted, so that in case of a breakdown or overflow there will always be one pump and one heater in reserve. The burners are very simple as to design, and are arranged for changing or cleaning. A burner can be taken out and changed in five seconds, and has various sized tips, which can be used as required, for increasing or diminishing the consumption.

With regard to the supply of fuel oil on the British Columbia coast, there are no present indications of failure. It was reported about the beginning of the year that there was in storage in California alone a quantity sufficient to take care of the world's consumption for seven months. The California and Texas oil fields are by no means exhausted; new wells are constantly being sunk and from indications in Alaska, Alberta and South America other fields will be developed. Notwithstanding, therefore, the immense increase in consumption, the supply promises to be adequate. Two large companies now have storage tanks in Vancouver, and one of these companies will shortly have a storage tank in Victoria. These companies are each prepared to make term contracts for the supply of oil fuel in large quantities.

◆

SUPERVISION OF SEWAGE WORKS.

The proper disposal of sewage is daily becoming a more important factor in the preservation of the health of populous communities. The customary methods of disposal by discharge into flowing streams and large bodies of water as the population increases must often be changed and some method of sewage treatment be used. A few plants for the treatment of sewage have already been installed in different parts of Canada, and it is to the operation of these plants already installed and the increasing number which will be built in the near future that these remarks are directed.

The mistake is made of deciding after the works have been installed that there is no further need for the sanitary specialist or engineer. The pursuance of this policy has been disastrous in many well-designed and well-constructed plants in the United States. Thousands of dollars have been spent for the construction of sewage work only to entrust their operation to unskilled and incompetent persons. Capable men to take charge of sewage treatment plants need a slightly different training from the constructing and designing engineer; but they should nevertheless be technically trained men. One of the leading experts in sanitary engineering recently stated that the ideal course for the operating engineer in charge of sewage treatment plants should give less attention to civil engineering features and more attention to mechanical engineering and laboratory work; also, more attention should be given to the subject of accounting and scientific management.

The work to be undertaken in the supervision of these works is not necessarily unpleasant, and it presents mechanical, chemical and biological problems which are well worthy of the time and energy of the technically trained man. The problems involved are not simple, but many of them are exceedingly complex because of the presence of biological factors. The treatment of sewage is a new and wide field for study and investigation which has scarcely been opened up.

In a recent issue of the monthly bulletin of the Ohio State Board of Health, it is stated that the larger American cities are able to employ technically trained men for this work, but many of the small cities are unable to do so; it was added that good and efficient supervision and operation of small sewage work could be secured by placing a technically qualified man over all the plants in a given district, which, in some instances, might be a single county, and in others two or more counties, the size of the district being determined by the number of plants.

This suggestion is a very good one, but would hardly do yet for the conditions existing in Canada. The plants are too few in number and too widely scattered for this method of supervision. It would appear that for some time to come the best method would be to place the supervision of the plants under the control of the Provincial Boards of Health.

◆

THE SHIPMENT OF CEMENT.

The question of how cement should be shipped is receiving considerable discussion just now. It has been argued for some time past that there would be a great advantage in shipping and handling cement on large jobs in bulk rather than in bags. One of the largest Portland cement companies in the United States has recently begun the shipment of cement in bulk. The results were so satisfactory that they are now sending out a circular urging the advantages of this method.

The wooden barrel method seems to have practically disappeared, the methods now remaining being shipment in cloth sack, paper sack and in bulk. The use of paper sacks has been strongly urged by some engineers on the ground that the return freight charges, the time and labor of collecting, counting, storing, keeping tally, packing, cartage, etc., of the cloth bags, the lost time in emptying them, the risk of loss through dampness, the risk of a dispute with the cement company supplying the cement and the risk of not getting the brand of cement specified leaves the balance in favor of the paper bag. There is a good deal of force in the above arguments, but it is unlikely that the use of the paper sack will increase much over the use of the cloth sack. The paper sack costs more to handle, and there is a greater probability of loss of cement in their use.

Shipment in bulk presents certain advantages over the cost of packing and handling cement in bags. There is a saving in cost all the way along the line. At the same time, it is extremely unlikely that shipment in bulk will ever come into general use. On large contracts, where a great deal of cement is being used, this method will give better results with a great saving in cost. The jobs, however, must be very large to warrant this method.

◆

EDITORIAL COMMENT.

An important feature that has marked a step forward for sanitary protection is the abolishment of the public drinking cup. It only remains for the Government to arrange for saloons to install the now familiar drinking mouthpiece, which will necessitate the use of a slot machine and eliminate treating the bartender.

* * * *

Attention is drawn to the article in this issue on "Canadian Draughtsmen and Engineers." The writer's suggestions deserve careful thought. The extension of the night classes in the technical schools is being done, and an impetus will be given this work, no doubt, when the long-deferred report of Royal Commission on Technical Education appears.

CANADIAN DRAUGHTSMEN AND ENGINEERS.

By **F. Tissington.**

It is with a certain amount of diffidence that I approach this subject, as, perhaps, I am not so well qualified to write about it as some others.

At the same time, I believe that, perhaps, my views may draw other people's attention to a serious handicap against Canadian engineering enterprise. What I refer to is the apparent lack of draughtsmen of almost every class, but more particularly the trained man, and further, those possessing any practical knowledge.

I have bracketed draughtsmen and engineers together in my title, because, to a large extent, the latter are recruited from the ranks of the former, and, failing an adequate supply of the first, how shall we keep pace with the demands for either class of men if our population keeps on increasing as at present, and incidentally their requirements from an engineering point of view?

To get down to the root of the matter, I would suggest that we are not training sufficient men, or training them quite the right way.

In the first place, it must be borne in mind that Canada is only in its infancy as regards engineering work, and that first and foremost it is essentially an agricultural country.

Now, from a common sense point of view it is not an easy matter to train a man for an engineer if his ancestors for generations back have been nothing but farmers, as he has a distinct bias for the land, which is a part of his heritage

Bearing these facts in mind, it is not surprising to find that we are to a large extent indebted to the States and the Old Country for a large proportion of our trained men, and who have had as ancestors workers in iron or steel instead of farmers or the like.

I would like to say right here that occasionally one sees instances of men who have come right off the land and climbed to the top of the engineering tree, but these are exceptions only, and I believe, as a general rule, environment plays a large part in what we are cut out for.

What is being done at the present time to raise up a body of men capable of carrying on the great traditions of the engineering service in Canada, or are we to be dependent upon other countries for people to fill this profession?

We have our colleges in the large towns, and presumably we are training some men in our offices and works, but, so far as I can see, no adequate scheme is in operation to satisfactorily train the men necessary to fill the positions of the future.

My experience so far has been that very few draughtsmen get a practical training; that is, they do not plough their way through the shops, and so get the fundamental knowledge of how to handle the material they are working into articles of commerce on their drawing paper, and the consequence is often seen in the inaccessibility of parts, poor details of construction, and lack of appreciation of the respective importance of things in general.

It is by no means uncommon to see the purely office draughtsman split hairs on dimensions, using 64ths, and so on, where it is totally unnecessary, and then miss the most essential points to make a workmanlike job.

There are also quite a number of men to whom technical knowledge is quite a stranger, although they claim to be draughtsmen, and it is, therefore, wholly impossible for them to do anything else but flounder.

Having thus severely criticized my own class, I would like to suggest a few ideas which would probably mitigate to some extent these faults.

First, I would suggest an extension of the evening technical schools as rapidly as could be found convenient, with grants from the Government on attendance at same.

In those districts where no such classes are available it would be a good scheme for the employers to interest themselves and get up classes in their own works suited to their own particular needs, and these could easily be run by one of the leading men if he would devote a little of his time to them. Probably the firm would be glad to make a small grant to act as an encouragement.

Then, for the practical side I would suggest that all the new men as far as possible are drafted from the works to the office, and this should act as a spur to the young men in the works to do their best and put in all the time at study they could, it being understood that those showing themselves most proficient, irrespective of age or length of service, should have first chance.

I am not at all in love with the premium apprentice system, such as is run in the Old Country. Generally speaking, the boy who stands on his own legs comes out at the finish the best man.

It will be seen that the scheme as outlined takes care of both the practical and theoretical features of the profession, and the reward of being transferred to the office, I believe, would influence quite a large percentage of young men in the works.

Some managers or owners may say that it would not appeal to them, because probably as soon as they had trained a young fellow up and improved his earning capacity he would be running away to some other shop and give them the benefit. This, however, appeals to me as a question of dollars and cents, and if the employer is not willing to pay a man according to his earning capacity, even though the firm may have been instrumental in giving it to him, then there is no doubt they should lose him.

The issue either way is entirely a business proposition, and cannot, therefore, be treated by either party as a philanthropic institution.

◆

GENERAL NOTES.

The precipitation was above the average in Eastern Ontario, over the whole of Quebec, the larger portion of New Brunswick, and in Southern British Columbia; elsewhere in the Dominion the average was not maintained. In Eastern Quebec and in New Brunswick the rainfall was heavy, varying from five to seven inches; whereas in our Western Provinces it was quite light, only a few localities reporting a total fall for the month exceeding much over half an inch.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for October, 1912:

	Depth in inches.	Departure from the average of twenty years
Calgary, Alta.	...	..
Edmonton, Alta.	0.70	—0.06
Swift Current, Sask.	[illegible]	0.01
Winnipeg, Man.	1.10	—0.41
Port Stanley, Ont.	2.6	—0.18
Toronto, Ont.	2.35	—0.35
Parry Sound, Ont.	3.0	—0.74
Ottawa, Ont.	4.4	+2.15
Kingston, Ont.	2.9	+0.20
Montreal, Que.	3.4	+0.39
Quebec, Que.	[illegible]	0.41
Chatham, N.B.	[illegible]	[illegible]
Halifax, N.S.	3.8	—1.77
Victoria, B.C.	2.3	+0.04
Kamloops, B.C.	0.6	+0.07

REPORT OF COMMITTEE ON SEWERAGE AND SANITATION.*

In reviewing the progress of events in the field of sewerage and sanitation during the past year it is very evident that representative governing bodies in both the United States and Canada are taking a greater interest. This is particularly noticeable in regard to the districts surrounding the Great Lakes, where an organization known as "The Great Lakes International Pure Water Association" has just held its second session at Cleveland.

Pollution of Surface Water.—There appears to be a general consensus of opinion among those representing state health authorities that the time has come when some definite action must be taken by the Federal Government. This is necessary, for while one State may have most drastic laws with reference to "river pollution," the adjoining State may have none. As an illustration, the Chicago drainage canal may be cited, where, by the simple but barbaric method of turning the sewage from its own water front to a river flowing through a neighboring State, there was caused much litigation and hard feeling. This central control also applies to Canada where this question has reached the same stage and where the central authority at Ottawa is being asked to supervise surface water pollution. Representatives from the United States and Canada have already had three meetings to work out a line of action in order to obtain the necessary data on which to pass an international policy taking all the States and provinces and centralizing under one association. The following bill was introduced in the Canadian Senate last year and, after being discussed, was referred to the committee of public health, and there is little doubt but that this or a similar bill will become the law in the near future. The bill briefly provides as follows:

"Every person is guilty of an offence against this act and liable on summary conviction to the penalties hereinafter provided, who puts, or causes or permits to be put, or to fall, flow, or to be carried into any navigable water, or into any other water any part of which is navigable or flows into any navigable waters:

"(a) Any solid or liquid sewage matter; or

"(b) Any other solid matter which, not being sewage, is poisonous, noxious, putrid, decomposing, refuse or waste; or

"(c) Any liquid matter which, not being sewage, is poisonous, noxious, putrid, decomposing, refuse, or waste; unless such matter, whether solid or liquid, is disposed of in accordance with regulations or orders made or permits granted under the authority of this Act."

While such a bill is drastic, there is no doubt but that it is necessary. Throughout the United States and Canada practically all the waterways and watercourses in the populated districts are so hopelessly contaminated that they are unfit as sources of water supply unless artificially treated, and these are the principal sources of supply through this country. While it is possible to filter a polluted water it is better to filter a slightly contaminated water than an altogether contaminated water provided, of course, you cannot get an unpolluted supply. In this country at present sanitarians rely more upon filtration and treatment of water supplies than upon the treatment of sewage. The Lake Michigan Water Commission adopted a resolution in which they stated that on that lake sources of supply even twenty to thirty miles from the point of entrance of large quantities of sewage, are not safe places from whence to derive water for domestic use. The Water Commission appointed at Toronto to investigate the source of that city's supply as to Lake Ontario, found that polluted water could be obtained sometimes as far out as fourteen miles in Lake Ontario. Tests were made of water every half mile out, both at the surface and seventy-five feet below and islands of polluted water would be found at different points out for the distance mentioned. In one instance a sample was taken about one mile out and was found free of bacteria coli, with a bacterial count of 70 per c.c. Twenty feet away another sample showed bacteria coli and a bacterial count of 13,000 per c.c. This is interesting, as showing that under certain conditions of the lake and wind that the sewage polluted water does not form a combination with the colder and cleaner water. In nearly every case the samples near the surface were purer than those taken 75 feet below.

A study of the chemical analysis of the Lower Great Lakes shows that the average amount of chlorine in the water is, at Detroit 4.7, Cleveland 10, Buffalo 10 and 6.5 in the middle of Lake Erie; the west end of Lake Ontario shows that the amount of chlorine has increased two and one-half times in thirty years, while the easterly end shows that the amount of chlorine has doubled in twenty years. The increase in the chlorine indicates sewage pollution, which, if not stopped or minimized, will in time render Lake Ontario unsafe for use as a public water supply. On account of the agitation now being carried on and mentioned before, it is probable that most large cities of the Great Lakes, anyway, will be treating their sewage with the resultant decrease.

The Treatment of Sewage.—The object of all present-day treatments of sewage disposal has been to knowingly or unknowingly take advantage of the oxidation process through the intermediary of living organisms. Those that have failed are those which have not supplied these micro-organisms with a sufficient supply of oxygen to carry out their functions. In connection with sewage treatment there are two distinct factors:

(a) The removal of all causes which may effect a nuisance.

(b) The removal of all causes which may effect disease Most of the standard methods of sewage disposal using screens and sedimentation tanks perform only the functions of clarification to a greater or less extent. Filtered through slag or stone, the nuisance is altogether removed and at present only in exceptional cases is the sewage treated to effect the total removal of disease germs. On account of the great cost and the cheaper means of treating the water supply by means of the addition of very small quantities of hypochlorite of lime, as low as two parts in one million, it is very seldom that the sewage is treated beyond the filter stage. This, then, seems to be the theory of the sanitarians of the present day, namely, to only remove the chemically organic attributes which create a nuisance by decomposition, from the sewage. No longer do we find the septic tank being built, for, being wrong in principle, it is doomed as an integral essential to any method of sewage disposal. Instead, we have the sedimentation tank in some cases, and a great vogue for two-story tanks, of which the Imhoff is at present the most popular.

Water Purification.—For years we have known that sunlight is a wonderful bacteriological agent, and that the active rays were the ultra-violet rays of the sunlight. Acting on this theory, special lamps have been devised to create the greatest possible quantity of these ultra-violet rays and experiments in sterilizing water have been going on for some time. As a result, Marseilles, in France, has installed a one-hundred-and-thirty-thousand-gallon plant for sterilizing water by this means. The cost of sterilization could not be ascertained, but ninety-nine one-hundredths per cent. of the bacteria was destroyed.

---

* Report presented to the annual meeting of the American Society for Municipal Improvements, held at Dallas, Texas, Nov. 12-15, 1912. Mr. A. F. Macallum, C.E., city engineer, Hamilton, Ont., chairman of committee.

Papers.—This committee has been fortunate in securing several papers on the Imhoff tanks, the purification of sewage, and the sanitary condition of Dallas. The committee wishes to extend its thanks for these papers to Mr. Y. Chalkley Hatton, of Wilmington; Prof. N. H. Ogden, of Cornell University; Mr. G. H. Daumgartner, city engineer of Dubuque, Iowa, and Mr. E. J. Dalton, of Dallas, Texas.

◆

LATERAL PRESSURE IN CLAY FROM SUPERIMPOSED LOADS.

Much has been written on the subject of earth pressure in general, and many have been the theories evolved relating to the stability of retaining walls, and the intensity and point of application of the pressure exerted by a mass of earth against the back of such a wall. In certain forms of construction the lateral pressure against a retaining wall or any vertical surface, induced by a vertical load applied at a given distance from that surface, becomes a matter of special interest. Mr. Walter L. Cowles, in a paper read before the Western Society of Engineers, gives an analysis of the lateral pressure of clay.

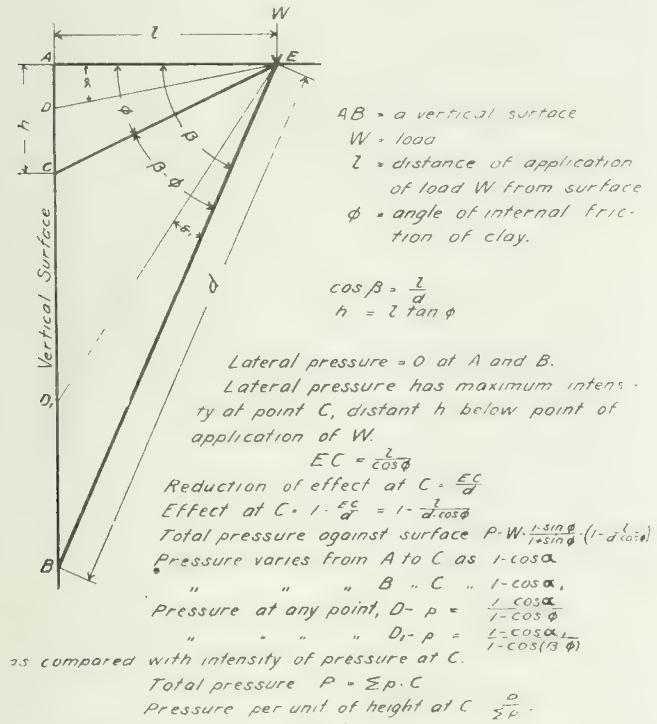
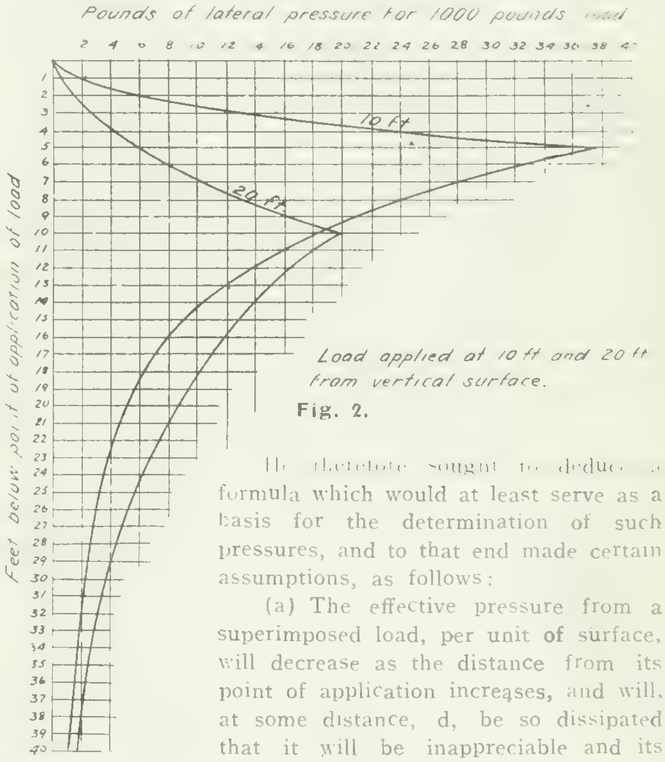

W
l
A
E
D
C
h
φ
β
β-φ
d
Vertical Surface
D₁
B
AB = a vertical surface
W = load
l = distance of application of load W from surface
φ = angle of internal friction of clay.
cos β = l/d
h = l tan φ
Lateral pressure = 0 at A and B.
Lateral pressure has maximum intensity at point C, distant h below point of application of W.
EC = l/cos φ
Reduction of effect at C = EC/d
Effect at C = 1 - EC/d = 1 - l/(d·cos φ)
Total pressure against surface P = W·(1-sin φ)/(1+sin φ)·(1 - l/(d cos φ))
Pressure varies from A to C as 1-cos α
" " " B " C " 1-cos α₁
Pressure at any point, D - p = (1 cos α)/(1-cos φ)
" " " " D₁ - p = (1-cos α₁)/(1-cos(β φ))
as compared with intensity of pressure at C.
Total pressure P = Σp·C
Pressure per unit of height at C P/Σp.

Fig. 1.

Having occasion to determine the amount of such pressure, he made a careful examination of the literature on this subject, with the result that he discovered a wide divergence of opinion as to the location of the maximum pressure as well as to its amount, varying from a maximum at the bottom of a cut to a maximum near the top, while the arguments advanced from a theoretical point of view, as well as the results of experiments and of observations of actual conditions under varying circumstances, might favor either conclusion.

Moreover, in the experiments described, the materials used were granular in character, the theories advanced were for the most part based on the action of granular substances, and the conclusions were not applicable to masses of clay such as constitute the sub-soil of Chicago.

In a few instances (notably in a paper by Wm. Cain, M. Am. Soc. C.E., published in the Transactions American Society C.E., Vol. LXXII., pp. 403-448) pressures from clay have been discussed, including the effect of cohesion. This was in line with the general direction of the investigation which Mr. Cowles was conducting, but still did not touch the particular point with which he was concerned, namely, the horizontal effect of a vertical superimposed load.



Load applied at 10 ft and 20 ft from vertical surface.

Fig. 2.

He therefore sought to deduce a formula which would at least serve as a basis for the determination of such pressures, and to that end made certain assumptions, as follows:

(a) The effective pressure from a superimposed load, per unit of surface, will decrease as the distance from its point of application increases, and will, at some distance, d, be so dissipated that it will be inappreciable and its amount may be considered equal to zero.

(b) The pressure in a horizontal direction will equal zero.

(c) The load may be considered as being supported at the apex of a cone, whose elements make an angle with the horizontal equal to the angle of internal friction of the material considered.

Clay, being a plastic instead of a granular material, has no "angle of repose," since, in excavating, it may be left with a vertical surface of considerable height; therefore this angle, commonly used in discussions of lateral pressure, is inapplicable to this material. Clay, however, has cohesion, and offers a certain resistance to shear due to its tenacity, and exerts also a resistance, due to its friction, against the movement of one portion of a mass over the underlying portion. The coefficient of this friction may be determined, and the angle of internal friction is that angle whose tangent is this coefficient.

Let us, then, consider an open cut with a vertical face, and a vertical load, W, applied at a distance, l, from the surface. Pass a plane through the point of application, and perpendicular to the face of the cut, cutting the latter in the line AB, Fig. 1. Draw the line, EC, making the angle ϕ equal to the angle of internal friction; also the line EB, making its length equal to d. By assumptions (a) and (b) the pressure will be zero at points A and B, and it is assumed as a maximum at point C.

Also, by assumption (a), at any distance, d_1, from the point of application, the reduction of effect will be equal to $\frac{d_1}{d}$, and the effective pressure will equal $1 - \frac{d_1}{d}$.

. Let the total pressure against the surface, AB, be found by Rankine's formula $= W. \dfrac{1 - \sin\phi}{1 + \sin\phi}$, reduced by the effect of the distance of C from E.

$$EC = \frac{1}{\cos\phi}.$$

$$\text{Reduction of effect} = \frac{EC}{d} = \frac{1}{d.\cos\phi}.$$

Total pressure against surface, AB, $= P = W. \dfrac{1 - \sin\phi}{1 + \sin\phi}. \left(1 - \dfrac{1}{d.\cos\phi}\right)$.

There will be pressure against the surface, AC, due to cohesion along the line (or plane, if W be considered a load per unit of length) EC, and this pressure may be considered as varying from A to C as $1 - \cos\alpha$, so that the unit pressure, p, at any point, D, as compared with the intensity of pressure at C will equal $\dfrac{1 - \cos\alpha}{1 - \cos\phi}$.

Let angle AEB $= \beta$, then will

$$\cos\beta = \frac{1}{d}.$$

Angle CEB $= \beta - \phi$.

Similarly, the pressure may be considered as varying from B to C as $1 - \cos\alpha_1$, so that the unit pressure, p, at any point, D, as compared with the intensity of pressure at C will equal $\dfrac{1 - \cos\alpha_1}{1 - \cos(\beta - \phi)}$.

The summation of the pressures against each unit of height will equal the total pressure against the surface, AB, or, if p be given in terms of the intensity at C,

$$P = C\Sigma p,$$

whence, the pressure against a unit of height at C is

$$C = \frac{P}{\Sigma p},$$

from which the distribution of pressure over the surface, AB, may be found.

This result is not offered as a final or adequate solution of the problem, but as an effort to arrive at some rational method of determining the probable lateral pressure exerted against a vertical surface by a vertical load at a greater or less distance, and the distribution of this load over that surface.

The values of both d and Φ will vary with the consistency of the soil, and d, especially, will be determined largely according to the judgment of the individual.

As an illustration of the results of this method, and without implying that the values are worthy of adoption, Mr. Cowles assumed in the figure an angle of 26 deg. 30 ft., equal to a slope of 2 to 1, for the angle of internal friction, and if a distance of 100 ft. be assumed for d, the curves of pressure for load applied at distances of 10 and 20 ft. from the vertical surface will be as shown in Fig. 2. The area included between the curves and the vertical line representing the surface will equal the total pressure against the surface.

◆

The Imperial Limited Canadian Pacific Express, westbound, was derailed Sunday night by a broken rail, four cars leaving the track near Wayland Station, 280 miles west of North Bay. Traffic was delayed about six hours by the accident

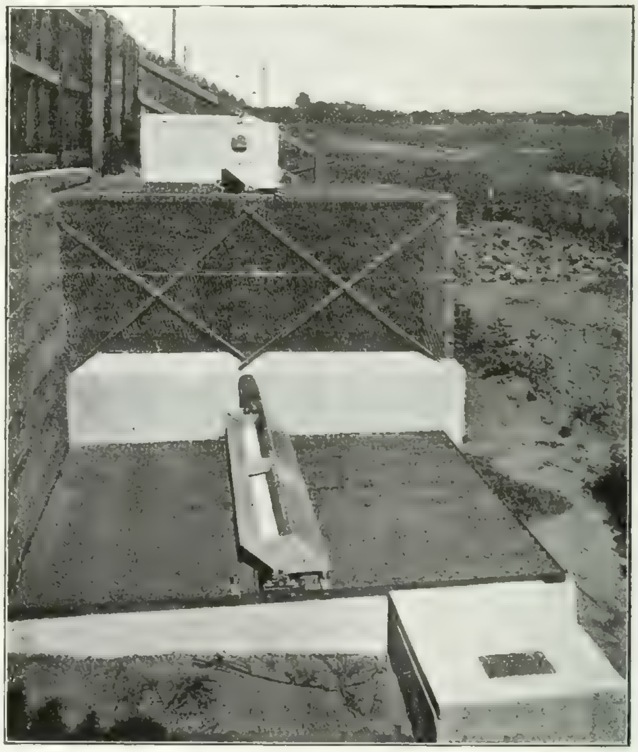
---

A SMALL SEWAGE PLANT.

By H. C. Clark.

For some time past difficulties have arisen in disposing of the sewage from Twyford Station, England, on the Great Western Railway Company lines, there being no local sewerage system. Various expedients temporarily tided over the requirements, but the necessity for more thorough steps became evident and plant was provided which represents the latest methods of scientific treatment about a year and a half ago. This plant follows the process by which Nature clears away effete organic substances, i.e., by fermentation and oxidation, in the order specified.

The second process occurs in filter beds about 4 ft. 6 in. deep, served by iron distributing trays, a tipper automatically deflecting to each filter bed alternately. The medium in these filters, between which an air space intervenes, is hard clinker, carefully washed, screened and graded; and the object of this provision is to develop the gelatinous growth in the interstices of the clinker and also to promote free oxidation, the anaerobic action being supplanted by the development of aerobic bacteria, for which a medium containing air is necessary, while the converted product, termed "humus," is retained in a small pit. The final purification is effected by a clinker drain. Special provision in the form of baffles and drain-off valves arrest and extract a quantity of paraffin oil used for cleaning the sanitary fittings.



View of Sewage Plant at Twyford Station in Operation.

The plant was designed to the approval of the divisional engineer, Mr. J. N. Taylor, and provided by Messrs. Tuke & Bell, Limited, sewage specialists, 69 Leadenhall Street, London.

The plant has now been in operation for a year and a half successfully, without a complaint from the Rivers Board, although the sewage from the station is an exceptionally strong one, and difficult to treat.

THE BUILDING AND ORNAMENTAL STONES OF THE MARITIME PROVINCES.*

By Professor W. A. Parks.

The economic production of stone for structural purposes in the Maritime Provinces is practically confined to granite and sandstone. A brief account of the condition of the industry is given below for each province separately.

NEW BRUNSWICK.

Granite.—The red, pink, and grey granites of St. George and the black granites of Bocabec, in Charlotte county, are being quarried by several firms; the product is nearly all manufactured into monuments in the extensive mills at St. George. In this country also, there is a small and intermittent production of grey granite from the vicinity of St. Stephen.

Near Hampstead, on the St. John River, the so-called Spoon Island stone is worked in two extensive quarries by D. Mooney & Company, of St. John. Both pinkish and grey, rather coarse-grained stone is obtained which is employed for monuments, for building, and for the making of paving blocks.

The rough grey granite boulders which are so plentifully scattered over the area north of McAdam Junction, in York county, are cut into building blocks by different operators and employed for structural purposes in Woodstock and other towns.

Near Bathurst in Gloucester county, a coarse-grained granite is from time to time quarried for local use.

Sandstone.—Roughly speaking, the sandstones of New Brunswick may be classified into red, grey, olive-green, and brown types. An excellent red freestone is quarried near Sackville, in Westmorland county, by the Sackville Freestone Company. The formation at this point is very favorable for the profitable extraction of stone. Large quantities are quarried and dressed by a modern plant, the product, in many cases, being shipped to a distance.

True grey sandstones occur along the Gloucester coast of Chaleur Bay; they are quarried by two companies for the making of grindstones. The cost of quarrying is, however, too great to allow this material being put on the market as a building stone.

Olive-green sandstone is quarried in Northumberland, Kent, and Westmorland counties.

The quarry region in Northumberland is situated on the Miramichi River, near Newcastle. Two firms are now actively engaged—the Miramichi Quarry Company, Quarryville, and Adam Hill, Cassilis. C. E. Fish, of Newcastle, proposes to reopen the old French Fort quarries at an early date.

In Kent county olive-green sandstone is quarried near Notre Dame, on the Moncton and Buctouche railway, by Hall and Irving, of Moncton.

Westmorland county was for many years the chief seat of the freestone industry in New Brunswick. At the present time a great many of the old quarries near Shepody Bay and Cumberland Basin are idle. H. Read and Company are operating a quarry at Northport, and the Dorchester Stone Works have a small quarry on the point between the Petitcodiac and Memramcook Rivers. Near Shediac, Dr. E. G. Smith is producing a stone which may be included in this class.

Brown sandstone is quarried by the Read Company, at Wood Point, in Westmorland, for grindstones, and the Cape Bald Freestone Company, of Port Elgin, is getting out building blocks at Cape Bald, on the eastern coast of Westmorland.

Crystalline limestone is largely quarried for the manufacture of lime at St. John, with the incidental production of a small amount of rough building stone.

The pure white gypsum at Hillsborough, in Albert county, has, in the past, been employed as a decorative stone, but there is no production for that purpose at present. The porphyritic felsites of Passamaquoddy Bay, the Tobique Valley, and elsewhere may have a future value as decorative stone but they are not at present utilized.

NOVA SCOTIA.

Granite.—A greyish, coarse-grained, and porphyritic granite is quarried by several firms along the Northwest Arm, near Halifax. At Terrence Bay, a coarser and lighter colored type was quarried for the construction of the Bank of Commerce in Halifax.

On the west side of Shelbourne harbor, in Shelbourne county, a very fine grey granite was formerly obtained. The character of the stone and the excellent shipping facilities should encourage the further exploration of this deposit.

At Nictaux, in Kings county, are extensive exposures of an excellent fine-grained grey granite resembling the famous stone from Barre, Vermont. The Middleton Granite and Marble Company, Thelbert Rice, S. Williamston, and John Kline, of Halifax, are quarrying this stone for structural and monumental purposes.

Sandstone.—The sandstones of this province are, for the most part, of an olive-green or reddish color, and are obtained more particularly in Cumberland and Pictou counties.

The most important quarry of red stone is that of the Amherst Red Stone Quarry Company, near Amherst. Two small operators are producing a reddish stone near River John, in Pictou county. At Toney River and other places along this coast, as well as at Whycocomagh and Judique, Inverness county, Cape Breton, there was a former production of red sandstones.

Olive-colored sandstones were at one time extensively quarried along the coasts of Chignecto Bay and Northumberland Strait, in Cumberland, Pictou, and Antigonish. In Cape Breton they were obtained, more particularly, on Boularderie Island and at points near Sydney. At the present time there are only two quarries worthy of mention here, although small amounts of stone are raised by other operators. The quarries of the Wallace Stone Company, at Wallace, in Cumberland county, have furnished stone for many of the chief buildings in Eastern Canada, and are still in active operation. The Pictou Quarry Company, of Pictou, produces a fine grade of stone which rivals the Wallace product in popularity.

Metamorphosed Slate.—A hard stone of this character is quarried on the Northwest Arm below Halifax. The product is largely employed for purposes of rough construction and, in some few cases, has been used in buildings of a higher type.

Crystalline Limestone.—The demand for flux in the steel plants has led to the opening of very large quarries at Marble Mountain and George River, in Cape Breton. Good exposures have in consequence been made which reveal the shattered nature of the formation. Although fair-sized pieces of considerable beauty could be obtained from time to time, there does not seem to be much promise of success in the operation of these quarries for marble. Variegated crystalline limestones of marble quality are known to occur at other points in Cape Breton: among these may be particularly mentioned Whycocomagh and Eskasoni. No positive evidence was obtained that these deposits are capable of economic working, as they are much covered by soil and present only isolated exposures.

---

* Abstracted from summary report of the Mines Branch, Department of Mines, for 1911.

Felsite-breccia.—Along the coast of Richmond and Cape Breton counties, and more particularly on the north shore of Scatari Island, handsome, varicolored felsite-breccias occur. Although this material could not be secured in very large blocks, pieces of sufficient size for many decorative purposes could be readily obtained. Somewhat less brilliant but still handsome felsites may be obtained at many points in Pictou, Antigonish, and Guysborough counties.

PRINCE EDWARD ISLAND.

The only stone suitable for building produced in this province is a red and not very durable sandstone of the Permo-Carboniferous age. Small and unimportant quarries have been opened at many places, but the only production at present is from Swan's quarry, near Charlottetown.

In the Maritime Provinces, as in other parts of the country, the stone industry has suffered severely from the general introduction of cement for purposes of construction. Those quarries which formerly produced heavy stone of a coarse type for bridge building and other works of a like nature are practically all closed. The long haul by rail to the chief centres of consumption is a deterrent factor in the profitable working of the finer grades of sandstone. The failure of the numerous quarries about the head of the Bay of Fundy has been ascribed to the almost prohibitive duty imposed by the United States government. This same factor has had much to do with the closing of the granite quarries at Shelbourne. It is encouraging to observe that Wallace, Pictou, Sackville, Amherst, and Miramichi stone can be profitably quarried and shipped to points as far distant as Toronto. It should be remembered also that many of the old quarries at Mary Point, Demoiselle Creek, Boudreau, etc., were operated almost entirely without machinery. Strong companies with modern equipment might well be able to revive the industry in this district.

The granite quarries of Charlotte county are handicapped by the long haul by team into St. George, by the small scale on which operations are conducted, and by the fact that no outlet is found for the large amount of debris. The stone has been quarried for monumental or large structural work only: in consequence, immense piles of material have accumulated from which paving blocks and even building stone of fair size could easily be cut. It is stated that an effort is being made to form a company embracing the various interests. It is to be hoped that such an attempt may meet with success, for such a company could concentrate the quarrying, provide better means of transportation, and devise ways for the utilization of the smaller stone.

◆

WATER STORAGE IN BRITISH COLUMBIA

A good example of what can be done in developing and, at the same time, conserving water-power resources is given by the Jordan River plant of the British Columbia Electric Railway Company, on Vancouver Island. Although the average precipitation over its watershed reaches the excessive figure of 80 inches, the Jordan River, like the majority of our streams, has a wide variation between summer and winter flow. The company has had the flow of this river systematically gauged since 1907 and the results obtained justified the building of large storage reservoirs for the purpose of impounding waters which would otherwise go to waste. The total capacity of these reservoirs, of which there are five, is 1,500,000,000 cubic feet, and they provide ample storage, within reasonable cost, for an ultimate maximum plant output of 24,000 h.p. to 36,000 h.p.

REPAIRING OF UNARMORED CABLES IN WET SHAFTS.

In a paper read before the East of Scotland Branch of the Association of Mining Electrical Engineers, Mr. J. Gillespie gave an interesting account of his experience with the above.

While there may be some room for divergence of opinion as to the respective merits of armored versus unarmored cables for shaft work, there can be very little room for any difference of opinion with regard to the great difficulty experienced in the execution of repairs on cables which come under the latter category, particularly when they have to withstand the stress of high-tension currents in wet or damp situations.

On a recent occasion the writer had some connection with a colliery at which the shaft cables were a source of continual trouble, they having on successive occasions broken down to earth on one or more phases. The cables in question consisted of three conductors of 37.14 copper insulated with vulcanized bitumen, taped and double-braided, installed in a pitch-pine casing 9 in. broad, which was screwed to the end tubbing of the pit, each conductor being in a groove by itself and the whole capped with 1-in. pitch-pine boards.

Prior to the writer's connection with the colliery several attempts had been made to eliminate the trouble, the method adopted being to build a substantial wooden box round the part affected, which box was then filled in solid with bitumen or some insulating compound. This improved matters for a time, but had no lasting effect, as another defect made itself apparent soon after each repair, at a point immediately above the range of the compound.

When the trouble first attracted the attention of the writer, he made a complete investigation, and became convinced that the root of the matter lay in a quantity of water finding its way into the casing at the junction where one length butted against the other. Water was found in appreciable quantities in each groove, the braiding of all three conductors being saturated while a continual stream flowed in the part of the groove between the cable and the capping. On consideration it was decided that it was impracticable to exclude the moisture from the casing, and that it was impossible to effectually insulate the cable in presence of the water. The alternative which presented itself to the writer's mind was that by some means the cables and casing should be removed from proximity to the water. The volume of water passing the affected part was found to be about two gallons per minute.

Fig. 1 shows the discarded method of repairing the cables. The wood box is shown fastened to the tubbing and surrounding the casing on three sides. One great defect of this is that it leaves the back of the repaired part exposed to any water which may find its way through the interstices of the barring. In addition to the presence of water in the casing, there had also to be considered the presence of a large amount of water in the open shaft, which at times was increased by the overflow from a small lodgment situated above and almost directly in the line of the cable run.

The cables having been placed behind the buntons it was necessary to arrange suitable water scaffolds between the buntons and the tubbing under which to carry on the work. These scaffolds were fixed in such a way as to divert the falling water, and were given such a run as would carry the collected water away from the casing in the direction of the tubbing, thus obviating the chance of the jointer's clothing becoming wetted by the drip water; in which case there would be present the risk of his carrying moisture to the joint.

The first step was to cut out the part of the cables which had been under the influence of the recurring earths. This was a length of 6 ft., and the casing was also taken out in such a way as to lay bare about 2 ft. of sound cable at both top and bottom. At the part from which the casing was removed a stout pitch-pine batten was fixed 3 in. from the barring by means of iron brackets, the space between the tubbing and the batten being left in order that any water which percolated through and was flowing inside the casing, might drip down clear of the joints. To this batten was screwed a length of casing in which were placed three pieces of new cable which had already been tested and proved to be impervious to water. The three protruding tails of the old cable at the part nearest the surface were then bent swan-neck fashion, the ends of each being turned down to meet the corresponding end of the new cable, and each conductor was jointed by means of a copper sleeve fastened to the cores by pinching screws and sweated solid. Pains were taken to arrange the bends in the cables in such a way that the water which found its path in the grooves of the casing was bound to drip from the rearmost convolution of the bend and fall clear of the joint. The major portion of the water being thus disposed of, the cables were heated gently over a protracted period in order to drive out the moisture saturating the braiding. This was carried out before making the joints, and continued until the cables were perfectly dry.

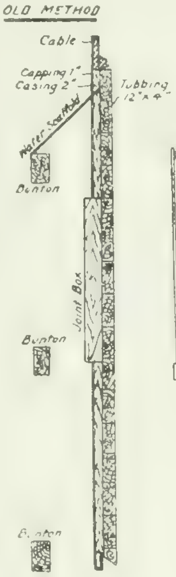


Fig. 1.

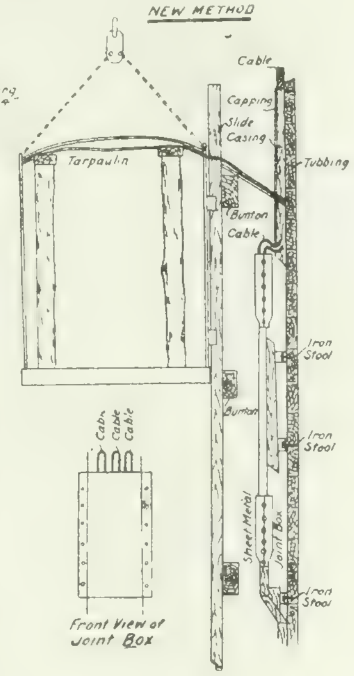


Fig. 2.

The drying process had to be repeated immediately before the box was filled in solid with compound, as it was noticed that some moisture showed a tendency to creep along the braiding even where it had to travel over the almost vertical portion of the bend in an upward direction. This the writer attributes to capillary attraction.

A joint box made up of 3/32 in. sheet iron (bent into the requisite shape at the Colliery) was then placed over the joints and was firmly glanded to the casing. Rubber insertion was used between the two portions of the box and between the box and the casing as jointing material, on account of its non-hygroscopic properties. Fig. 2 includes an enlarged sketch view showing the front elevation of the joint box with the cables entering same from above. Diatrine compound was used to fill up the box, and during the progress of the filling and for some time after the box had been filled a blow-lamp flame was kept playing on the front and sides of it so as to ensure that all traces of moisture were eliminated. At the lower end of the repair a similar joint box was used, but at this point there was no need to put close bends on the cables, as on account of the water-shedding arrangements prepared for the upper joint, that part of the casing immediately above the lower was found to be comparatively free from moisture. The work having been carried out at a holiday time, it was possible to make use of the cage for lengthy periods without unduly interfering with the output. The length of time occupied with the work was bounded by the period during which it was possible to keep the dock pumps idle without danger.

In order to arrange an almost completely water-tight structure from which to carry on operations, the ironwork forming one side of the cage was removed, and a tarpaulin fixed up in pitman fashion, by means of trees. This arrangement was carried out immediately under the cover of the cage, and one part of the tarpaulin was draped to form a flap, which, when the cage was in position for carrying on the work, was laid on the upper side of the water-scaffold to form with it a fairly water-tight roof some 8 ft. in length by 7 ft. in width. This permitted of tools and other gear being laid down in a dry position, besides providing more comfort than is usual in shaft work. Fig. 2 illustrates how the work was carried to completion. It shows the upper and lower joint boxes with the cage in position for making the upper joints. The work has been completed for a considerable period, and as yet shows no sign of recrudescence of the trouble. The cure is apparently of a permanent nature.

The writer does not intend that these few remarks should be construed into an argument in favor (or the reverse) of any particular type of cable, but hopes that they may be of service to any member who may encounter similar difficulties. He further hopes that during discussion, modification or improvement may be suggested of which he may take advantage should the repair as outlined turn out to be other than permanent.

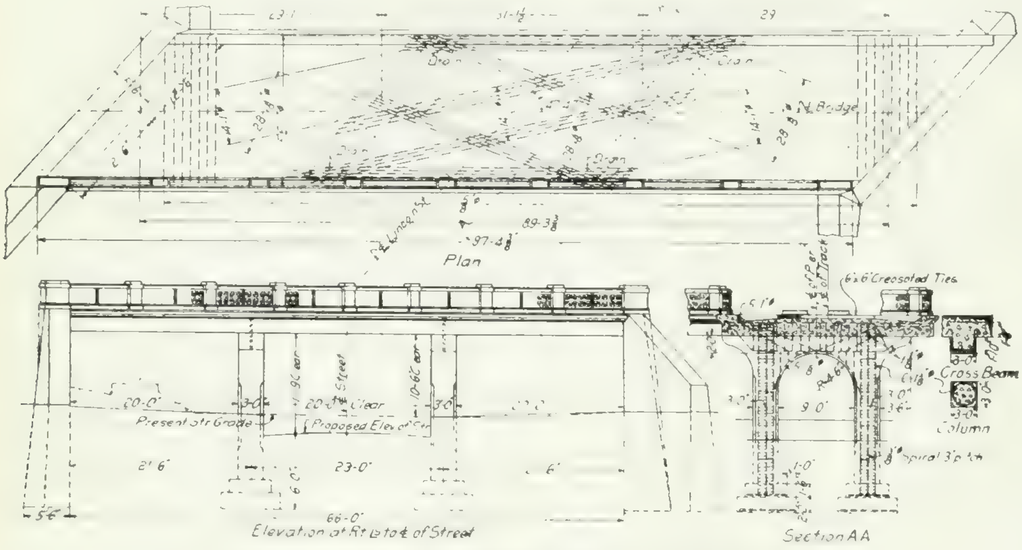
◆

CALGARY WANTS NATURAL GAS AS PUBLIC UTILITY.

The possibility of acquiring natural gas as a public utility is exercising the minds of many prominent citizens of Calgary. Since the introduction of the gas on a large scale by the Canadian Western Company, the convenience of its use in residences has been brought closer to more people. There is no complaint that at 35 cents per thousand feet it is too expensive when properly used, but having in mind the many wells scattered throughout Alberta where only a small portion is being used, or none at all, the question is freely asked why the city should not have its own supply? True, there is a well within the city limits piped into many houses and used extensively for lighting the streets east of the Elbow River, but its depth, 3,300 feet, and the difficulties met with when it was drilled, rather discouraged any further attempts just then. There is a pressure of 230 lbs. to the square inch at this well. At Bow Island the pressure is 800 lbs. But large manufacturers, though they may, with this gas at present prices, produce power at a cost of under $10 per horse-power per annum, would be more readily induced to locate in this city if that rate was reduced, a concession that the present company is not prepared to make. Hence it is advocated that the city ask the ratepayers to sanction an expenditure of $100,000 on the chance that a sufficient quantity can be tapped at a reasonable depth.

REINFORCED CONCRETE SLAB BRIDGE.

The Minneapolis, St. Paul & Sault Ste. Marie has adopted concrete slab bridges, reinforced by the "mushroom" system, for a number of highway crossing locations. This system of reinforcement, patented by C. A. P. Turner, consulting engineer, Minneapolis, has been in use for some time in building construction, but has not been widely adopted for railway bridge construction. Two bridges built in the town of Amherst, Wis., are typical of these structures. The details of the Lincoln Street bridge are described in a recent issue of the Railway Age Gazette and are shown in the accompanying illustration.



Plan and Elevation of Subway Built at Amherst, Wis.

The street is crossed on a skew of 47 deg. and 40 min., the abutments and piers being parallel at an angle with the centre line of the street. The piers consist of two reinforced concrete columns 3 ft. square spaced 12 ft. centre to centre, connected at the top by a concrete beam. The footings are spread to 7 ft. square and are reinforced in four directions, as shown in the drawing. The columns are reinforced by six 1⅛-in. round rods set vertically and banded spirally by ⅜-in. round rods on 3-in. pitch. The columns are 14 ft. 3 in. high from top of footings to bottom of slab, and the corners are chamfered to a depth of 3 in. The transverse beams, which have a minimum depth of 2 ft. below the slab, are arched between columns and are carried out beyond the columns on the curved lines shown in the accompanying cross section. The beams are reinforced in the upper plane by five 1-in. round rods, and in the lower plane by eight 1⅛-in. round rods bent up for shear reinforcement, and five 1⅛-in. rods bent down for surface reinforcement over the arch. In addition to this, there are ⅜-in. stirrups spaced 12 in. centre to centre between column reinforcements.

The floor slab is reinforced in four directions, in accordance with the usual "mushroom" design, the rods being crossed over each column in the piers. The reinforcement parallel to the centre line of track consists of 1-in. round rods spaced 4 in. centre to centre, and that perpendicular to the centre line of tracks of ⅝-in. rods spaced 12 in. centre to centre. The diagonal reinforcement connecting alternate pier columns consists of 1⅛-in. round rods for the shorter lengths and 1-in. rods spaced 6 in. centre to centre for the longer lengths. The central span is 31 ft. 1½ in., and the two sidewalk spans are 29 ft. 1 in. Drainage is carried in troughs built in the upper surface of the slab on either side of the ties to outlets over each pier. The clearance over the street level is 11 ft. 9 in., and between railings 16 ft.

A similar bridge over Wilson Street was built first. In this case turnouts were installed and a temporary pile trestle was driven alongside the old structure, over which trains were operated during the construction of the new bridge. In building the Lincoln Street bridge, however, traffic was maintained over the structure during the construction work. To accomplish this, the jack stringers, guard rails and long ties were removed and the deck of the original pile bridge was jacked up about 2½ ft., run-offs being provided at both ends by cinder fills. The track was blocked up in this position on cast iron spools. These spools were 2 ft. 3 in. long and 10 in. in maximum diameter, placed so as to not interfere seriously with the slab reinforcement. They were concreted into the floor slab and allowed to remain in the position shown. The forms for the concrete slabs were built on the old trestle, effecting a saving in the cost of false work. This hump in the track made it necessary to operate carefully over the bridge during construction, but traffic was never interrupted. These bridges were built under the direction of Thomas Green, chief engineer, and C. N. Kolk, principal assistant engineer.

◆

PATENT AND TRADE MARKS.

We have been forwarded the following news item which appeared in the Manchester Guardian, by Mr. Egerton R. Case, foreign member of the Chartered Institute of Patent Agents, London, registered patent attorney, Temple Building, Toronto:

"I learn that one of the last questions discussed between the Canadian Ministers and the Government relates to a scheme that is being prepared by the Board of Trade for the assimilation of the laws of patents and trade marks in the United Kingdom with those of Canada and of the other dominions. This question was first raised at the conference of colonial premiers in 1902, and again at the imperial conferences of 1907 and 1911. The majority of the patents issued in the self-governing dominions are granted in Canada, and the number granted in any one year in the whole of the dominions amounts to considerably more than half of those granted in the United Kingdom. It has been generally agreed that uniform legislation on these subjects should be established. In the United Kingdom a patent may be granted to one or more applicants. In Canada a patent may be obtained by the inventor or his assignee. In Australia the applicant for a patent may be the actual inventor or his nominee. In New Zealand one of the applicants for a patent must be the first inventor. In Newfoundland before any person can obtain a patent he must make an oath in writing that he is the inventor or discoverer. In the Transvaal and the Orange Free State one or more of the applicants must be the first inventor or his legal representative. The object aimed at by the Board of Trade is that a patent granted, say, in London should have validity right through the Empire.

THE DEVELOPMENT AND STATUS OF THE WOOD PRESERVING INDUSTRY IN AMERICA.*

By E. A. Sterling.†

The literature on the subject of wood preservation in America is voluminous, but so fragmentary that a summarized review of the developments and present status of the industry is, perhaps, justified because of the importance of the question to scientific and commercial interests.

The first recorded use of treated ties is that of kyanized chestnut, laid in the tracks of the Northern Central in Maryland in 1838, which were still sound when examined eleven years later. Kyanized oak trees, laid in the tracks of the Chesapeake and Ohio in 1840, were sound when examined fourteen years later.

The first treating plant, worthy of the name, was probably that built at Lowell, Mass., in 1848, by the proprietors of the locks and canals at that point. The plant consisted of two wooden tanks, each 50 feet long, eight feet wide and four feet deep, in which the lumber was immersed in accordance with the kyanizing process, using bichloride of mercury. Prior to 1895, several temporary plants were constructed by railway companies, among those being one established by the Central Vermont in 1856; another by the Erie in 1861, at Owego, N.Y.; another by the Union Pacific in 1867, at Omaha, and one by the Philadelphia, Wilmington and Baltimore in 1863, all of these being for the use of zinc chloride by the burnettizing process. The first permanent railway plants were built in 1875 and 1876, one being constructed by the Louisville and Nashville at West Pascagoula, Miss., which is still in operation, and the other by the Houston and Texas Central. Both were creosoting plants.

In spite of the many attempts at wood preservations during the past forty years, the rapid and permanent developments have mostly occurred during the past ten years. In 1900, there were eleven plants in operation, while at the beginning of 1912 there were about one hundred, with several more under construction or authorized. Prior to the year 1900 the most definite developments were in the West, where scarcity of timber forced the railways to adopt measures by which longer life could be given their cross ties. We thus find that the Southern Pacific has a burnettizing plant which has been in operation since 1867, while a plant using the same process was put into service by the Santa Fe in 1885. The latter road has since adopted the Reuping creosoting process. Several commercial plants were also built in the western part of the United States prior to 1900, but the general adoption of preservative treatment throughout the United States, particularly by the eastern roads, has all been during the last ten years.

In Canada the developments have been even slower than in the United States, and it is only within the past two or three years that treating plants of any size have been put into operation. At present the Canadian Pacific and the Canadian Northern either use treated ties from plants already in operation, or have arranged for the construction of plants. In Mexico and South America little or nothing has been done, although some of the Mexican roads have experimented extensively with crude oil and several plants have been built. In South American countries there are no plants, as far as the writer's knowledge goes, but large quantities of creosoted material have been shipped from plants in the United States for use, particularly in marine work.

At the beginning of the year 1912, 101 plants were listed by the American Wood Preservers' Association. Of this number, twenty-five are owned and operated by railway companies, and twelve in addition are maintained solely for railway work. The remainder do a general commercial business. The industry in the United States, up to the present time, has been built up largely on railway cross ties, yet out of the 148,000,000 ties used in 1910, according to census figures, only 26,000,000, or about 18 per cent., received preservative treatment. This, however, is an increase of 275 per cent. over the number treated in 1905. During the year 1910, there were also treated approximately 133,000,000 board feet of lumber, which represents only 0.33 per cent. of the total consumption. The total output of all treated material in 1910 amounted to slightly over 100,000,0000 cu. ft., which was 500 per cent. more than was treated in 1904. To treat this amount of material in 1910 there were consumed approximately 17,000,000 pounds of zinc chloride and 63,000,000 gallons of creosote, 71 per cent. of which was imported.

In 1911, according to statistics compiled by the American Wood Preservers' Association, a total of 110,372,660 cu. ft. of material was treated in the United States, this being an increase of 10 per cent. over the previous year and a 62 per cent. increase over 1907. Of this amount, 84,672,370 cu. ft. consisted of cross ties, 3,910,740 cu. ft. of piling, 1,085,971 ft. of poles, 10,140,474 cu. ft. of paving blocks, 6,831,416 cu. ft. of construction timber and 2,568,857 cu. ft. of lumber and miscellaneous material. By kinds of treatment 73,558,621 cu. ft. were treated with creosote, 29,501,665 cu. ft. with zinc chloride and 7,312,374 ft. with zinc chloride and creosote.

The kind and character of the timber treated varies greatly in different sections of the country. In the northeastern States the bulk of the material is hardwood, including red oak, beech, birch, maple and pine, which is shipped in by water from south Atlantic States. In the Lake States and the upper Mississippi valley the cross ties treated are almost exclusively hardwood of the species above named. In the south Atlantic and Gulf States, and to some extent in the Southwest, pine is used almost exclusively; while in the lower Mississippi valley and adjacent territory both black and red gum are being treated with apparent success. In the West and Northwest the wood most largely used for treatment is red fir. Considerable difference of opinion exists as to whether the so-called sap pine is suitable for cross ties. It is used extensively by some of the railways in the South and Southwest, where traffic is comparatively light, but the experience of the railways in the northeastern States, where traffic is heavier, indicates that the soft sap pine does not hold the spikes well and is not sufficiently resistane to rail-cutting.

At the present time only two standard preservatives are in general use in the United States, namely, creosote and zinc chloride. Of these, creosote seems to be gaining ground steadily, while zinc chloride is used mainly in the semi-arid regions of the Middle West or in combination with creosote. It should be mentioned that the Santa Fe is making very extensive experiments with a crude oil which carries a high percentage of asphaltum. While possessing no toxic properties this oil seems to effectively close the pores of the wood and act as an inert filler against the entrance of air, moisture and fungus spores. In later experiments a mixture of natural asphaltic oil and creosote has been used. In addition to the accepted preservatives named, many manufactured preservative compounds are on the market. Most of these are intended only for superficial application with a brush or in open tanks. Although the number of accepted preservatives has been reduced to two or three, several different and distinct processes for introducing the solutions into the wood are in general use. Each of these has its ardent advocates, and each has points of merit which can hardly be disputed. The following table summarizes the processes now used in America. The high-pressure processes are most generally used, and, while the so-called open tank or atmospheric pressure and the low-pressure treatments have been used quite extensively by small concerns which could not afford expensive plants, it may be expected that the pressure treatment will prevail almost universally within a short time:—

---

* Presented at the Eighth International Congress of Applied Chemistry, September, 1912.

† Forest and Timber Engineer; president of the American Wood Preservers' Association.

High artifical pressure processes	Full cell	Bethell—creosote. Burnett—zinc chloride. Wellhouse—zinc chloride, glue and tannin. Card—zinc chloride and creosote. *Crude oil—natural asphaltic oil. *B. & M.—zinc chloride and aluminum salts.
	Empty cell...	Reuping—creosote. Lowry—creosote.
Atmospheric pressure processes	Full cell	Soaking in cold preservatives. Soaking in hot preservatives. Alternate hot and cold treatments.
	Empty cell ..	Hot, cold and hot treatments. Hot and graded cooling treatment
Low artifical pressure processes	Full cell ..... Empty cell...	

* May be considered as still in the experimental stage.

In addition to the above, kyanizing and vulcanizing plants are still operating in New England, the latter being a rapid drying or baking process without the use of a solution.

The question of specifications and standards and many important technical points requiring consideration do not come within the province of this paper. Zinc chloride, being a mineral salt, can be manufactured to meet definite specifications. Since crude oil is a natural product, it is necessary to procure the supply from oil wells which produce the quality desired, namely, that with a very high percentage of asphaltum. The oil which has been found most suitable for preservative treatment is that known as Bakersfield oil from southern California, also from certain districts in Mexico.

In the matter of creosote specifications much more difficulty is encountered. Coal tar and creosote being a by-product of a by-product, and not manufactured exclusively for preservative purposes, varies greatly in its chemical composition, and except by re-distillation cannot be made up to meet too strict specifications. The consumers have rather definite ideas as to the quality of creosote desired, but unfortunately it has been necessary to base the specifications on the kind of oil available, both abroad and in this country, rather than to make arbitrary standards and expect the manufacturer to meet them.

Several additional problems relating to the use of creosote as a preservative are pressing for solution. These include the advisability of using various mixtures of creosote and other products, such as filtered tar, water gas oil, or the combining of creosote of different grades, the use of water gas creosote either alone or in combination with pure coal tar creosote; the value and possible use of oil from coke over tar; and the combined use of creosote and crude oil.

The mechanical equipment of the modern American plant leaves little to be desired. High pressure cylinders six or seven ft. in diameter and up to 150 ft. long are practically the standard. Labor-saving devices are in much more general use than in Europe, and hand work is reduced to a minimum. One of the important recent improvements [illegible] the measuring and weighing tanks are mounted on scales, so that the amount of creosote or other solution absorbed is measured closely by weight rather than by volumetric scale readings.

Automatic devices for unloading full tram carloads and machines which adze, bore, saw to even length and stamp with the date ties before treatment, are included among the mechanical developments.

The present tendencies are towards lighter impregnation with creosote, except in construction timber, or the use of mixture, which reduces the initial cost. No less than sixteen of the plants listed by the American Wood Preservers' Association use a light impregnation creosote process, and probably as many more use it on at least one part of their material, while several more plants use zinc chloride and creosote in mixture. This means that a large percentage of the treated cross ties used by the railways have less than six pounds of oil per cubic foot. Actually, they have more than six pounds in the treatable or sap portion of the tires, because the absorption is figured on the gross cubic contents. It may be argued that these light treatments are poor economy in the long run, and it is indisputable that they have not had the test of time. It must be remembered, however, that wear under the rail is responsible for a large percentage of tie failures after five years, and that full impregnation would certainly not be justified without large and expensive tie plates and screw spikes. Recent developments in the adzing and boring of ties before treatment promises a solution of the question of mechanical wear in relation to impregnation and decay.

Apart from the many details which are in a fair way of being worked out, there are two very broad problems which confront the wood preservers of America, and to which they should give their attention if the industry is to remain permanent and profitable. One of these is the source of supply for creosote oil, the present indications being that a shortage is imminent and that high prices will prevail. While the consumers can, perhaps, do little of themselves to stimulate production, they can at least co-operate with the manufacturers and encourage the construction of by-product ovens in America, and maintain trade relations, which will guarantee to the European distillers a definite market for their available creosote. Enough creosote is burned in the beehive coke ovens of the United States every year to supply all reasonable demands for years to come.

The other problem is that of timber supply, and it is one to which the wood preservers have paid too little attention. This applies to the owners of commercial plants, and particularly to the large railway companies which either operate their own treating plants or have their work done by contract. At the present rate of increase, the cost of treatable cross ties and other material will, in a very short time, be equal to that of white oak and other more durable woods. There are still enormous supplies of cheap woods available, and it is for this very reason that steps should be taken to perpetuate the supply. In some regions, however, the supply of treatable timber is already becoming depleted, and many plants will have to seek new locations or have their material shipped long distances within the next ten or twenty years.

Most of the hardwood timber, suitable for treatment, is of such slow growth that under present conditions it would not be profitable to reproduce it under any system of forest arrangement. In the South, on the other hand, are several fast-growing trees which would respond very readily to a system of conservative management. In the loblolly pine belts, for example, the output of timber from a definite area could easily be made permanent. It is estimated that about 100,000 acres of well-stocked loblolly pine land would produce 1,000,000 ties per annum for all time. It would have been very easy at the time some of the first railway plants were built to have acquired timber lands at comparatively low cost, and by proper management made them a permanent source of cross tie supply. This has not been done.

GAS AS A MEANS OF HOUSE HEATING.

By Lyman B. Jackes.

The adaption of gas, both natural and artificial, to house and building heating is a problem that has been worked upon by several inventors. The factors which were in favor of the commercialization of the scheme are many.

First there is the point that would appeal to many householders, viz., the elimination of ashes. A second might be considered to be the handling of coal, and this at once suggests the storage of that fuel and the use that could be drawn from the space, providing the coal could be dispensed with. The varying qualities of the coal, to say nothing of the tendency of prices upward, and the bother of relighting a furnace after the fire has been extinguished, are all among the dreams that have led inventors on from step to step in the hopes that a success could be made from their designs.

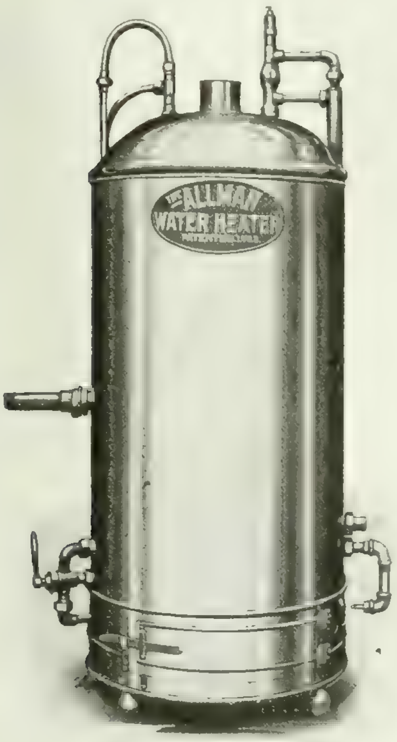


Fig. 1.

In the first attempts that were made much attention was paid to the burners; the idea apparently being to reduce the consumption of gas to a minimum, at the same time securing a maximum output of heat. Then the inventors became bolder, but their attempts did not fill the ideal that was hoped for and the old-fashioned cylindrical gas heater became an installation in many rooms not heated from the furnace; but the results attained were crude. The specifications of a capable gas heater were few, and yet it was many years before even the less complicated features were properly worked out. It was the invention of the automatic water heaters now on the market that contained the original germ of success. In these heaters a circular tube of copper is arranged above a burner supplied with a pilot light. A valve that is controlled by the running water gives entrance to the gas at the burner when a faucet is turned and the escaping gas is ignited by the pilot, with the result that scalding hot water is supplied through the tap. After the water has been turned off the valve closes, the gas is cut from the burner, and all light extinguished excepting the pilot.

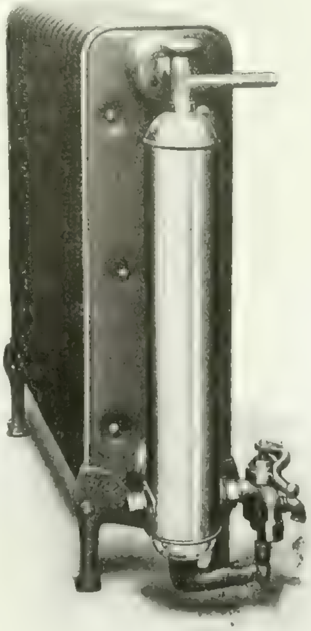


Fig. 2.

There was on exhibit in one of the industrial buildings at the recent Canadian National Exhibition a system of water heating, for house warming, that was the outcome of many years' experimenting, and would appear to have a brilliant future. The system contains a central heater and individual heaters for the radiators. The main heater is shown in Figure 1, and the radiator in Figure 2.

The main heater has many points in common with that described above. One advantage, however, not to be found in the older system is the fact that there are facilities for the storage of thirty gallons of water at a temperature of 150 degrees Fahr. with a consumption of only three cubic feet of gas per hour. This may be used for kitchen, bath or laundry.

The operation of the scheme, put briefly, is as follows: The heater is lighted and water drawn through the radiator until the same becomes warm; then the burner attached to the radiator is lighted and the warm water kept warm. This gives the privilege of using any number of the radiators installed and should it be found convenient to close certain ones the gas consumption is reduced accordingly and the remaining heat confined to the rooms in which the active radiators are operating. The pipes connecting the radiators with the central heater are half-inch in size and the radiators consume four feet of gas per hour each.

The central heater is entirely automatic in all its workings and should either the water or gas be turned off, between the heater and the street, the gas supply is automatically locked and the heater cannot be lighted till the gas has been turned on at the safety valve.

HIGHWAY BRIDGES.

The Illinois State Highway Commission has issued as bulletin No. 9, a 56-page pamphlet entitled, "Modern Bridges for Illinois Highways." The purpose of the bulletin is to encourage the construction of better highway bridges. Better bridges are needed for the traffic of to-day, it is stated, and good bridges are an essential factor towards future road improvement. The bulletin, it is further stated, shows by illustrations the difference between poorly and well constructed bridges, the text having been purposely reduced to a minimum and a relatively large number of illustrations used. These, it is believed, will show clearly the difference between old and modern types of bridges.

The illustrations occupy 41 pages of the bulletin and are accompanied, in most cases, by titles and sub-titles containing much explanatory matter. They show existing bridges of poor design and of correct design and include structures of long and short spans, concrete bridges, steel bridges with both wood and concrete floors, and wooden bridges. Many of the structures shown were built from plans drawn by the State Highway Department. Several of the illustrations show old bridges and the structures which have replaced them. Some of the views show a test bridge built by the Department, and illustrate the tests to which it was subjected.

This test bridge is a reinforced concrete arch having a clear span of 40 ft.; and was built at the Southern Illinois Penitentiary by convict labor and subjected to a number of very severe tests. Heavy loads were placed upon it, each heavier than would be likely to be brought on a bridge or a public highway. In one of these a layer of crushed stone, 12 ins. deep, was spread over the bridge and on top of this cut stone was piled to a depth of 3 ft., making a total unit load of about 300 lbs. per sq. ft., or a total load of 106 tons. Under this the total sag due to the bend in the floor, as well as that in the girders, was ⅛ in. This load was allowed to remain on the bridge for about three weeks, during which there was no increase in the deflection. The original deflection disappeared when the load was removed.

Another test described in the bulletin was made about a year later, when a railroad track was laid on the bridge and a very heavily loaded freight car was run upon it. As the car was somewhat longer than the bridge it was evident that when one truck was placed the centre of the span would produce the maximum bend or sag in the structure. The weight on one truck was found to be 44 tons, and the rails were so cut that they would give no support to the load beyond the length of track occupied by the truck, which was about 8 ft. Thus the total load of 44 tons was applied over an area approximately 5 ft. by 8 ft. Under this load the total deflection, including the sag in the floor as well as that in the girder, was found by careful measurement to be 0.09 in. This deflection disappeared when the load was removed, and six or eight applications of the same load produced the same effect.

During the summer of 1911 another series of tests, more complete than the preceding ones was undertaken, according to the bulletin. Nine brick piers were built beneath the bridge for the purpose of measuring the deflections and the steel reinforcements in the girders and floor was exposed in 15 places to permit determinations of the deformations by means of gauge marks placed on the steel, and bolts were set in the upper part of the concrete girders to determine the deformation in the concrete. A load consisting of 420 tons of crushed stone was placed in eight large bins, and, in addition, 100 tons of pig iron were placed on the west girder and about 60 tons on the east girder. This load produced a total deflection of 1 in. in the west girder and ¾ in. in the east girder without causing failure of the structure. The pig iron was removed within a few days, but the load of 420 tons of stone remained on the bridge for a year, until the present summer. It was then taken off, the deflections being noted as it was removed. When the structure had been completely unloaded it was found to have recovered its original position.

The remainder of the text of the bulletin consists of a general discussion of the economy of well designed bridges of modern types; a detailed presentation of the subject of creosoted timber for bridge floors, and an explanation of the Highway Commission's part in the construction of bridges.

MONTREAL FIRE AND WATER.

The frequent breakdowns in Montreal's water department were discussed by the fire underwriters this week, an increase of rates being considered. Mr. A. W. Hadrill, secretary of the Canadian Fire Underwriters' Association, stated after the meeting that the discussion was the result of the heavy loss at the fire in St. Patrick Street on Sunday night, as no one denied the lack of water had run up the loss. "When we consider that both buildings were fully equipped with fire sprinklers, we feel the fire should have been confined to the rope-walk and that probably would have been the case had there been enough water. The neglect of the water department to have their 15,000,000 gallon pump ready, which was ordered last year, is an instance of the way things are done. We are inclined to believe that the cause for so many accidents is either bad material or bad engineering, or insufficient supervision."

CEMENT DUTY BACK AGAIN.

The five months period in which the duty on cement was reduced by half expired on November 1st. The Government will not extend it. The remission was granted because of the alleged lack of supply in the West and inability, for transportation or other reasons, of the Canadian companies to meet it. The Government's action caused heavy importations from abroad.

During the four months June, July, August and September the importations of cement increased greatly. In these four months of 1911 they were 327,000 barrels, and in those of 1912, they rose to 793,000. The figures by months are:—

Month.	1911. Bbls.	1912. Bbls.
June	55,646	171,395
July	27,314	267,405
August	72,695	188,404
September	171,784	166,452
Totals	327,439	793,656

Significance of these figures will be better understood when the importations into the three prairie provinces are given:—

Month.	1911. Bbls.	1912. Bbls.
June	263	50,434
July	514	140,084
August	187	62,166
September	2,227	49,766
Totals	3,191	302,450

Thus the remission brought the imports up from 3,000 to 300,000 barrels.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended October 21st:—

	1911.	1912.	Increase or decrease.
C.P.R.	$2,532,000	$2,943,000	+ $411,000
G.T.R.	1,023,892	1,132,152	+ 108,260
C.N.R.	459,000	561,100	+ 102,100
T. & N.O.R.	44,182	27,959	— 16,222

The following are the railroad earnings for the week ended October 31st:—

	1911.	1912.	Increase or decrease.
C.P.R.	$3,675,000	$4,295,000	+ $600,000
G.T.R.	1,463,496	1,648,054	+ 184,558
C.N.R.	794,700	628,500	+ 166,200
T. & N.O.R.	61,285	40,234	— 21,051

The gross earnings of Canadian Pacific Railway last month reached $12,962,000, the largest in the history of the road. The increase over October of last year was $1,847,000. The earnings for the first four months of the company's fiscal year were $48,845,000, which is an increase of $7,498,000 over the corresponding four months of last year.

The statement of the revenue and expenditure of the Intercolonial Railway for the year ended with March 31st, last, shows:—

Passenger traffic, $2,842,810; freight traffic, $6,891,937; mails and express, $428,985; miscellaneous, $430,052; total revenue, $10,593,785. Maintenance of way and structures, $1,812,419; maintenance of equipment, $2,681,543; traffic expenses, $217,943; transportation expenses, $5,630,139; general expenses, $248,990; total working expenses, $10,591,035.

COAST TO COAST.

Toronto, Ont.—It is reported that work will be commenced on the new Union Station for this city early in the coming spring.

Galt, Ont.—Building permits issued in this town during October last have a total value of $80,000. This is 100 per cent. above the same period last year.

Haileybury, Ont.—The Haileybury Board of Trade is opposed to the re-building of the Energite Explosive Foundry here. This is the factory which was destroyed by the explosion in which six persons lost their lives.

Calgary, Alta.—City Commissioner John Chalmers and A. W. Ormsby, of Edmonton, made an examination of the lighting facilities of the city in order that a report might be prepared for the consideration of the Edmonton authorities.

Calgary, Alta.—Figures recently made public by the chief clerk of the electric light department show that the number of users of power for domestic and other purposes from the civic electrical department increased by about 500 during the month of October last.

St. John, N.B.—Mr. W. T. Thorne, president of the Imperial Dry Dock Company, as a director of the proposed steel works for this city has requested the provincial government for aid in the finances of the project. If this work is commenced it is expected that the plant will cost about $3,000,000.

Montreal, Que.—The plants of the Canada Cement Company at the present time are operating on an output of 8,000,000 barrels a year, but with the extensions to present plants and new ones being erected, the company expect by the first of August of next year that there will have been an increase of 50 per cent. in output, bringing the total output for the year to over 12,000,000 barrels.

Province of New Brunswick.—The Transcontinental Railway commissioner has decided in the public interest to operate the completed line of the National Transcontinental Railway in New Brunswick temporarily, or until such time as the G.T.P. has applied for and been granted a lease of this section of the line, under the terms of the National Transcontinental Railway.

Ottawa, Ont.—The Marconi Wireless Telegraph Company, of London, England, have signed a contract with the Canadian Government for the operation and maintenance of nine additional stations on the Great Lakes in Canada. When the stations are completed the company will receive an additional subsidy from the government of $31,500 per annum. The agreement is for nineteen years.

Petrolea, Ont.—At a largely-attended meeting of delegates from various portions of Lambton County of an organization to be known as the Lambton County Good Roads Association, the following were elected officers:—President, Dr. C. O. Fairbank; vice-president, A. D. Arvillee; secretary, A. B. Rocu, and the executive committee will consist of the Reeves of all the municipalities in the county. A grant will be immediately asked for from the county to cover organization expenses. The meeting was addressed by Mr. W. A. McLean, of Toronto, the Provincial Good Roads Engineer.

Oriole, Ont.—The joint campaign committee of the Good Roads Association and Ontario Motor League, at a recent meeting discussed the appointment of a man who would give his whole time to the work of rousing the Ontario public to a realization of the necessity of improving the highways of the province. The board decided to seek for this important position the services of an energetic young man, preferably with newspaper training. In order that as large a number of applications as possible might be received by Mr. George Henry, of Oriole, Ont., the secretary of the Good Roads Association, it was decided to leave the appointment until a subsequent meeting to be held on Friday, November 22nd.

Peterborough, Ont.—That the city may in the near future be defendants in an action for damages instituted by the townships of Otonabee, North Monaghan, and South Monaghan for alleged pollution of the Otonabee River with sewage, was brought out at the meeting of the city council last week. Notice of the issuance of a writ by the legal firm of Peck, Kerr and McEderry on behalf of the said townships, for an injunction restraining the city from polluting the Otonabee River with sewage, and for damages, was submitted for the consideration of the council. On motion of Ald. Johnston and Ald. Anderson, the city solicitor was authorized to appear on this writ within ten days, as after that time plaintiffs would be allowed judgment by default.

Toronto, Ont.—Commissioner R. C. Harris has presented a report, on a proposed Garbage Disposal Plant, to the municipal council. According to the figures submitted the plant will cost $942,000, and the yearly cost of operation will be $298,000 less $224,000, the value of the by-products. Under the plan the commissioner proposes the establishment of four loading stations within the city limits, with incinerators adjacent thereto, at which the garbage is stored in railway cars during the day and removed at night to reduction works, located outside the city limits. The rubbish gathered would be burned at the incinerators near the loading stations, together with a quantity of ashes containing sufficient combustible matter to aid in the destruction of the rubbish, the balance of the ashes to be used for purposes of filling.

Canadian Pacific Railway.—The Canadian Brotherhood of Railroad Employees, claiming to represent 5,000 men on the Canadian Pacific, has for some time been threatening a strike on that road. Last week reports from Winnipeg said that 1,500 of these men, mostly clerks in the freight department, had left their work. They had demanded a large increase of pay. Officers of the road said that the places of the strikers would be filled without much delay. The Minister of Labor, Mr. Crowthers, refused to appoint a board of conciliation, and the railway company not only refused to deal with the representatives of the brotherhood, but announced that it would not nominate a member of the proposed conciliation board. Giving its reasons for its position, the railway company said: "We cannot permit any employees engaged in confidential positions or who have access to the company's correspondence to be a member of any organization, as such would be contrary to the interests of the company. If the employees were permitted to join an organization such as this the records of the company would be confidential no longer. The company from time to time has granted and quite recently granted substantial increases to the above-mentioned class of employees."

Hamilton, Ont.—The municipal council have requested the Dominion Railway Commission to act as arbitrators in the matter of a civic law calling for all electrical companies in Hamilton to bury their wires underground. At a meeting of the board Manager Coleman, of the Hamilton Street Railway Company, testified that it would occasion the Cataract Company a loss of $123,000, and maintained that compensation should be allowed. He was willing that the board's engineer should estimate the extra cost to the company. Chairman Drayton, of the Dominion Railway Board, said it seemed to be felt that the Cataract Company, in estimating the cost, was not merely charging for the work which would be made necessary by the change, but for the improvement of the system. Hon. Adam Beck added that in the estimates the board could take cognizance of the actual expense of going underground only, and not of resultant betterments. Mr. John Markey, for the G.N.W. Telegraph Company, declared that in a municipality of only 80,000 population the revenue derived by the company was insufficient to warrant the change. The gross revenue from outgoing telegraph business in Hamilton was $18,486, and the expenses within the city were $15,147. In addition, the office had to bear its share of charges for everhead wires. The Hamilton office actually stood the company a net loss, and other cities had to assist in paying its deficit. Mr. Edward Beatty, for the C.P.R. Telegraph Company, said his company was not making great objection except on the question of principle. He estimated his company's cost at $12,000.

◆

AN OLD GEORGE WASHINGTON LANDMARK.

The house shown in the accompanying illustration was built by George Washington in 1790—122 years ago. It is located in Glasgow, Barren County, Ky., although when it was built that section was located in Fairfax County, Va. Mr. A. L. Harris now owns and occupies the house.

George Washington, at the time the house was built, owned all that land which now comprises Virginia, Tennessee and Kentucky, it having been granted to him by a greatful American government in consideration for the services rendered during the Revolutionary war.

George Washington built this house as a residence for his cousin, General Spotteswoode, who was governor of Virginia at that time. General Spotteswoode was, by nature, of a very retiring disposition and later became a recluse. He occupied this house until his death, the exact date of which we were unable to learn, and is now buried at Knob Lick, a small hamlet about five miles from Glasgow, Ky.

House Built by George Washington in 1790.

The architecture of the house is a wonderful combination of the frontier's man precaution and the city type of dwelling. The walls are solid brick, 36 inches thick. The floors are of hardwood, two inches thick, made of chestnut and laid with dowel pins. The original roof was hand-drawn chestnut shingles, one-half inch thick and fastened with wooden pegs. There is not a single nail in the entire building, for nails were not manufactured at the time when this house was built.

The windows are of glass that was brought over from France, for glass was not made in America at that time. The wear and tear to which a building is subjected in the course of the years is here given full proof, for this glass is worn so thin that many of the panes are no thicker than an ordinary piece of tissue paper. In late years, light rain storms have at times been sufficient to break out some of the panes.

The portion of the roof shown in the accompanying illustration, is still covered with the original hand-drawn chestnut shingles. A small part of the roof was replaced with a tin roof by Mr. Harris a few years ago. Lately, Mr. Harris has covered the kitchen with J-M asbestos roofing, manufactured by the H. W. Johns-Manville Co., New York.

With the exception of this roofing on the kitchen and the tin roof, the house has not been remodeled during its 122 years existence, and only such minor repairs have been undertaken as were absolutely necessary for its preservation.

◆

CANADA'S PACIFIC COAST ACTIVITIES

With the calling of tenders for the erection of its smelter at Granby Bay, Observatory Inlet, the Granby company is making a start in the practical initiation of a large mining industry in the northern part of the province. Much preliminary work has been done, and much money spent, and it is now proposed to have the smelter in operation inside of another year. It will be able to handle 2,000 tons of ore daily, and will have three copper furnaces, the expenditure to be over $1,500,000. After the copper furnaces are in commission a lead stack will be installed so that custom ores from the Hazelton district can be treated. Already 400 men are employed by the company, which means quite a little town.

Industries are steadily being established on the coast, the operation of which mean much to business and supply men. Close to Vancouver there is the Britannia mine; at Texada Island two or three good mining propositions are being exploited; at Powell River a pulp and paper mill is in operation; at Swanson Bay is another pulp mill; at Ocean Falls, another, along with a large sawmill; mining prospects at Hazelton are bright, while on the Portland Canal the Granby Company will have a mining town of its own.

Although conditions have been reported quiet in Vancouver, figures of different public departments do not show much diminution. Building returns had new records this week; the new Canadian Pacific Railway depot created a record for the largest permit. Just what the Canadian Pacific Railway has in view on the Pacific coast is indicated by what it proposes to do in the way of hotel accommodation in this city. Some time ago plans were submitted to the city building department for a new Vancouver hotel to be eleven stories in height and to cost $800,000. These plans have been cancelled, for it is proposed to make the structure sixteen stories high at a cost of at least a million dollars. Besides these two items just mentioned, there is the Canadian Pacific Railway tunnel under the city to its yards on False Creek. The Canadian Northern Railway has agreed with the city to expend several millions in connection with the improvement of the head of False Creek, the expenditure to be made within a specified time. The Great Northern will spend another million or two. Several other schemes involving large expenditures have been suggested.

Surveys have been begun by the British Columbia Electric Railway Company for a line to be constructed between New Westminster and Port Moody. When this line is built it is hardly probable the construction will stop there, for it would be an easy matter to complete the belt line via Vancouver. The utilization of these routes would give the British Columbia Electric complete control on the lower mainland.

United States capital is seizing opportunities in the northern interior in the way of colonization possibilities, and the latest deal is an immense one. Mr. Lauchlin Maclean, of Spokane, and associates have bought 550,000 acres for $2,730,000. The question might be raised, though, if the acquisition of these large areas by syndicates might not be a cause in discouraging the bona fide settler who wants land as cheap as he can get it, as otherwise he cannot afford to pay two or three profits.

HIGHWAY ENGINEERING COURSE IN COLUMBIA UNIVERSITY.

The following non-resident lecturers in highway engineering at Columbia University have been appointed for the 1912-1913 session: John A. Bensel, New York State engineer; William H. Connell, chief, Bureau of Highways and Street Cleaning, Philadelphia; Morris L. Cook, director, Department of Public Works, Philadelphia; C. A. Crane, secretary, the General Contractors' Association; W. W. Crosby, chief engineer to the Maryland Geological Survey and consulting engineer, Baltimore; Charles Henry Davis, president, National Highways Association; A. W. Dow, chemical and consulting paving engineer, New York City; Walter H. Fulweiler, engineer, research department, United Gas Improvement Company; John M. Goodell, editor-in-chief, Engineering Record; D. L. Hough, president, The United Engineering and Contracting Company; Arthur N. Johnson, state highway engineer of Illinois; Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City; J. C. Nagle, professor of civil engineering and dean of the School of Engineering, Agricultural and Mechanical College of Texas; Harold Parker, first vice-president, Hassam Paving Company; H. B. Pullar, assistant manager and chief chemist, American Asphaltum and Rubber Company; J. M. F. de Pulligny, ingenieur en chef des ponts et chaussees, et Directur, Mission Francaise d'Ingenieurs aux Etats-Unis; John R. Rablin, chief engineer, Massachusetts Metropolitan Park Commission; Clifford Richardson, consulting engineer, New York City; Philip P. Sharples, chief chemist, Barrett Manufacturing Company; Francis P. Smith, chemical and consulting paving engineer, New York City; Albert Sommer, consulting chemist, Philadelphia; George W. Tillson, consulting engineer to the president of the borough of Brooklyn.

REGINA ENGINEERING SOCIETY.

About sixty members of the Regina Engineering Society and their friends sat down to the second annual dinner in the cafe of the Parliament Buildings on the evening of November 7th.

The event was a complete success and it is probable, as was suggested by the president, A. J. McPherson, that the dinners will be given oftener than once a year in future.

The president's response to the toast "The Engineering Society," was filled with suggestions of future policy. He touched on the need of a home for the society, and advanced his suggestion of a club with the members of the Engineering Society in the majority.

◆

Some months ago there appeared an article in *The Canadian Engineer* dealing with a sun power plant, the invention of Mr. Frank Shuman, of Philadelphia. Word has been received from Zeitoun, Egypt, which states that one of these plants is installed at Meadi, a suburb of Cairo, and is pumping water with complete satisfaction.

PERSONAL.

MR. M. B. HASTINGS, until recently with the Toronto Hydro-Electric system, has accepted a position with A. H. Winter Joyner, Limited, Toronto, as sales engineer.

COLONEL CLOUGH, formerly assistant superintendent of Halifax and St. John district of the Intercolonial Railway, has been appointed assistant to General Superintendent F. P. Brady.

MR. T. KENNARD THOMSON, C.E., consulting engineer, of New York, addressed the Canadian Club of Niagara Falls, Ont., on Thursday, November 7th, on "Bridges of the Past and Future."

MR. W. A. STEWART, of Cornwall, late superintendent of operation, St. Lawrence Canals, has been appointed superintendent of works for Mr. D. R. McDonald, on his harbor contract at St. John, N.B.

MR. M. R. SHAW, a graduate of the Faculty of Applied Science, Toronto University, of the class of '09, has been appointed to a research fellowship, the funds for which have been raised by the Engineering Alumni Association of the University.

MR. PAUL SEUROT, M.Can.Soc.C.E., M.Am.Soc.C.E., of Montreal, Que., has been awarded a Telford premium of the Institution of Civil Engineers of Great Britain for a paper published in the "Proceedings" of the society during the 1911-1912 session.

PROF. C. A. ZAVITZ, of the reforestation station in Norfolk county and lecturer at the Ontario Agricultural College at Guelph, has been appointed provincial forester by the Ontario Government. This appointment, in all likelihood, means the establishment of a forestry branch in connection with the Department of Lands, Forests and Mines with Prof. Zavitz as its head.

MR. A. CHAUSSE, chief building inspector of Montreal, is attending the convention of the American Society of Municipal Improvements as a delegate from Montreal. He will call on the return journey at Detroit, Chicago, St. Louis and Kansas City to study matters in connection with the administration of building departments and with building operations in those cities.

MR. CHARLES H. BIGELOW has accepted the position of chief mechanical engineer of the Millville Manufacturing Company, Millville, N.J. Mr. Bigelow recently returned from St. Catharines, Ont., where he had charge of the construction of a factory which will handle the Canadian business of the Yale and Towne Manufacturing Company, Stamford, Conn.

MR. DONALD MALCOLM McINTYRE, K.C., of Kingston, has been appointed chairman of the Ontario Railway and Municipal Board to succeed the Hon. James Leitch, who was recently appointed to the high court bench. The announcement of this appointment was made by Sir James Whitney recently. Mr. McIntyre will assume the chairmanship in the near future.

MR. J. A. MacMURCHY, of the Class '96 Faculty of Applied Science, University of Toronto, chief draughtsman to the Westinghouse Machine Company, of Pittsburg, will address the Engineering Society of the University of Toronto on Friday afternoon, November 15th, at 4.30 p.m., on "The Development of a Reaction Steam Turbine." His address will include explanatory notes on practical methods employed in this manufacturing plant. The meeting will be held in the Chemistry and Mining Building.

NATIONAL ASSOCIATION OF CEMENT USERS.

The ninth annual convention of the National Association of Cement Users will be held in Pittsburgh, Pa., December 10-14, inclusive. The convention proper will open on Tuesday evening, December 10, and will close on Friday evening, December 13. The sessions and headquarters of the convention will be at the Fort Pitt Hotel. In view of the numerous suggestions received to that effect, the convention period has been reduced over those of former years by two days, and in order that an equal amount of work may be accomplished, afternoon sessions will be held. No session will be held on the evening of the opening of the Cement Show in order that members may be afforded the opportunity to attend the same. The annual banquet will be held on Thursday evening.

◆

COMING MEETINGS.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lecture, Nov. 23rd, at 8 o'clock. "The Prevention of Sewage Pollution relative to Water Supply," by T. Aird Murray, C. E., Toronto. Secretary, J. Patterson.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh. Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

UNION OF MANITOBA MUNICIPALITIES.—Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg, Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago. Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

◆

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P O Box 1290

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES. President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION. President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.: Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr, G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—*Secretary*, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page
Albert, N.B., wharf with approach and bed	Nov. 18.	Oct. 31.	65
Bassano, Alta., waterworks	Nov. 18.	Oct. 31.	74
Kamloops, B.C., intake, dam and flume system	Nov. 14	Oct. 31.	65
London, Ont., bridge over Thames River	Nov. 13.	Oct. 17.	74
Ottawa, Ont., re-erection of Lobinz rock-breaker	Nov. 14.	Oct. 31.	65
Ottawa, Ont., conveyance of H.M. mails	Nov. 29.	Oct. 24.	74
Point Grey, B.C., steel pipes	Dec. 2.	Oct. 17.	74
Quebec, P.Q., grain elevator	Nov. 30.	Oct. 17.	76
Rimouski, Que., wharves and dredging	Nov. 12.	Oct. 31.	76
Toronto, Ont., engines and boilers	Dec. 10.	Oct. 31.	74
Winnipeg, Man., plans for city hall	**Feb. 15.**	**Sept. 26.**	**68**
Winnipeg, Man., Fire Department apparatus	Nov. 13.	Oct. 17.	66
Winnipeg, Man., extension of water works	Nov. 15.	Oct. 24.	74
Yorkton, Sask., auto fire truck	Nov. 12.	Oct. 24.	74
Fredericton, N.B., bridge, Reversible Falls	Dec. 2.	Nov. 7.	74
Dunnville, Ont., turbine pump	Nov. 18.	Nov. 7.	74
Ottawa, Ont., conveyance of H.M. mails	Dec. 13.	Nov. 7.	76
Kerrisdale, B.C., steel pipes	Dec. 2.	Nov. 7.	76
Calgary, Alta., examining warehouse	Nov. 15.	Nov. 7.	65
Fernie, B.C., drill hall	Nov. 21.	Nov. 7.	65
Regina, Sask., telephone building	Nov. 14.	Nov. 7.	65
Three Rivers, Que., public building	Nov. 25.	Nov. 7.	65
Vancouver, B.C., electric elevators	Nov. 18.	Nov. 7.	66
Victoria, B.C., cable	Nov. 25.	Nov. 7.	66
Wallaceburg, Ont., public building	Nov. 20.	Nov. 7.	66
Winnipeg, Man., boiler	Nov. 15.	Nov. 7.	66
Winnipeg, Man., cable	Nov. 15.	Nov. 7.	66

◆

TENDERS.

Halifax, N.S.—Tenders will be received until noon of November 14th, 1912, for the construction in permanent materials, of bridges, culverts, etc., required on road, Baddeck to Hunter's Mountain, County of Victoria. Plans, etc., at the office of the Road Commissioner, Halifax; John G. Morrison, Englishtown; George McRae, Baddeck; A. A. Buchanan, M.P.P., Neil's Harbor. E. H. Armstrong, Commissioner Public Works and Mines, Halifax, N.S.

Humboldt, Sask.—Tenders will be received until November 21st, 1912, by W. H. Stiles, secretary-treasurer, for the following works:

Contract "B"—Power House.
Contract "H"—Two Return Tubular Boilers.
Contract "J"—High Speed Steam Engine.
Contract "K"—Electric Lighting System.

Plans and specifications may be seen at the office of Messrs. Chipman & Power, Engineers, Winnipeg and Toronto; and at the town hall, Humboldt. O. W. Anderson, Esq., Mayor.

Kamloops, B.C.—Competitive plans are invited for the laying out of Riverside Park. The best plan, if selected, will be awarded an honorarium of $200. Plans to be in by December 16th, 1912. J. J. Carment, City Clerk.

Montreal, P.Q.—The Central Railway Company of Canada invites tenders for supplying railway ties in lots of five to one hundred thousand. Tenders to be received until noon of December 20th, 1912. F. Stuart Williamson, Chief Engineer, 44 Beaver Hall Hill, Montreal.

Ottawa, Ont.—J. G. Desbarates, Deputy Minister of the Naval Service, Department of Naval Service, will receive tenders up to noon of December 3rd, 1912, for the following metal naval stores: Brass and copper sheets, bars and tubes, zinc and lead sheets, steel plates, sheets, angles and bars, steel wire ripe, colder, spelter and tin, babbit metal, copper and steel nails, steel files. All for delivery at H.M.C. dockyards at Halifax, N.S., and Esquimalt, B.C. Full particulars may be obtained from the Naval Store Officer at either dockyard, or at the office of the Deputy-Minister.

Ottawa, Ont.—Tenders for the construction of two gasoline launches for the Fishery Patrol Service, in the Province of British Columbia, will be received until November 20th, 1912. Plans, etc., can be obtained upon application from the Chief Inspector of Fisheries at New Westminster, Inspector of Fisheries at Nanaimo, E. B. Schook, Vancouver, and from the agent of the Department at Victoria, B.C. Alex. Johnston, Deputy Minister of Marine and Fisheries, Department of Marine and Fisheries, Ottawa.

Peterborough, Ont.—Tenders addressed to R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until November 20th, 1912, for interior post-office fittings. Plant, etc., at the office of Mr. F. Bartlett, Architect, Peterborough, Ont.; Mr. T. A. Hastings, Clerk of Works, Postal Station F., Toronto, and the Department of Public Works, Ottawa.

Three Rivers, Que.—Tenders for the construction of a public building will be received until November 25th, 1912, at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa. (See Advt. in The Canadian Engineer.)

Toronto, Ont.—Tenders addressed to W. C. Wilkinson, Secretary-Treasurer, Board of Education, will be received until noon of Friday, November 15th, 1912, for the several trades required in the erection of a new school building on Pauline Avenue. Specifications, etc., at the office of the Superintendent of Buildings, City Hall, Toronto.

Toronto, Ont.—Tenders will be received by the Chairman of the Board of Control, City Hall, Toronto, until Tuesday, November 19th, 1912, for the construction of a number of sewers on different streets. Specifications, etc., at the office of the Sewer Branch, Department of Works, City Hall, Toronto. H. C. Hocken, (Mayor), Chairman of the Board of Control.

Winnipeg, Man.—Tenders addressed to the Chairman, Board of Control, will be received until November 20th, 1912, for the following machinery for the machine shop at the city yards, Ross Avenue:—

1 Double-backed Geared Gap Lathe. Gap 60-in. by 3-ft. long. Lathe 12-ft. 6-in. between centres. Fitted with A. C. Motor.

1 Single Jaw Punch and Shear fitted with A. C. Motor.

1 Five ft. Radical Drill, fitted with A. C. Motor.

Specifications, etc., at the office of the City Engineer, 223 James Ave. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the supply and installation of turbine pumps and motors required for the extension of the artesian well water supply system of the city of Winnipeg, will be received until November 29th, 1912. Specifications, etc., at the office of the City Engineer, 223 James Ave. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders addressed to the chairman, Board of Control, will be received at the office of M. Peterson, Secretary, Board of Control Office, until November 22nd, 1912, for the supply of 600 manhole grates in accordance with plan and specification, copies of which may be obtained at the office of the City Engineer.

◆

CONTRACTS AWARDED.

Arrowhead, B.C.—The contract for the lockup has been let to Mr. Harry Fraser, at a price of $1,750.

Brantford, Ont.—The Hydro-Electric Power Commission have awarded a contract to Messrs. Bennett & Bordon, of Brantford, for the erection of the substructure of the Brant transformer station.

Brockville, Ont.—Timber superstructure of wharf, on part of Tunnel Bay Dock. Contractors, Messrs. C. L. McCool and Thos. H. Moffat, of Pembroke, Ont., at unit prices involving an amount of $15,382.75.

Goderich, Ont.—Mr. Wm. Bermingham, of Goderich, has received the contract for the construction of a breakwater, at a contract price of $26,000, on amended plans and specifications.

Guelph, Ont.—At a meeting of the Light and Heat Commission, the contract for the cement and brick work of their new building was let to Messrs. Johnston and Williams, at $2,350. The carpenter work will be done by the Commission themselves, and tenders will be asked for the supply of lumber.

Massett, Queen Charlotte Island, B.C.—Construction of pile wharf. Contractor, W. G. Gillett, Esq., of Vancouver, B.C., at $4,875.

New Westminster, B.C.—The following contracts have been awarded:—

District A, B and "Cutfall" in Sec. No. 2, of the Sapperton District, the construction of about 7¾ miles of combined sewers, contractors: "A" The North West Municipal Construction Company, of New Westminster, at $41,283.00; "B," The Powers Contracting Company, of New Westminster, at $30,270.00; and "Outfall," T. R. Nickson, of Vancouver, at $44,237.00, for reinforced concrete lock joint pipe construction.

Supply of 10,400 feet of reinforced concrete pipe, in Dist. "A," "B" and "Outfall," of Section No. 2. The Pacific Lock Joint Pipe Company, of Seattle, $44,557 and Mr. M. P. [illegible]

Red Deer, Alta.—Messrs Borton and Willets, of Spokane, Wash., have received the contract for the erection of the new Merchants Bank building.

Toronto, Ont.—Mr. Gordon Perry, manager of the National Iron Works Company, has awarded a contract to Mr. John E. Russel for new buildings for extension to their cast-iron pipe foundry at Ashbridge's Bay. The new buildings will more than double the capacity of their plant, and the total cost will approximate $300,000. Work will be started at once.

Victoria, B.C.—The contract for the kitchen and laundry machinery for the Mental Hospital at Coquitlam has been awarded by the Minister of Public Works, to Messrs. McLennan, McFeely and Co., of Vancouver, at a price of $8,753.30.

◆

RAILWAYS—STEAM AND ELECTRIC.

Calgary, Alta.—Mr. McCauley, superintendent of the street railway, has proposed that a line of motor busses be established as an extension to the existing lines now under operation. The suggestion has been viewed with favor by the commissioners, but no definite decision has been arrived at.

Central Railway.—An officer writes that a contract has been given to C. J. Wills & Sons, Montreal, Que., for work on this line. The plans call for building from Montreal, via Hawksbury, Ottawa, Carleton Place, Bannockburn, Fenelon Falls and Orillia to a point on Georgian Bay, about 340 miles. Track has been laid on about 60 miles. The company expects to develop a traffic in grain, lumber, minerals, general country produce and manufactured goods. William Owen, president, C. N. Armstrong, vice-president and managing director, and F. Stuart Williamson, chief engineer, 44 Beaver Hall Hill, Montreal.

Vancouver, B.C.—The British Columbia Electric Railway Company have installed five new cars on their line between this city and New Westminster.

Winnipeg, Man.—The Winnipeg, Selkirk and Lake Winnipeg Electric Railway have started construction work on an extension of their line in a westerly direction to the base of Stony Mountain. Wilford Phillips, chief engineer.

◆

LIGHT, HEAT AND POWER.

Chatham, Ont.—Negotiations are now pending for the transfer of the C. W. and L. E. Electric Railway, and it is understood that a bond of $50,000 has been put up as an evidence of good faith, in the deal. The new owners will likely extend the road from Erie Beach to the Eau and from Wallaceburg to Sarnia.

Merritton, Ont.—A number of the old street lamps are to be replaced with new ones. Richard Clark, Town Clerk.

Nelson, B.C.—If a by-law, introduced by Ald. Walley, chairman of the Fire, Water and Light Committee, becomes active, small consumers of electric power from the municipality will have their rates reduced by 15 per cent.

St. Boniface, Man.—The management of the Winnipeg Electric Company tendered a rate of 1 cent per kw.h. for power to be used in the new pumping station on Plunket Street for a term of five years. The town council objected to the term of five years and notified the company that they must reduce it to two years or the negotiations would be cancelled.

Welland, Ont.—The town council has instructed the Hydro-Electric Commission to install a lighting plant for this municipality. The cost of this work will be about $95,000.00.

◆

GARBAGE, SEWAGE AND WATER.

Toronto, Ont.—Mr. R. C. Harris, Commissioner of Works, has presented an estimate of costs regarding the installation of mechanical filters to safeguard water users in sections of this city recently annexed. In his report he states that the cost would be about $56,000 for a pumpage of 2,500,000 gallons per day.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Brantford, Ont.—The Pratt and Letchworth Company of this city, which employs 500 hands in the manufacture of malleable iron castings, has been acquired by the Canadian Car and Foundry Company, of Montreal.

Hamilton, Ont.—Mr. T. J. Stewart, M.P., has received a communication from the Department of Public Works, Ottawa, which would indicate that work on the harbor of this city would be commenced in the immediate future. The letter states that the matter of calling tenders is well under way.

Hamilton, Ont.—The Board of Education are considering the matter of building an addition to the Barton Street School. Mr. Foster is the secretary of this Board.

Lethbridge, Alta.—A report states that the management of the McClary Company are considering the matter of erecting a warehouse in this city. At the present time the Stafford-Agnew Hardware Company are distributing agents for the McClary interests.

Moose Jaw, Sask.—Mr. W. L. Brackett is taking steps to interest a number of business men of this city in a scheme calling for the erection of a 300-roomed hotel.

Money Point, N.S.—It is reported that the government will rebuild the fog alarm station at this point.

Tarvia

Preserves Roads
Prevents Dust~

Section of Government Parkway, Ottawa, Canada, treated with Tarvia B.

The Property Owners' Investigation.

IN the City of St. Thomas, Ont., the property owners on Gladstone Avenue contemplated petitioning the City Council to improve the roadways. They commissioned one of their number to visit various American cities, inspect pavements and make a report. Their investigator, Mr. E. A. Horton, visited various cities in New York and New Jersey. In his report he made the following statements:

> "I saw a 'Tarvia X' road in Rochester which extends from the city to the lake front, a distance of about six miles It had been in use for eighteen months, and when I saw it, it was in excellent condition, with heavy traffic over it every day. I........inspected a piece of road in Newark........the surface when finished was smooth, and to my mind was one of the finest pieces of road it was my privilege to see. We then inspected another piece of 'Tarvia X' which had been done by the Road Commission two years ago........Constant heavy traffic passes over this road every day, and trucks have loads of from 6 to 8 tons. Steel-tired drays were used with most of their heavy traffic. This piece of road, as I saw it, did not show any wear whatever, and was apparently in as good condition as when it was put down.
>
> "I did not confine my attention to Tarvia roads as I saw (here he mentioned five of the commonest types of road treatment) and every other kind of road that is known.
>
> "I must say after making enquiries from people who were in no way interested, nor did they know I was seeking information, that everyone had a good word to say for the Tarvia road. I have no hesitation in recommending it for use on our street, and at the estimate cost that has been given us, after seeing the many pieces of road that I have seen, I think it is the cheapest road that can be built."

The foregoing is quoted from the St. Thomas, Ont., Journal of February 20th, 1912. Since that date Gladstone Avenue has been constructed with Tarvia X.

Anyone who will investigate the road problem with the same thoroughness will reach similar conclusions. Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B" (applied cold) for dust prevention and road preservation.

Booklet describing the latest developments in methods for building tarviated roadways and pavements will be sent free on request. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

Montreal, P.Q.—Following a recent purchase by Messrs. George Marcil & Company, a report states that a ten-story building will be erected on the site within the next few months.

Regina, Sask.—The municipal council are preparing estimates and making preliminary preparations for the erection of a new police station. Mr. E. B. Fulton is acting as architect in the matter and Mr. Zeats is chief of police.

Stratford, Ont.—Mr. Hennicke, formerly of the Hard Manufacturing Company, Buffalo, N.Y., is interested in a new concern starting in this city for the manufacture of brass beds. The company have secured temporary quarters in the Kemp Building and will, in all probability, erect a structure for their own use next summer.

Toronto, Ont.—The directors of the Fred Victor Mission are planning to erect a new hall at a cost of $50,000.

Vancouver, B.C.—The directors of the Granby Consolidated Mining, Smelting and Power Company will erect a new smelter at Granby Bay, Observation Inlet, Portland Canal district. Mr. F. M. Sylvester, acting general manager.

Vancouver, B.C.—According to plans filed by the Canadian Pacific Railway, the new hotel for this city will be 16 stories instead of 11. This will increase the estimated cost of erection by $400,000.

Windsor, Ont.—The directors of the Young Men's Christian Association will erect a $70,000 building in this city.

Winnipeg, Man.—Mr. E. A. Taylor, 26 Guelph Avenue, Toronto, is interested in a projected company that is forming for the manufacture of stained glass windows in this city.

◆

BRIDGES, ROADS AND PAVEMENTS.

Edmonton, Alta.—A demonstration was recently made by the directors of the Nakamun Asphalt and Oil Company to show the qualities of their asphalt for street paving in Western Canadian cities.

Fredericton, N.B.—The provincial board of works will erect a $300,000 bridge at St. John.

Nelson, B.C.—The new bridge to be erected across the Taghum River at this point will consist of three steel spans, each 170 feet in length, supported on three thirty-foot concrete towers. The cost of this work is placed at $100,000. J. P. Ford, resident provincial public works engineer.

St. Boniface, Man.—The ratepayers voted in favor of spending the sum of $400,000 on the erection of a new bridge over the Red River at the head of Provencher Street. J. B. Cote, town clerk.

Toronto, Ont.—The Municipal Council passed a by-law calling for the erection of six bridges at a cost of $[illegible]. The [illegible] are as follows:—

Crawford Street	$29,450 00
[illegible] Avenue	58,000 00
[illegible] (foot bridge)	12,000 00
[illegible] Street	[illegible] 00
[illegible] Road	14,118 00
[illegible] Street	11,800 00

R. C. Harris, Commissioner of Works.

Walkerton, Ont.—The engineering department of the Canadian Pacific Railway will erect a bridge at this point at a cost of $[illegible].

◆

CURRENT NEWS.

Berlin, Ont.—The mayor and council of this city have had preliminary estimates of the cost of a new city hall prepared. The report is now to hand and calls for an expenditure of $[illegible].

Montreal, P.Q.—The failure of the water supply is causing considerable inconvenience to the hospitals.

Ottawa, Ont.—The number of claims for compensation arising from the recent typhoid epidemic now number [illegible].

Preston, Ont.—The management of the Anchor Bedding Company have asked certain inducements prior to their decision to erect a factory at this point. The ratepayers will [illegible] November 18th.

Port Alberni, B.C.—The municipal council will receive applications for the position of City Engineer up to November 26th next. Each applicant to state age, experience, salary expected, and when he could come. All letters in this matter to be addressed to the council and marked "Engineer."

Sarnia, Ont.—The ratepayers carried the water works by-law calling for the expenditure of $500,000. H. A. McLean, Town Engineer.

Saskatoon, Sask.—The municipal Board of Trade are taking an active interest in the matter of a public library, and if their present plans are adopted the city will have a fine building.

St. Boniface, Man.—Tenders for the supply of an electric motor for pumping purposes were received from the following firms:—Heath and Thomas, Canadian Foundry, Drummond and McCall Company, Goldie Engine and Supply Company, Canada Traders, Ltd., Dominion Equipment and Supply Company, Stuart Machinery Co., Skinner and Co., John McDougall and Co., Chapman and Walker and Escher, Wyss and Co. The prices varied from $1,943.40 to $2,000. The award has not yet been made public.

Sydney, C.B., N.S.—The following is tonnage of the products of the Dominion Iron and Steel Company for the month of October last:

Coke	50,540
Pig-iron	31,090
Steel ingots	29,075
Steel blooms	27,880
Rails	[illegible]
Rods	[illegible]

Victoria, B.C.—The management of the Victoria Opera House Company state that the plans for their new building will be sufficiently completed in a few weeks to allow of tenders being called and contracts awarded. This structure is to be built entirely of Canadian materials.

◆

NEW CONCRETE COMPANY TO LOCATE IN MOOSE JAW, SASK.

Samples of the products of the Shope Concrete Products Co., of Portland, Oregon, who will locate their factory in Moose Jaw, have been received by the Board of Trade. The bricks and tiles are in different shades, and the most striking feature in connection with them is their light weight. Their lightness does not, however, deteriorate from their strength or durability, as engineering tests have demonstrated. The brick is made in a patent process in which sand is largely used, and it only requires 24 hours to make a brick. The new concern will employ 50 men at the outset, and it is possible for each man to daily turn out 2,000 bricks.

◆

POWER SPRAYERS.

The Gould, Shaply and Muir Company, Limited, Brantford, Ont., are manufacturing a power sprayer under the trade name of "The Ideal." The engine is of 2½-h.p., and keeps cool with a couple of pails of water. The water jacket surrounds the cylinder and extends above it with opening on top for filling. The water jacket can be easily filled or drained in a moments time. The speed of the engine can be instantly changed to run fast or slow as desired and is controlled by hit and miss governor. This engine is built on the 4 cycle principle, the same as our horizontal style, and is very economical in the consumption of fuel.

The pump has large water ways which permit all gritty particles to pass through valves. The glands and followers, valves, valve caps and seats are all made of bronze. The plungers are outside packed and easy to get at. The valves can be readily reached by removing the valve covers. The air chamber is large and enables a uniform high pressure to be maintained. Discharge openings are provided on each side of the air chamber and will supply two leads of hose with two or more nozzles each. The pump is run by means of a rocker arm attached to the pump gear. This outfit includes, pressure gauge, water relief valve, 10-ft. of rubber suction hose, 1 strainer 3¼-in. in diameter, two 25-ft. lengths of ⅜-in. discharge hose and couplings, 2 brass Y connections, 4 "Mistry Jr." nozzles, 2 bamboo poles 8-ft. and 10-ft., 1 brass Y discharge and shut off, so that both discharges may be opened or closed at will.

48 in. CONTINUOUS STAVE LINE

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS
For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

DEPT. OF RAILWAYS AND CANALS, WELLAND

Superintending Engineer's Office.
Messrs. Wettlaufer Bros., St. Catharines, Feb. 7th, 1912.
No. 178 Spadina Ave., Toronto.

Dear Sirs :—Replying to yours of the 6th, I beg to say that the two Mixers received from you last summer proved to be very handy, useful machines. They turned out excellent concrete and we had no trouble with them at all.

Yours truly, J. L. WELLER, Superintending Engineer.

CANADIAN NORTHERN RAILWAY

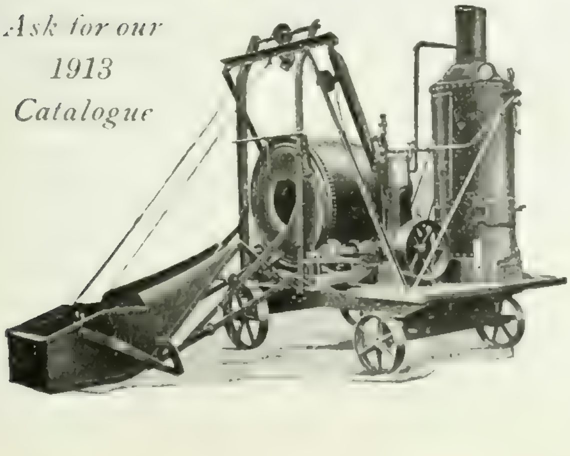
Belleville, Ont., Feb. 14th, 1912.
Wettlaufer Bros.,
178 Spadina Ave., Toronto, Ont.

Dear Sirs :—I think it is my duty to inform you that I am entirely satisfied with the two Concrete Mixers purchased from you last season. I have tested them in every way possible, and in every case I have found them capable of doing first-class work. Yours sincerely, J. O. GIROUX.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

Compare the thoroughness, simplicity and durability of our mixer with other makes. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing and the saving of power.

Ask for our 1913 Catalogue



WETTLAUFER BROS.
Head Office and Warerooms
178 SPADINA AVENUE,
TORONTO
WORKS AT MITCHELL, ONT. DETROIT, MICH. BUFFALO, N. Y.

HOOTON & MOORE, 613 Ashdown Block, Winnipeg
LAVALLE-ROSS, Alexander Block, Edmonton, Alta.
A. R. WILLIAMS MACHINERY CO. 15 Dock St., St. John, N.B.
WETTLAUFER BROS., 316 Lagauchetiere St. W., Montreal, Que.

ADAMS-HYDRAULICS, LIMITED.

The Adams-Hydraulics, Ltd., 7 Old Queen Street, Westminster, S.W., have forwarded a list of the manufactures they specialize in. The following covers the full list:—

Air compressors and "Adamic" distributors. "Adamics" fittings.

Bacteria bed apparatus, basement drainers, back pressure valve, bell mouth outlets, bucket bridges, bucket pump.

Cast iron pipes, castings, centrifugal pumps, chain pumps, covers, "Cresset" distributors.

Decanting valves, distributors, drinking fountains.

Ejectors, engines.

Filters, filter presses, flush tank syphons, flap valves, flushing syphons, floating arms.

Gulley grates.

Hydrants, hydraulic machinery.

Manhole covers, motors, mechanical rakes, motor power ejectors.

Overflow weirs.

Pressure regulating pumps, penstocks, pressure filters, petrol engines, pressure reducing valves.

Rams, reflux valves, reservoir fittings, recorders, revolving discs.

Screens, sewage disposal appliances, sewage ejectors, sewage lifts, sewer flushing syphons, stand pipes, sludge elevators.

Tanks, turbine pumps, turbine regulators, trench pumps, telescopic weirs.

Valves, vacuum pumps, vent columns.

Water filters, water mains, water softening plant, water wheels, water works supplies, wind engine pumps.

◆

THE OLIN GAS ENGINE COMPANY.

The above company, of Buffalo, N.Y., U.S.A., have commenced the manufacture of a gas engine known as the "Olin engine." They are made in sizes varying from 6½ to 40 horse-power under the following specifications:—

Frame is of graceful design, heavily trussed on under side and very rigid.

Cylinder is of special fine grained iron, accurately bored and is bolted and dowel pinned to frame; has ample water space and means for readily cleaning same.

Cylinder head is separate from the cylinder and is water jacketed.

Valve chamber bolts to frame, is water jacketed, and carries exhaust valve.

Valve chamber cap carries fuel valve and main inlet valve.

Valves are of the poppet type and are amply supported by stems in long bearings.

Wheels are carefully proportioned and counterbalanced and are turned crowning.

Crankshaft is exceptionally heavy and is cut from solid forging of 28 point open hearth steel. It is finely machined and has finished throws.

Connecting rod is of marine type, carefully designed and machined.

Piston is of exceptional length and fitted with rings which are made eccentric and finished under tension.

Main bearings are lined with high grade babbitt. The crank bearing is of bronze lined with high grade babbitt.

Igniter is of the hammer break type having points tipped with platinum; wearing surfaces are exceptionally large.

Governor of the hit and miss type acts by holding the exhaust valve open and fuel valve closed when the charge is not needed to keep up the speed. A hand wheel is provided for regulating the speed while engine is in motion. A relief cam provides for throwing off the compression when starting the engine.

Governor of the throttling type acts by varying the quantity of both the gas and air according to the load.

Gasoline equipment is of simple, efficient and approved design. It has hand priming pump and double valves.

Fly wheels, rims and hubs, shaft cap, crank throws, cylinder head, valve stems, rods, governor and brass fittings are polished.

Cast surfaces are filled, rubbed and coated with several coats of enamel.

Standard gas engine equipment consists of gasometer, muffler, lubricators, oil guard, gas index cock, shaft cap, standard pulley, piston wrench, electric igniter, batteries and spark coil.

Standard gasoline engine equipment consists of muffler, lubricators, oil guard, shaft cap, standard pulley, piston wrench, gasoline attachment, electric igniter, batteries and spark coil.

Five large Edison type batteries are furnished.

Mr. Marshall Armstrong, Hagersville, Ont., is the Canadian representative.

◆

NEW INCORPORATIONS.

Tate, Sask.—Tate Telephone Co., $900.

Venn, Sask.—Venn Telephone Co., $600.

Wilcox, Sask.—McIllraith Lumber Co., $100,000.

Lethbridge, Alta.—Bathurst Mining Co., $20,000.

Victoria, B.C.—Sidney Rubber Roofing Co., $150,000.

Kelowna, B.C.—Black Mountain Water Co., $600,000.

Munson, Alta.—Munson Farmers' Elevator Co., $25,000.

Medicine Hat, Alta.—Medicine Hat Construction Co., $10,000.

Port Alberni, B.C.—Port Alberni Sanitary and Heating Co., $10,000.

Midland, Ont.—Midland Dry Dock Co., $250,000. D. S. Pratt, J. Playfair, D. L. White.

Edmonton, Alta.—General Construction Co., $10,000. Morris-Hagen Agencies, $50,000.

Hamilton, Ont.—Canadian Porcelain Co., $300,000. E. D. Cahill, J. A. Soule, R. L. Latham.

Maisonneuve, Que.—Federal Shoe Factories, $500,000. E. Wilcox, O. P. Dorais, A. P. Dorais.

Chambly, Que.—Canadian Leatherboard Co., $50,000. H. N. Chauvin, A. H. Duff, W. Stewart.

Coldbrook, N.B.—Maritime Motor Car Co., $250,000. W. W. Skinner, W. G. Pugsley, G. G. Hyde.

Regina, Sask.—Regina Storage and Drying Elevator Co., $1,000,000. Regina Grain Co., $50,000.

Quebec, Que.—Hydro-Electric Company of Quebec, $750,000. J. Thomson, A. Veasey, F. Flynn.

Calgary, Alta.—Alberta Electric Co., $150,000. Pattison Electric Co., $20,000. Cunningham Electric Co., $35,000. Imperial Supply Co., $50,000.

Orangeville, Ont.—Pine River Light and Power Co., $200,000. H. B. Smith, F. H. Kilbourn, J. Garvie, Owen Sound.

Vancouver, B.C.—South-east Kootenay Coal and Coke Co., $100,000. Westminster Power Co., $1,000,000. Vancouver Fire Despatch and Salvage Corps, $25,000.

Owen Sound, Ont.—Riverside Rink Co., $40,000. F. W. Harrison, A. N. Harrison, A. J. Creighton. Canadian Malleable Iron Co., $150,000. H. A. Gutenkunst, L. E. Best, R. M. Frient, Milwaukee, Wis.

Winnipeg, Man.—Northern Supply Co., $50,000. E. Guilbault, R. Cote, St. Boniface; P. A. Talbot, Winnipeg. Twin City Separator Co., $30,000. J. Rosholt, C. A. Paulson, Mrs. C. M. Rosholt, Minneapolis. S. H. Wright Electrical Co., $5,000. S. H. Wright, A. W. Morley, C. L. Richardson.

Toronto.—Humber Cement Brick Co., $40,000. G. H. Kilmer, J. A. McAndrew, W. H. Irving. Rocmac (Ontario), $300,000. H. Riley, J. F. MacGregor, W. H. Walter. National Automobile Woodworking Co., $40,000. A. J. H. Eckardt, A. Meerbeck, J. H. Young. Sanitary Water-Still Company of Canada, $200,000. A. E. May, J. C. Mitchell, R. B. Beaumont.

Montreal, Que.—Steel Specialties for Canada, $50,000. G. L. Richards, Boston; G. J. Foster, R. Mackay, Montreal. Petrolite Company of Canada, $250,000. Hon. F. E. Gilman, E. H. Brown, Westmount; L. H. Boyd, Montreal. Dominion Tire Company, $1,000,000. A. Chase-Casgrain. E. M. McDougall, G. S. Stairs. Lock Joint Pipe Co. (Canada), $25,000. F. G. Bush, G. R. Drennan, H. W. Jackson.

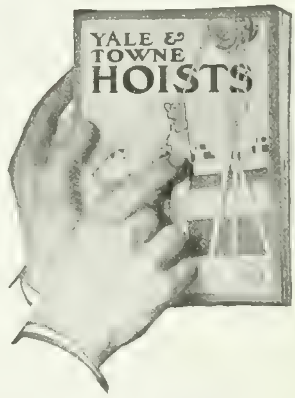
◆

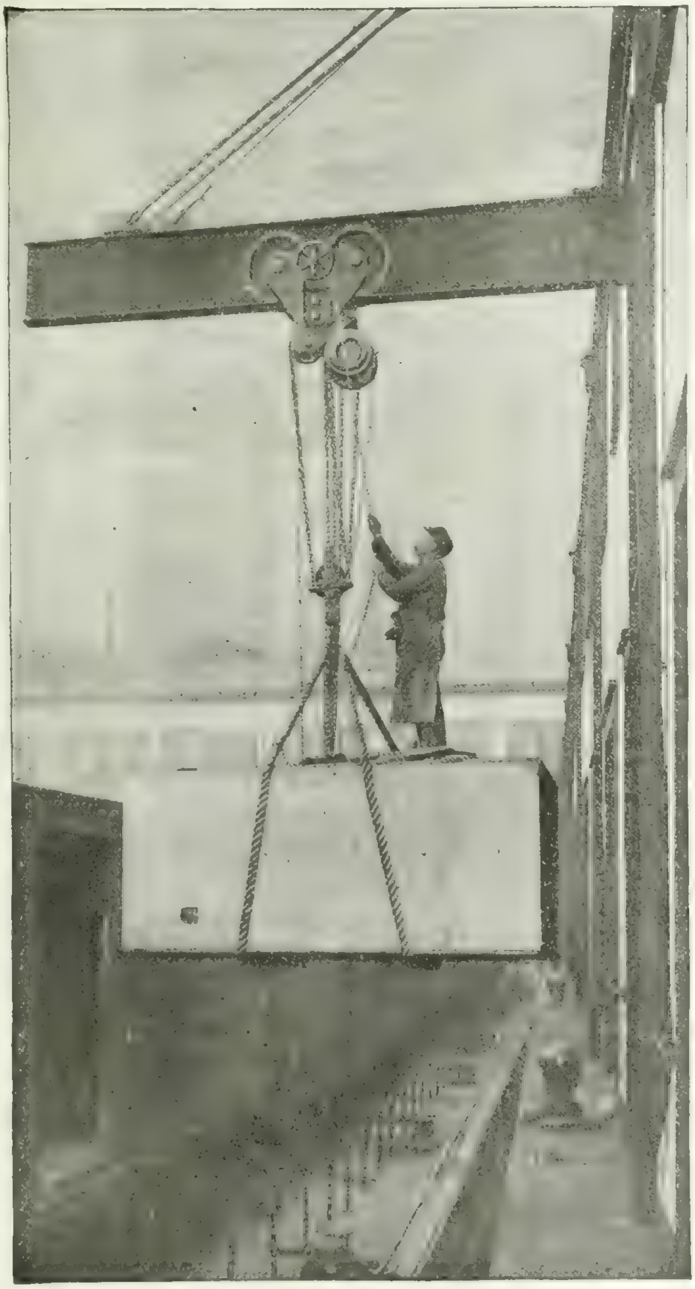
COPY OF ENGINEER WANTED.

One copy of our issue of July 11th last, is required. The person forwarding the same to this office will have his subscription extended one month.

THE TRIPLEX BLOCK

REASONS FOR SENDING TODAY FOR THIS BOOK.





Triplex Block built into a 10 ton geared trolley and used for loading on floats lying alongside a pier in New York City.

A Book on the Handling of Load, the Latest Practice Here and Abroad.

The change is coming fast. Modern plants today are equipping throughout to give each workman easy mastery over any load up to 20,000 lbs.

The new practice is to reduce all loads to one-man manageable loads, from the raw material coming in to the completed material going out. This frees the factory from an enormous waste. The primitive way of pitting time-paid muscle against stubborn weight, soon costs any manufacturer who stands for it a fortune in wages and restricts his output.

Months of research were spent by Yale and Towne engineers to make this book cover a wide range of conditions, so the man who sends for it will find it the most practical and helpful book that ever came to his desk.

Send for a free copy now, before the thought is out of your mind.

Triplex Blocks { **16 Sizes:** One-fourth of a ton to forty tons.
9 Active Stocks all over Canada.

Every Block Tested to Fifty Per Cent. Overload.

The Canadian Fairbanks-Morse Co., Limited

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

17869—October [illegible]—Directing C.P.R. to construct spur from main line east of Neebing Ave., Fort William, Ont., to a point 100 feet south of C.N.R. passing under C.N.R. by means of subways; and directing C.N.R. at its own expense, to raise its railway at least [illegible] feet so as to carry it over Neebing Ave., and the proposed branch line; and construct temporary structure across said Neebing Ave.; and rescinding Orders Nos. [illegible] and [illegible], dated [illegible] August [illegible], and October 11th, 1912.

17870—October [illegible]—Directing the Cumberland Ry. and Coal Co. to equip its cars with automatic couplers and air brakes, within twelve months from date of this Order.

17871—October 30—Approving revised location C.P.R. Sudbury to Sault Ste. Marie Branch as now constructed, from mileage [illegible] from Webbwood, to mileage 34.76 on the Algoma Section, said revision [illegible] Serpent River Indian Reserve.

17872—October 30—Authorizing C.L.O. & W. (C.P.R.) to construct across Three (3) highways, mileage 93.59 to mileage 95.8 in Co. Northumberland, Ontario.

17873—October 30—Authorizing C.L.O. & W. (C.P.R.) to construct across Sidney Street in town of Trenton, mileage 87.14 from Glen Tay, and across West St., mileage 87.41, said town.

17874—October 30—Refusing application of J. A. C. Ethier, M.P., of Ste. Scholastique, Que., for an Order compelling C.P.R. to erect platform for milk shipping purposes between St. Herman and Ste. Scholastique, at point known as Cote St. Lumis, Que.

17875—October 29—Authorizing C.P.R. to open for traffic Moose Jaw North-West Branch from Outlook to Conquest, 9.3 miles, including bridge across South Saskatchewan River.

17876—October 30—Authorizing C.P.R. to construct spur leading to its ballast pit near Olds, Alta., across Edmonton Trail on N.W. ¼ Sec. 19, and across public road allowance between Secs. 19 and 30, Tp. 32, R. 1, W. 5 M., and road allowance between S.W. ¼ Sec. 30, Tp. 32, R. 1, W. [illegible] Tp. [illegible] R. [illegible] W. [illegible]

17877—October 29—Approving proposed location C.P.R. station near the boundary line between Tps. of Amaranth and Melancthon, Co. Dufferin at Shelburne, Ont.

17878—October 30—Authorizing C.P.R. to construct double track across G.T.R. at Delson Jct., and rescinding Order No. 17437, dated September [illegible]

17879—October 30—Allowing correction of plan showing location of sta- [illegible] R[illegible], C.P.R., Boissevain to Lauder Branch.

17880—October 29—Authorizing C.P.R. to construct spur for the Ontario Wind Engine and Pump Co., Calgary, Alberta.

17881—October 29—Authorizing C.P.R. to construct proposed bridge No. 8.7 on the Interprovincial and James Bay Ry., in Province of Quebec.

17882—October 29—Authorizing C.P.R. to open for traffic double track of Moose Jaw Subdivision, from Belle Plaine, mileage 117.0, to Pasqua, [illegible]

17883—October 30—Further extending, until November 30th, 1913, the time within which C.P.R. complete branch line across certain highways [illegible] Marquette.

17884—October 29—Authorizing Esquimalt & Nanaimo Ry. to construct bridge No. 8.5 ever Little Qualicum River, on its Comox Extension, B.C.

17885—October 29—Authorizing C.N.O.R. to construct across Three (3) highways on its Hawkesbury-Monrteal Line, Parish of St. Laurent, Co. Jacques-Cartier, Quebec.

17886—October 30—Rescinding Order No. 17782, dated October 17th, [illegible]

17887—October 31—Authorizing C.N.O.R. to construct across and divert public road between Lots 10 and 11, Con. 8, Tp. Chisholm, District of Nipissing, Ont.

17888—October 30—Authorizing C.N.O.R. to construct across tracks of the Montreal Tramways Co. near Cartierville, by means of an overhead structure.

17889—October 29—Authorizing C.N.R. to construct its Swift Current Extension across Two (2) highways, in Prov. Sask.

17890—October 29—Authorizing C.L.O. & W. (C.P.R.) to construct [illegible] Province of Ontario.

17891—October 30—Authorizing C.L.O. & W. (C.P.R.) to construct across Nine (9) highways, Tp. Tyendinega, mileage 59.45 to mileage 65.75, Ontario.

17892—October 30—Approving location G.T.P. Branch Lines Co. Moose Jaw Northwest Branch from East Line of Sec. 10, Tp. 21, R. 4, to East [illegible] Tp. [illegible] R. [illegible] W. [illegible] M. [illegible]

17893—October 30—Authorizing G.T.R. to construct bridge No. 41, mileage 109.35, 20th District, Middle Division, over creek and public road [illegible]

17894—October 29—Authorizing the Corporation of city of Saskatoon, Sask., to carry its Municipal Street Rly. across C.P.R. at Avenue A and at Twenty-third St., Saskatoon.

17895—October 31—Dismissing complaint of Canada Cement Co., Ltd., [illegible]

[illegible] road at mileage 88.2, Calgary-Boundary Branch, in N.E. ¼ Sec. 9, Tp [illegible]

[illegible] C.P.R. to construct [illegible] D. L. [illegible] on Lots Cadastral No. 328, in incorporated village of St. Louis Parish Montreal, Que., now in city of Montreal, at Mile End Station, Que.

17898—October 31—Authorizing C.P.R. to construct spur into the premises of the Department of Natural Resources for the C.P.R., on west [illegible] Sec. 14, Tp. [illegible], R. [illegible], W. [illegible] M., at Strathmore, Alberta.

17899—October 30—Authorizing C.P.R. to construct an industrial spur for Sampson Walker, Winnipeg, Manitoba.

17900—October 31—Dismissing application of W. Harris Dawson and residents in vicinity of Stonefield, Que., for an Order directing C.P.R. to stop trains at road between Staynerville and Grenville Stations, to pick shipments of cream.

17901—October 30—Approving C.P.R. Plan No. 50177, dated October 24th, 1912, showing extension of bridge No. 0.41, Fort William Terminals, Ontario.

17902—October 31—Approving proposed layout of C.N.O.R. station grounds at Clarendon, Twp. Clarendon, Co. Pontiac, Que.

17903—October 29—Authorizing the city of Saskatoon, Sask., to carry its Municipal Street Railway across C.P.R., at Twentieth Street, said city.

17904—October [illegible]—Authorizing C.P.R. to [illegible] station building at l'Acadie, Parish Ste. Marguerite de Blairfindie, mileage 24.51, Farnham Section.

17905—October 31—Approving location F.T.P. Ry. proposed station at South Hazelton, on Lot 9, Cassiar District, B.C.

17906—November 2—Approving location C.N.O.R. through North Bay, Ontario, mileage 343.55 to mileage 346.42 from Montreal, (North Bay to Capreol Jct., Line).

17907—October 26—Authorizing G.T.P. Ry. to construct spur for Thomas Jackson & Son, city of Winnipeg, Manitoba.

17908—October 2—Authorizing C.N.R. to construct proposed cut-off through city of Winnipeg, to connect its Fort Rouge Yards with its Eastern Yards.

General Order No. 95—November 2—Directing that whenever a railway company subject to the jurisdiction of the Board, issues an embargo against any traffic, it shall, within 48 hours thereafter file with the Board copy of such embargo, with statement of conditions rendering such embargo necessary, the action required to remove such conditions, and probable time such embargo will be continued. And when such embargo is withdrawn or cancelled, the company shall forthwith file with the Board copy of such withdrawal or cancellation.

17909—November 4—Certifying that correction of error, in location plan of Toronto Eastern Ry. Co., in Lot 13, Con. 2, Tp. of Darlington, at town of Bowmanville, is allowed, upon condition that the company cross mill pond by trestle work and do no filling in the mill pond.

17910—November 4—Authorizing C.L.O. & W. (C.P.R.) to construct bridge No. 11.15, in Province of Ontario.

17911—November 6—Postponing, to and including the 31st day of December, 1912, the effective dates of the following tariffs covering increased charges for cartage: G.T.R., C.R.C. No. E. 2627; C.P.R., C.R.C. No. E. 2467; C.N.R., C.R.C. No. E. 184; P.M.R.R., C.R.C. No. 1533; M.C.R.R., C.R.C. No. 1967; C.W. & L.E., C.R.C. No. 254; Q.M. & S., C.R.C. No. 459; K. & P. Ry., C.R.C. No. 421; N.Y.C. & H.R.R., C.R.C. No. 2414; T.H. & B., C.R.C. No. [illegible] N.Y. [illegible] C.R.C. No. [illegible]

17912—November [illegible] N. St. C. & T. Ry. to [illegible] to property of Thorold Pulp Co., Ltd., town of Thorold, Co. Welland, and to property of Interlake Tissue Mills Co., Ltd., village of Merritton, Co. Lincoln.

17913—November 4—Authorizing St. John & Que. Ry. to cross, by overhead bridge, tracks of C.P.R. at station 2608.69, between 49th and 50th miles, north of McAdam Jct., northern section of Atlantic Division.

17914—November 5—Authorizing C.L.O. & W. (C.P.R.) to construct across Toronto and Eastern Ry., by overhead bridge, at mileage 162.98, town of Whitby, Co. Ontario, Ont.

17915—November 4—Authorizing C.P.R. to construct across public road, Lot No. 59, Parish Kildonan, Man., (main line, Winnipeg to East Selkirk).

17916—October 31—Approving location C.P.R. Swift Current-Southeasterly Branch from a point in Sec. 11, Tp. 11, R. 10, W. 3 M., to Junction with its Moose Jaw-Southwesterly Branch in Sec. 23, Tp. 10, R. 1, W. 3 M., mileage [illegible] to mileage [illegible], and to cross [illegible] highways.

17917—November 5—Directing C.P.R. to remove embargo on sand loaded in cars other than its own, shipped into Winnipeg from points on C.N.R. line.

17918—November 2—Authorizing C.N.R. to construct spur for D. R. Fraser & Co., Ltd., Edmonton, Alta.

17919—November 5—Authorizing C.N.O.R. to construct across Park Avenue, city of Montreal, Quebec.

17920—November 5—Authorizing C.N.O.R. to construct across Mance Street, city of Montreal, Quebec.

17921—October 31—Authorizing C.N.O.R. to construct across McPherson Avenue, city of Montreal, Quebec.

17922—November 4—Directing C.N.Q.R. to provide a flag station for passenger purposes only at Larose Station, Quebec.

17923—November 5—Authorizing G.T.P. Branch Lines Co. to divert Lake View Avenue, Moose Jaw, and to construct Regina-Moose Jaw Branch under such diversion, mileage 41.7, Dist. Moose Jaw, Saskatchewan.

17924—November 4—Authorizing G.T.R. to construct siding, and spur therefrom, and to reconstruct or deviate siding to the Breithaupt Leather Co., Ltd., said line commencing at a point on its railway on Fox St., north of Cambridge St., Penetanguishene, Ont., thence extending northerly upon and along Fox St., to the Dominion Stove and Foundry Co., Ltd.

17925—November 4—Authorizing G.T.R. to construct siding for the Sarnia Chain Co., Sarnia, Ontario.

17926—November 2—Authorizing G.T.R. to construct an additional track and reconstruct existing track across road allowance between 5th and 6th Concessions, Tp. Thorah, Ont., and to construct siding commencing east of Beaverton Station on Lot 12, Con. 5, Tp. Thorah, extending to premises of Snelgrove and Teer, (Beaverton Brick & Tile Co.), on Lot 12, Con. 5.

17927—November 4—Authorinzing G.T.R. to construct the northerly track across Cote Noir Road, Parish St. Antoine De Longueuil, Quebec.

17928—November 2—Directing G.T.R. to install two sets of gates at crossing of Lapiniere Road, between towns of Greenfield Park and St. Lambert, Que.

Volume 23. Toronto, Nov. 21, 1912

Contents of this issue on page 769

The Canadian Engineer

An Engineering Weekly

LAYING A DEEP SEWER IN BAD GROUND.

By GEO. PHELPS, C. E.*

On one section of the sewerage scheme which has recently been carried out in North Toronto, and which was designed by T. Aird Murray, consulting engineer, Toronto, Ont., a part of the main trunk sewer is laid at a depth of about 30 feet. The following account of the work shows some of the difficulties which were encountered and the methods adopted in overcoming the same.

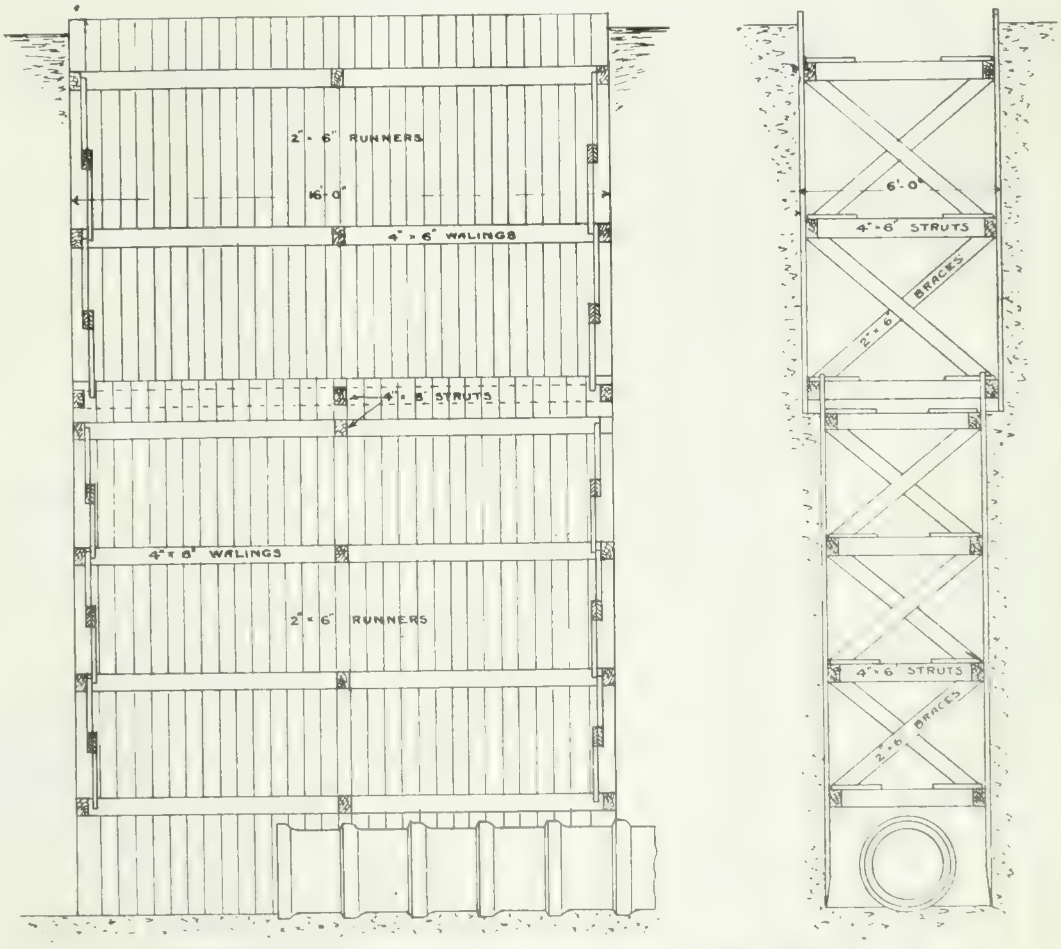


Fig. 1.—Plan Showing Cross Sectional Views of a Top and Bottom Setting of Timber.

The sewer has a total length of nearly two miles; about 2,200 feet of this consists of 20-inch diameter pipes, and 7,000 feet of 24-inch, laid at a grade of 1 in 700. It passes through ground of varying character and at depths for the most part between 20 and 30 feet. Some of the deep work presented no special difficulty beyond hard picking and digging, but towards the lower end of the sewer, water and running sand interfered considerably with the progress of the work. The 20-inch pipes were laid during the summer weather, the greatest depth being about 24 feet, and the soil for practically the whole length of this part consisted of very hard clays and shale. Most of the trenching was done by short open cuts and tunnels about 20 feet long. The sides were so firm that no timbering beyond the stages for shovelling were required, and no water was encountered.

The sewer crosses a creek near where the 20-inch and 24-inch pipes join, and a little further on the ground quickly changes from the hard clay and shale to sand. The following section was laid during the fall of 1911; the greatest depth is about 24 feet, and although the greater part of the work was in sand, no timbering of any importance was required and the trench was free from water. A large part of this section also was carried out on the open cut and tunnel principle.

At the time these two sections were laid there was no outlet for the water at the lower end of the sewer, but pumping was not found necessary, as the trench was dry throughout the whole of the length.

The remainder of the 24-inch sewer, about three-quarters of a mile in length, passed through some bad ground and proved a difficult and costly piece of work. In November, 1911, although the main outfall sewer to which this section joins, was not completed, it was decided to proceed with this part of the work or, it was feared, a large part of the sewer system would be held up for want of an outlet. It having been ascertained by sinking trial holes that there would be water to contend with, a pit was sunk at the point of junction with the outfall sewer. A steam boiler and pulsometer were provided for dealing with the water, which was met with at a depth of about 16 feet. The sewer here is 30 feet deep, the trench being in sand the whole depth. From this point to the next manhole there is a fairly steep grade, sufficient to carry the water and fine sand which came with it through the sewer as it was laid to the pump sump.

---

* Engineer in charge of North Toronto sewerage system.

It may here be said that the pulsometer did not give entire satisfaction for the work. In capacity it was found to be more than sufficient to deal with the water from the trench, and it only required to be worked intermittently. For this reason the sand which was carried by the water settled down on the valves during the periods of rest, and there was often a delay in getting the pump to start again.

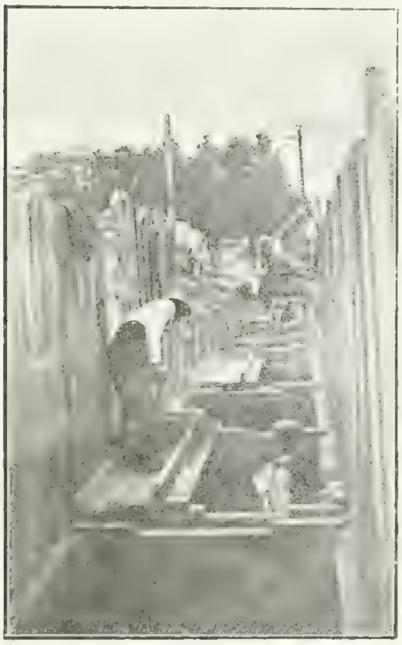


Fig. 2.—View of Trench, Showing Timbering in Position.

After passing the first manhole to the south of this point, the line of the sewer lay between a row of telephone poles and the fences of the property alongside the road, giving a width to work in of only 8 to 10 feet, which was obviously insufficient to accommodate the excavated material in addition to the trench. The use of a conveyer for hoisting and backfilling the earth was considered, but this idea was given up as being impracticable, chiefly owing to the interference of the telephone poles. The open cut and tunnel principle could not be adopted here on account of the quicksand and water, the only reasonable method apparently being the one adopted, viz., of open cutting the whole way by manual labor and removing the material from the trench by stages. The grade from this point on is 1 in 700.

The trench had necessarily to be timbered in a very substantial manner, as the sand was loose and the sides of the trench quickly fell in if unsupported. In fact, the conditions soon got so bad that it was found necessary to timber the trench with close sheeting from top to bottom. The work was carried on through the winter in order that the trunk sewer might be completed in good time, and the severe weather helped to make progress slow. Not only was there three feet of frost to break through at the top, but the excavated material froze almost solid, making the filling-in quite a large part of the work. Frost wedges and dynamite were used to break up the material for filling in the trench.

Although it was found possible to continue the laying of this sewer right through the severe weather of last winter, except for a few odd days, there is little doubt that from an economical point of view the laying of a deep sewer in ground where quicksand and water are met with had better be stopped in the winter, unless, as here, it is a case of being pressed for time. If such work must be carried on in severe frost, some kind of conveyer should, if possible, be used for backfilling the excavated material over the pipes laid as soon as it is removed from the trench, not allowing it time to freeze at the top of the ground.

Shortly after the commencement of the work on the flat grade it was found impossible to keep the sewer free from the sand which was carried in suspension in the water, and which, being very fine, quickly settled down in the pipes and formed an obstruction. Attempts were made by means of rods and chains drawn through to keep the pipes clear, also by flushing from a hydrant. But the level of the water could not be kept down sufficiently to make good joints, and pumping in front of the pipe-layers had to be resorted to. A four horse-power vertical gasoline engine and a belt-driven centrifugal pump were provided for this purpose, the pump being set down in the trench about 10 feet above the invert of the sewer; 35 feet of flexible suction hose was attached to the pump, making it possible to lay about 70 feet of pipe before moving the pump further along the trench. The gasoline engine occasionally gave a little trouble, but the centrifugal pump proved quite satisfactory for dealing with the very sandy water, which was raised to the surface and discharged on the other side of the road.

The pipe joints were made in the usual way with cement mortar, gaskets being first put into the sockets of the pipe. Only a few pipes, about eight or ten, were laid at a stretch, the method of procedure being to excavate a length of trench, except a foot or so at the bottom, sufficient for the length of pipes to be laid; that part of the trench was then cleared of the stages, and the last level of the bottom got out while the pipes were being laid. This was necessary on account of the rapidity with which the trench silted up. The joints were cemented and covered over with sods, and the sand which was being removed from the bottom of the trench filled on to the top of the pipes shortly after. The water was not allowed to rise in the trench again or flow into the pipes until after the cement had set. Derricks were used for lowering the pipes into the trench, as well as for drawing the timbers after the pipes were laid. Two men on the derrick were able to handle the pipes with ease, and the pipes were by this means lowered and set in position in the shortest possible time. These derricks were rigged up on the job, a double purchase winch being used, fixed to a wooden frame - work with wooden mast and boom.

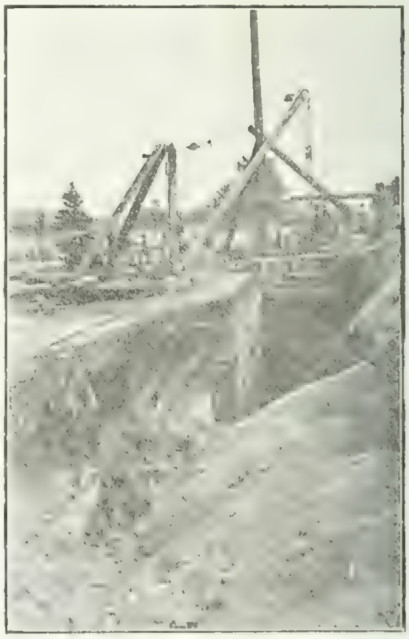


Fig. 3.—View of Trench After Removal of Timbering.

It is generally recognized to be a matter of some difficulty to make good cement joints in a wet trench, but that this can be done providing great care is taken in the jointing, and the water kept well pumped out in front of the pipe laying, is demonstrated in the present case.

Before leaving at the end of the day a stopper was put in the last pipe laid, to prevent the sand washing into the pipes at night. The sand flowed so freely into the trench that often, after standing over the week-end, it had filled the trench up to the level of the top of the pipes. The bottom of the trench was, as a rule, good, the quicksand coming from a few feet higher up. In some places, however, where the bottom was soft, timbers were put in to give a firm bearing for the pipes. As a result of the flow of sand into the trench, caves were formed behind the sheeting, and when for any reason a delay occurred causing the trench to be left open a little longer than usual, big falls of sand took place, due to the cave and the weight of earth above. These often pulled down the top setting of timber a few feet with it and causing the walings to snap. This constituted a great danger and the work was delayed on several occasions by the caving in of the sides of the trench from this cause. The system of cross braces shown in Fig. 1 was adopted to prevent the occurrence. Extra diagonal braces were often put in as well, but even this did not always prevent the settling down of the timber work with the falling sides. The timber consisted of two settings of 2-in. x 6-in. pine runners, the top setting being 12 feet deep and the bottom 16 feet deep. The walings and struts were of 4-in x 6-in. pine, and the cross braces of 2-in. x 6-in. pine. A uniform width of trench was kept, and each setting was 16 feet in length, this being the length of walings used. The walings were about four feet apart vertically, three on each side for a top setting, and four for a bottom setting. The cross braces and 4-in. x 6-in. struts were placed at each end of the walings, in addition to 4-in. x 6-in. struts in the middle, the timbering thus being divided up into 8-foot bays. After the bottom setting of timber had been driven down to the full depth, the joints of the runners were covered with short lengths of 1-in. boards to keep back the sand as much as possible. This helped considerably, but did not entirely prevent the sand from washing in.

The drawing of the timbers after the pipes had been laid was attended with some danger. The bottom setting was first drawn, often exposing big caves in the sides of the trench where the material had washed away. These, with the trench, were filled up to the bottom of the next setting before any of the top timbers were disturbed. On removing the struts from the top setting the sides of the trench often fell in from several feet back to the great danger of the timbermen, but fortunately the work was completed without any serious mishap from this cause.

In passing the telephone poles, which came immediately on the side of the trench, the top setting of timber was left in for safety. In addition, stays were placed on the poles and left there after completion of the work to protect them from heeling over or sinking until the trench settled down quite firm. In some places, where the ground was very bad, particularly at a point where the trench passed close to a grove of trees, the whole of the timbering was left in the trench, and after filling such places a large amount of surplus earth remained to be hauled away. The trenches have shown very little sign of settling down since being filled and it is likely that the caves left behind the timbering where it was not drawn will silt up from underneath quicker than the filling material will find its way through from above.

After completion of the sewer it was found necessary to do a certain amount of flushing to remove the sand from the pipes. The sewer is now in satisfactory operation.

It is interesting to note that during the excavation of the trenches, which were situated some six miles from Lake Ontario and at a level of about 250 feet above the lake, a number of boulders were continually being met with, some of them over a ton in weight. The rocks from which these came were of a very varied character, and many of the boulders showed by their scored surfaces unmistakable signs of having been ice borne. No doubt many of them had been brought from long distances and deposited here when the lakes covered a larger area than they do at the present time.

In the fall of 1911 this work was taken out of the contractor's hands and conducted by myself under the direction of E. A. James, the engineer for North Toronto, Ont.

ROADS OF SASKATCHEWAN.*

By A. J. McPherson.†

I have to express my gratification at being allowed the opportunity of laying before you some information regarding Saskatchewan roads and also at being able to attend your convention, as I am very much interested in learning the objects and aims of your association. I can say for the Highway Commission of Saskatchewan that they will do what they can to further the aims of the association, and from what information I have had up to the present is should be done without any confliction with our present policy, as we appear to be trying to arrange our provincial affairs entirely in accord with the ideas expressed by those of your officers whom I have had the pleasure of meeting. I understand that one of the objects of your association is to bring into existence a national highway leading from coast to coast across the Dominion. I propose to show you before I am through how this can be accomplished as regards that part of it lying within Saskatchewan. I will also try and outline the general policy regarding roads which we have been following for the last five or six years with more or less success.

Importance and Benefits of Good Roads.—It hardly seems necessary to refer to the importance or the benefits to be derived from good roads before such a convention as this, the members of which are all more or less enthusiastic, their presence here showing that they realize the importance of the question. The importance of proper means for facilitating easy transportation, however, cannot be over estimated. Man is naturally gregarious in his nature and everywhere he is found living in tribes and flocks. He attains his greatest success and most advanced development when living in communities. If a man lived in isolation and depended entirely on his own efforts for everything he needed he would be compelled to live in a very crude way and any advancement he made during his lifetime would die with him. This is an age of specialization and we find one community will confine its efforts to the production of one article of commerce and another to another. Other communities are engaged solely in the manufacture of one class of machinery while still others will devote all their time to the development of ideas, education, etc. It is necessary that articles thus produced or manufactured be interchanged and transported to where they are needed, and we find a commerce resulting in articles grown or manufactured in all parts of the world. The whole fabric of our modern civilization depends on the interchange of ideas and the gradual improvement on them by succeeding generations. It is thus that advancement is made. Means of communication are essential that this commerce of ideas and commodities be carried on, and the railways and highways with the navigation of the waters form these means of communication. The first trail between the haunts of two savage tribes was the beginning of civilization. We thus see that our modern civilization has a close dependence on the state of the highways. I once heard it said that three of the most important questions affecting mankind were religion, education and transportation, and as one could neither go to church nor to school without roads leading to these places when we undertook to improve the roads we were really engaged in the most pious work.

---

* Read at convention of Canadian Highway Association, held in Winnipeg.

† Chairman of the Board of Highway Commissioners of Saskatchewan.

A farm adjoining a good road will sell for a higher price and is worth more than one on a poor road. There is a great advantage in having a farm within reasonable distance of a railway station. So much so is this the case that the matter of the distance from the railway has a very material effect on the price of land. Anything grown on a farm has little value unless it can be transported to a market, and many homesteaders look to the improvement of means of communication to give a value to their homesteads which they have not now. Anything that will facilitate the ready access to market from the farms cannot help but add to the value of them, and good roads are as essential a part of the machinery for doing successful business in the country as suitable houses, stables and other improvements which farmers recognize as being absolutely necessary.

So much money is wasted in transportation over bad roads that it is cheaper to improve the roads than to leave them as they are, and money invested in roads will give a return of the greatest dividends.

In many sections at certain times of the year the condition of the roads prohibits people from getting about and people lose their interest in current events, become dissatisfied and are not in a position to carry on their business with the enthusiasm which is so necessary to make a success of it. Bad roads react in this way so as to affect all the departments of life and improving the roads indirectly raises the standard of living all along the line.

History and Development.—For many years such traffic as existed in Saskatchewan followed along the historic Hudson Bay trails, which had been used by the supply trains of the Hudson Bay Company voyageurs for more than two hundred years. These trails led across country in various directions following the highest and most suitable land, and skirting the rivers between the various forts of the company. When arrangements were made between the Hudson Bay Company and the Dominion of Canada, whereby the latter took over the lands of the West, one of the provisions of the agreement was that the company were to be allowed to carry on their trading operations at their various forts. Later the Dominion passed laws whereby any public travelled road or trail which existed prior to the subdivision of the land could thereafter be reserved for highway purposes and surveys made of the same. In a few cases surveys have been made and rights-of-way have been retained, thus fixing them for permanent roads.

On the advent of the Canadian Pacific Railway in the early eighties several trading centres and towns developed, such as Moose Jaw, Qu'Appelle, Regina, Moosomin, Swift Current, Maple Creek, etc., and for a number of years trails led out from these places in every direction, in many cases replacing the old Hudson Bay trails.

About 1890 there commenced an immigration which has gradually grown larger until in the last few years it has become a regular flood, and has had the effect of covering nearly the whole of the southern part of Saskatchewan with settlers. This has been attended with considerable railway development with the resulting coming into existence of new towns and market places. As the settlers commenced to break up the land many of these old trails have been ploughed up, as in most cases they run across country in the most direct and suitable lines, no attempt having been made to follow surveyed allowances provided for roads. In the rougher parts of the country, which are sparsely settled, many of them are still in existence and are being used, but the traffic is adjusting itself to new conditions brought about by settlement and railway development, and follows the most suitable road allowances.

When a railroad is constructed through a new section of country a new string of towns or shipping points is created. It is found that traffic immediately abandons all its old lines and around each shipping point a new system of roads develops and is immediately necessary. The lines along which traffic will develop are the most direct lines that are suitable leading to these new towns, and immediately a lot of improvements are necessary to facilitate traffic over these new lines. I have heard it boasted that the Canadian Northern Railway have averaged more than a mile of railway brought into operation per day for the last seven or eight years. As this means a new town or shipping point about each week, and as the other railroads are carrying on a similar development, and as each new town or shipping point necessitates the improvement of a system of roads leading to it fit for the traffic, one gets some idea of the problem the various authorities having in hand the improvement of the roads have to cope with.

Traffic on these new systems may be divided into two classes, that between the towns which is ordinarily light traffic, and that from the country to the town. The first usually follows approximately parallel to the railway, while the more important lines followed by the latter are the most direct lines from each town out into the country, and as nearly as possible at right angles to the railway. In some cases both kinds of traffic follow the same lines as from a town on one railway to a town on another railway, and in these cases a very heavy traffic may develop and an important road come into existence. In many of the more advanced and wealthy parts of the country a new phase of traffic is developing. Many of the farmers and townspeople now use automobiles, and the traffic from town to town by this means is increasing and rendering these roads more important. There is thus a traffic developed that is not so local in character as the ordinary traffic of the country and the lines which it seeks to take are more of the nature of through lines between the larger towns, cities, summer resorts and other such objective points.

Organization.—The authorities provided for undertaking road improvement work in the province of Saskatchewan are the provincial government and the local authorities, such as councils of cities, towns, villages, rural municipalities and local improvement districts. There is no well defined limit to the jurisdiction of these various authorities. In practice the local councils, which collect taxes for the purpose, direct their expenditure of these taxes within the limits of their municipalities. The provincial government build nearly all the bridges required and attempts to confine its expenditure to construction of main roads, and the construction or reconstruction of important works that are beyond the means of the local authorities. The maintenance of all the roads devolves on the local authorities.

There is no recognization of a statute labor system in the province, but in many municipalities the farmers are employed by the councillors to work on the roads for a few days in the year and the payments made for this work are returned in lieu of paying taxes. This is practically equivalent to a statute labor system. In the newer parts of the province, where the settlers are just commencing, if the local authorities are going to do anything on the roads, this is about the only feasible plan, as these settlers are not in a position to pay their taxes in cash. In many of the older districts the farmers cannot be got to work on the roads, being so busy on their farms, and many of the muicipalities have gangs organized to commence in the spring and work on the roads through the full season, thus making a business of constructing roads to the exclusion of other interests, and securing much better work and more value for the money expended. Some of the rural municipalities have issued debentures and have spent considerable sums from capital account in constructing roads.

The provincial government does road improvement work by two methods: first, by gangs directly under the supervision of the government officials, and by assisting the municipalities.

In determining the location of the roads where improvements paid for by the province are warranted, the provincial authorities recognize that roads should be classified as to their importance. The destination of most of the traffic over the roads is some point on a railway or a market town thereon. The traffic collects from the outlying districts where traffic exists or where it is purely local, and forces itself along certain well defined lines until, as it nears the town, there are certain lines along which it becomes very heavy. The nearer the town one gets the heavier it becomes. These certain lines then develop into main roads for traffic. The local authorities are called upon to maintain a road with a very heavy traffic, much of which is derived from a part of the country outside their jurisdiction. It is quite as beneficial, necessary and important to the people of these outlying districts that the part of the road nearest the town and furthest away from themselves be in as good shape as that nearest their own front doors. It is more expensive to construct and maintain a leading road carrying a heavy traffic such as this than one that simply carries the local traffic of the immediate district, as the road has to be wider and it wears out sooner. Is it, therefore, entirely fair to ask these local authorities to stand this extra expense for the benefit partially of outlying peoples who bear no share of it? I do not think it is, and as an evidence that many of these authorities insensibly object to it, we find that often the nearer one comes to a town the worse the road becomes, until the last mile into the town is the worst of all. As the improvement of roads such as this will benefit a large number of residents scattered over an area that is larger than the usual local district it would seem to be a field where provincial funds could be employed to advantage and with fairness to all concerned, and accordingly the provincial authorities have been pursuing a policy of confining as much as possible the expenditure of provincial funds to the improvement of main roads.

In a new country such as Saskatchewan, where development has taken place so rapidly, many improvements are urgently required which are so large and expensive as to be beyond the means of the local authorities, even when located on purely local roads. Nearly all bridges of any size, long grades across marshes and sloughs, side hill roads across ravines, etc., come in this class and the provincial authorities could not but recognize that if these much needed works were to receive attention it must be from provincial funds. As a result, practically all bridges of 20-ft. span and over, and many culverts and small bridges have been constructed by the provincial government and in most cases the maintenance has also devolved on the provincial authorities.

Systems for the administration of the provincial funds available for road improvement have been tried and a system gradually evolved which seems to meet the conditions as they exist throughout the country.

In 1906, the year after the province was formed, the method that was theretofore in force was followed. When it was decided to carry out an improvement in some certain locality one of the local residents who was known to have ability in that kind of work was appointed to organize the local labor and do it. The result of this system was that the improvement of roads was always considered a secondary matter and the work was attended to or not, depending on whether the appointee found time to undertake it after attending to his own business, and as a result, in many cases, the work was not done or the money was spent at a season of the year when the most value could not be obtained for the amount expended.

In 1907 the system of administering the vote was changed with the idea of overcoming the defects observable during 1906. Instead of local men being appointed, the best men that could be selected from the list of foremen employed in 1906 were appointed as road foremen to act during the full season and to go around from place to place where it was decided to make improvements, organize the local labor, and see that the work was properly done. A great improvement was noticed under this system as the season advanced. These foremen rapidly became expert at laying out the work and directing how it should be done, wasted less in misdirected efforts, and the quality and style of the work throughout the province became more uniform.

The same policy, with slight modifications to meet changing conditions in different years and in different parts of the country, was followed in 1908 and 1909, and regarding a large part of the expenditure on roads up to the present time. Conferences of these foremen have been held, many manuals and publications regarding road matters have been distributed to them and to the local authorities, and a force of skilful inspectors has been constantly kept visiting them during the progress of their work, the result being that we have now a large number of men scattered over the province in all parts who have an excellent idea of road building and of what is necessary in this regard to meet varying local conditions.

In 1910 this policy of education was extended more directly than heretofore to the local authorities by asking them to work out their own problems and sending what assistance was possible to them in doing so. This was effected by making grants, under regulations approved by the Lieutenant-Governor-in-Council to all municipalities who had completed their organization under the rural municipality act whereby the work had to conform to a certain standard, and they had to collect certain information, thus ensuring a certain amount of study of conditions in the municipality before they would be entitled to the grant. This system has produced a good effect and has given satisfaction where properly worked out.

A large number of bridges, deemed advisable to construct as steel bridges on concrete foundations or of reinforced concrete, have been treated as permanent structures and paid for out of capital, but all the road work and the majority of the bridge work has up to the present been met from the current revenue of the province. Many of these improvements are an undoubted permanent asset to the province, and should be considered as capital and treated accordingly, while a great deal of the work, such as grading, minor improvements in filling holes, maintenance of bridges, etc., the result of which will disappear in a few years, should properly be met from the current revenue.

It is considered that there is a necessity of a more rapid development regarding works which are of a more purely capital nature, and with this object in view provision was made by legislation in 1912 for meeting the cost of these improvements to the extent of $5,000,000, and it is the intention to proceed as fast as is considered advisable, consistent with economy, efficiency and the resources available in the way of labor and equipment, with the prosecution of the work. This is additional to the ordinary expenditures undertaken as in the past, but the latter will be made to cover works of a more purely maintenance character with the tendency constantly existent to spend the money in such a way as to produce permanent results.

A commission was provided for by legislation to administer the funds available for road improvement from various provincial sources, and this commission has had the matter in hand during 1912. The commission have followed the same methods in the distribution of the funds, i.e., in enlisting the interest and co-operation of the local authorities in various ways and in the recognition of principles as already outlined regarding works of a provincial nature, such as main roads, large and expensive works beyond the means of the local authorities, etc. They have, however, extended the idea somewhat, consistent with the larger amount of money available, and have endeavored to select roads in each municipality which, while being main roads, will also form a system of roads joining up properly with systems in surrounding municipalities and giving proper means of access from all parts of the country in the most direct manner possible to the market places and towns and between the towns.

The roads forming these systems thus become through-roads between the towns, as well as serving the local traffic, and by linking up the more important of these main roads a provincial system is developed which warrants the expenditure thereon of a larger proportion of provincial funds. The most important roads of this provincial system lead between the cities and other places where large numbers of the population wish to go, and the section of the national highway within Saskatchewan will be made up of those roads from the provincial system leading in the proper direction and properly located to join up with the parts of such a proposed road in Manitoba and Alberta, and a little concentration on such a through-road where gaps may occur will make it a through-road suitable for traffic. A further concentration of attention will gradually raise the standard from the usual earth road to a good hard gravel or macadamized road in a few years. This will be brought about by the macadamizing or gravelling of the parts of it through the more wealthy and populous districts and where suitable material is readily available at first, and the extending of this out to the parts in more outlying territory.

The local authorities have been asked to take these things into their consideration and have spent a great deal of time and thought in working out proper systems. The commission, under regulations adopted by order-in-council, assists municipalities in the improvement of any part of such a system, when approved, to the extent of 50 per cent. of the amount expended and have a large staff of inspectors constantly engaged in examining these roads as to their importance, advising and helping the local authorities and giving a general supervision to the work being carried on. Nearly all the inspectors have been recruited from the staff of foremen that have had experience under the system for the last four or five years and are well acquainted with the objects and aims of the commission. It is found that they not only have an effect on the work being carried out by the commission, either by their own gangs or through the organization of the municipalities, but indirectly on the work done by the local councils with whom they are constantly conferring. The amounts being spent on the works are constantly increasing from year to year.

Amount of Funds Available. In [illegible] there was spent in the province on road improvements from provincial funds $[illegible] and from local improvement district sources $[illegible], or a total of $1,156,000.00. In 1912 there was available for road improvement from provincial sources:

Chargeable to current account:	
For bridges	$ 140,000.00
For roads	225,000.00
Aid to municipalities	172,000.00
Ferries and inspection	62,000.00
Chargeable to capital account:	
Bridges and ferries	303,000.00
Road improvement	1,300,000.00
	$2,202,000.00
Raised and spent by rural municipalities from taxes and debentures approximately	1,500,000.00
	$3,702,000.00

In addition to this the cities are spending large sums in permanent pavements and the towns and villages in improving the streets within their limits. This looks like a large amount of money to be spent annually on the roads, but when it is remembered that south of Prince Albert, which is almost wholly settled, there are approximately 250,000 miles of road allowances, a large part of which must receive some attention, to enable the settlers access to markets from their farms it is easily seen where it is absorbed.

Class of Roads and Details of Construction.—Up to the present there are very few places in the province where anything more than improvements to make the best possible earth road are undertaken and it is only where gravel is easily available that short stretches of gravelled road have been constructed. In some of the older towns their main streets are gravelled and are kept in very good condition, but so far as the country roads are concerned almost without exception they are simply earth roads.

There are many places throughout the province where the country has developed to a high degree and where, in order to be consistent with conditions, some better form of road than an earth road is warranted.

Settlement in other places has taken place rapidly, with the result that the necessary attention to the roads has not been possible, and many obstructions exist and long stretches of almost, or, at times, impassable, roads prevent ready access to markets. The standard of road to be aimed at must necessarily, therefore, vary for different localities, but it is exceedingly advisable that as high a standard as possible should be set. In some localities gravel and broken stone roads should be constructed, while in others the removal or overcoming of obstructions and the construction of the best earth road possible is immediately advisable with the possibility of a better grade of construction in the near future kept constantly in view.

For many years the highest class of road that will be attainable generally over the country will be the best earth road that can be made. In this age, where every proposal is put to the acid test of the question "Will it pay?" it is proper that it be applied to the construction and improvement of roads. In the more populous cities we find large sums spent in paving the streets with pavements regardless of cost, and their expenditures are no doubt warranted by the results and the amount of the traffic. On the other hand, we find where there is very little traffic that no attempt at improvement beyond making the roads passable is attempted. The amount of money that we are warranted in spending to improve the roads must be in some measure proportionate to the traffic or to the resulting traffic after the improvement is made. It will be found that we do not always cheapen the cost of transportation by spending extravagant sums in improving roads with little traffic and the most expensive road may be one that has been improved beyond the needs of the traffic on it. There is no doubt but what loads can be hauled much cheaper over gravel or macadam roads than over ordinary earth roads, but if we consider the cost of constructing such roads and then apply the interest and a sinking fund that will pay back the cost of the improvement in five or ten years as a charge on the traffic, we will find that the cost of hauling may be by no means lessened. The cost of hauling farm products over our ordinary earth roads, as it is usually done in this country, is from twenty to thirty cents per ton mile. One way of reducing the cost of hauling is to increase the size of the load, use a wagon and a trailer and put four or six horses to draw seven or eight tons in a load. This is the method followed in the mountains, where a great deal of freighting is done hauling supplies to the mines over very indifferent roads. If loads can be hauled both ways, so that there is no unremunerative trip to make, very cheap hauling is done over roads that, in comparison with our ordinary graded prairie roads, would be considered impassable.

I had occasion to have some packing done some years ago in the Yukon district. I found packing on pack horses at that time cost about ⅓ cent per pound per mile, or about $6.00 per ton mile. This was with hay and oats at 8 cents per pound and other prices corresponding. By brushing out the trails and grading the side hills so as to make a road passable for a wagon at a cost of $2,000 to $3,000 per mile, this haulage cost was reduced to $1.00 per ton mile. The interest on the cost of improving in this way and a sinking fund that will pay back the cost in seven or eight years, which is considered about the life of a placer mining camp, comes to about $400 per mile per year. The reduction in the rate for freighting, according to the above figures, is $5.00 per ton mile. If 80 tons per year were hauled over this road the reduction in cost would therefore pay for the improvement, and when, owing to the reduction in the cost of supplies for mining, many otherwise unproductive properties became paying propositions, and by this means a traffic of more like 80 tons per day resulted, it is seen how well warranted the expense was.

The same principles may be applied to the matter of improving ordinary prairie roads. Suppose by gravelling a road at a cost of $2,000 per mile the saving in hauling over it would be five cents per ton mile. This would likely be in the shape of the larger load that could be taken over it or the greater speed with which the same load can be hauled. With interest at 5 per cent. and the principal paid back in 5 years this improvement would be warranted if 10,000 tons or 350,000 bushels of wheat came over it each year, without other traffic. If the road materials can be obtained and assembled at less than $2,000 per mile, a less amount of traffic will warrant the improvement. It will be seen from the above that an earth road in its best condition may be the cheapest road for the traffic, no matter how much money is available for road improvement. On the other hand, it is also seen, especially if considerations that cannot be put into figures in this way are taken into account, that many of our leading roads would well warrant the expenditure of large sums in improving them to a higher standard than simply the best earth roads.

Maintenance.—The maintenance of any road, no matter of what material it is constructed, is a definite case of "a stitch in time saves nine." The nearer the roads come to receiving constant attention the better and more economically will they be maintained. As the local authorities are in the better position to give the roads this constant attention, being, as it were, constantly on the ground, it naturally follows that the maintenance of the roads and bridges should devolve on them, and they should recognize this and provide for it. It will, in most cases, cost far more for any provincial employee to get to a place where some maintenance work is required than the actual cost of doing it when he gets there, and the provincial employees should, therefore, be asked to confine their attention to the work of construction and reconstruction alone.

As nearly all of the highways in the province must continue for years to be simply earth roads, and as even at their best they cut up easily at certain seasons of the year, the government have been experimenting to find out the best methods of maintaining earth roads in their best condition. The experiments performed with road drags indicated that an ordinary road can be kept in its best condition after being properly constructed by running one of these drags over it periodically about six to eight times each season, and a large number of them are now coming into use. It is found that the operation of the drag must be changed to suit different qualities of earth going to form the roads in different parts of the country, but use of them on any road will in a short time indicate the most successful way in which to operate them.

Future Developments.—The highway commission of the provincial government are endeavoring to have the local authorities give special attention to their main lines of traffic and develop systems of roads which will enable any person living in the province to have a good road direct into town from a point within a few miles of his place and to go directly from town to town. They give a tangible incentive to the local authorities to do this by assisting them or contracting with them to make improvements on roads that are considered part of such a system at the expense of the commission. They also make improvements on roads that will form such a system with their own road building organization.

By linking up the main roads in these systems in the proper directions a provincial system will be evolved on which every person wishing to go from one point of the province to another will have a ready means of doing it. The commission have this in view and the local authorities are in many cases showing their accord with it.

There is no reason why in some parts of the country the improving of the main roads in these systems to a higher standard cannot be undertaken and especially this provincial system gradually be constructed as gravel or macadam roads where the material is available.

It is the intention of the commission to take such steps as to give an incentive to do this whenever suitable, and to concentrate efforts as much as possible without sacrificing other considerations along this line so as to work out a proper provincial system of high-class roads in a few years. Where proper material is scarce and expensive this may not be possible. With the object of overcoming this, they are having experiments carried out to see if the ordinary gumbo clay, scattered so widely, cannot be treated in some way whereby it will have a greater resistance to traffic during wet weather and will not form into mud so readily. These experiments would indicate that there is some chance of success along these lines and they are having a sample piece of road built at present to try out a process of burning with straw which has been suggested.

Any information that is obtained from these efforts will be distributed, as fast as it is found reliable, to the authorities who are interested or may be able to use it.

The commission proposes to make a special effort regarding the maintenance of roads in their best condition, and feel that much can be done along this line.

The local authorities are becoming much interested in the work and are giving every evidence of taking hold of it with greater intelligence and knowledge each year, and as they form almost the only means by which any improvement along these lines can be carried out it is very encouraging.

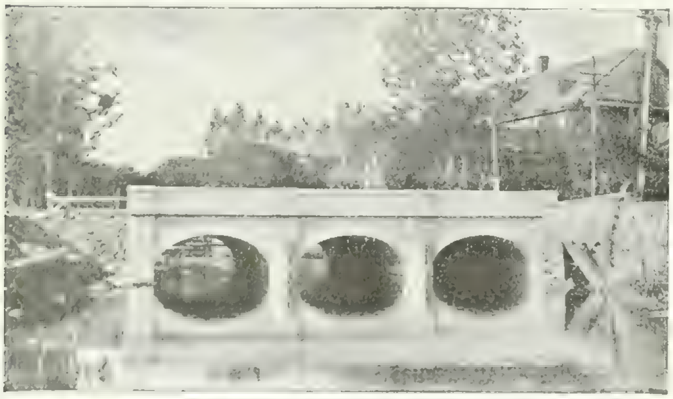
It is hoped by the co-operation of the various authorities in all this work and by keeping up the interest of the general public that the standard condition of the highways in Saskatchewan will be gradually raised, and that eventually the state of the highways will be such that it will be a pleasure at all times to travel over them; that they will entice people to go afield and become acquainted with their fellows, and that they will thus be one of the means of ensuring to Saskatchewan a broad-minded, prosperous and happy people.

◆

AN ATTRACTIVE CONCRETE BRIDGE AT METHUEN, MASS.

The recently completed "New Broadway Bridge," which spans the Spicket River on the road between Lawrence and Methuen, Mass., is an interesting example of what may be accomplished in bridge design with concrete when both utility and aesthetic appearance are of importance. The bridge is a gift to the town of Methuen from Edward F. Searles, its most prominent citizen.

In designing the bridge the Aberthaw Construction Company, of Boston, Mass., who also built it, followed the suggestions of the donor. It was desired to erect a structure that would serve the traffic needs of the town to the best advantage and at the same time add as much as possible to the appearance of that section. Mr. Searles did not desire anything elaborate or ornate, so the bridge was designed with almost severe plainness. It is to its very severity of architectural treatment that much of the attractiveness of the bridge is due.

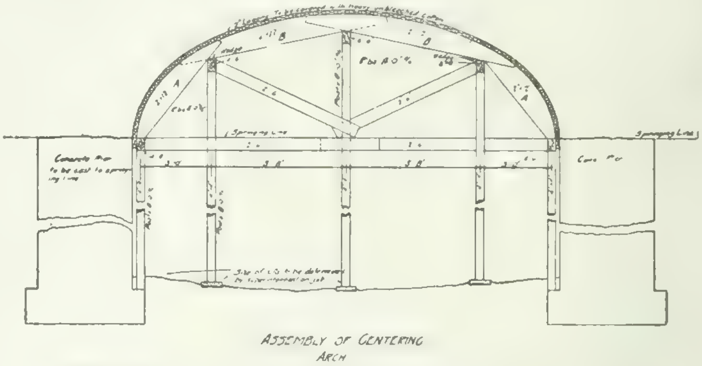


Broadway Bridge at Methuen, Mass.

The bridge is 80 feet long from the end of one abutment to the other, and 74 ft. 2 ins. overall width. It has three arches, each 18 ft. wide, placed on 22-ft. centres. The forms for these arches were detailed at the contractors' office, so that there was no confusion or delay on the job. The details of these forms are shown in the accompanying cut. The concrete footings are 5 feet wide and the piers themselves 4 feet thick. A 1:2:4 mix was used.

Across the central portion of the bridge run the double tracks of the Bay State Street Railway Co. On either side of the car tracks is a roadway, and flanking the roadways are two sidewalks 8 feet wide. The width of the roadway from one sidewalk curb to the other is just 50 ft. The road is of macadam, and between it and the concrete bridge floor is a three-ply waterproofing of felt and asphalt.

As will be seen from the photograph, the parapet on either side of the bridge is without ornamentation, being simply a wall with plain capping. The parapet was chosen in preference to an iron railing, as it added enough to the artistic appearance of the bridge to pay for the extra expense. At either end of the piers is a small buttress of uniform cross section which, despite its plainness, adds considerable to the appearance of the bridge. The surface of the spandrel and parapet walls are picked, while the edges of the arches, the floor, and the parapet capping were rubbed smooth.



Showing Assembly of Centring on Broadway Bridge, Methuen, Mass.

Provision has been made for four electric light posts, one at each buttress. When these are installed, they will add to the general attractiveness of the bridge.

In putting in the piers a small coffer dam of 3-inch matched sheeting was sunk into the gravel bed of the river, and the pier centring was hung from the horizontal sheeting braces.

A 16-inch water main that crossed the river at the bridge was provided for in the following manner: The pipe was carried on a 4-inch I-beam which rested on two trench braces at each pier. The braces placed side by side were expanded until the pipe was brought to the proper level. Then the concrete was poured around the braces and a permanent support at this level was assured.

◆

NEW ENGINEERING LABORATORIES.

The new engineering laboratories at University College, Dundee, are now in use, though they have not been formally opened. The block is two stories in height. On the ground floor there are an hydraulic laboratory, small lecture room, library photographic rooms, and engines and generating plant. On the second floor are accommodated the principal lecture room, the drawing offices. the staff rooms, the workshop, and the stress and cement testing laboratories. Water is supplied to the hydraulic laboratory from a tank at the top of a tower, about 60 ft. above floor level, through an 8-in. main, and is returned to the tank by a motor-driven centrifugal pump which lifts 475 gallons a minute.

The heat engine laboratory is divided into an engine room proper and a boiler and producer house, and the engine plant consists of a horizontal tandem compound engine, with drop and Corliss valves and surface condenser, capable of developing 150 b.h.p. at 100 r.p.m. There are also a Babcock and Wilcox boiler with an auxiliary electric-driven feed pump and economizer, the boiler being fitted with a separately fired superheater, and working up to 250 lb. per square inch; a 30 h.p. gas engine with suction gas producer; a motor-car engine with appliances for quantitative measurements of its power and heat efficiencies, and a 50-ton testing machine.

THE UTILIZATION OF PEAT FUEL.

By H. Poynter Bell.*

The report on the utilization of Peat fuel for the production of power, issued by the Dominion Department of Mines, was mentioned in the columns of *The Canadian Engineer* some weeks ago; it is, however, of such importance that it calls for further mention than could then be given to it. The report is so written as to be useful to power users in general, as well as to engineers, and contains an account of the actions and processes which take place in the producer, and of the construction and manner of operation of the gas engine. A full description is given of the plant and testing apparatus at the fuel testing station at Ottawa, and of changes in the gas-producer and gas-cleaning plants, made during the series of tests in order to obtain better results.

The nature and the results of the tests which were made are simply described for the use of non-technical readers, but, besides this, details of all observations are given in full for the information of engineers and those who have special knowledge of the subject. The very encouraging results which were obtained may be commended particularly to the notice of those whose ideas on the utilization of peat are founded on the failure of some previous attempts in the same direction. Many such attempts were made at a time when the nature and proper methods of using peat were very imperfectly understood in both America and Europe. They were made with unsuitable appliances and often without regard to the differences between Canadian and European peat. Since that time very great improvements have been made in Europe in the methods of treating and using peat, while knowledge about Canadian peat has been considerably advanced, chiefly through the work of the Department of Mines.

The present report shows clearly that with suitable conditions power can be obtained from peat by the use of gas-producers and gas-engines, at a cost which compares favorably with that of power from coal, and may even, in some cases, be at least as low as the cost of hydro-electric power. It is not pretended that this can be the case in all places and for all purposes, but if the power can be raised at or near the peat bog, and more especially if it is required for a fairly uniform load, peat producer gas is clearly a very economical fuel.

It is found that peat in a suitable condition for use in the gas-producer can now be delivered f.o.b. at the bog—that is, at the producer if it is on the spot—for not more than $2 per ton, which is equivalent to $4 or even less per ton for high-grade coal. On this basis electric power can be produced, as shown in the report, at a fuel cost of $8.40 per horse-power per year of 3,000 hours. The whole of the work required on the plant used at Ottawa (60 horse-power) could be done by one man.

The tests were evidently made under fair working conditions, and with the use of only such plant and appliances as are obtainable by everyone. A producer and engine were chosen of a type which had proved successful with European peat. As a result of the experience gained in the earlier tests, changes were made in the producer which, as completely described in the report, may be taken as a type suitable for use with Canadian peat.

The results given, satisfactory as they are, need not be considered to be the best that can possibly be obtained. Apart from improvements which may be made in the getting of the peat, there are various other gas-producers and engines designed for use with peat and it is possible that with some one or more of them even better efficiency may be obtained than that which is shown in the report.

The report gives, further, a description of some heaters intended for utilizing the exhaust heat of gas engines. Tests with these heaters had not been made when the report was written, but particulars are given of tests made elsewhere with heaters of this kind. It appears from these tests that not less than 40 to 50 lbs. (4 to 5 gallons) of water can be heated by the engine jacket and the heater to 190 deg. Fahr. per brake horse-power of the engine, and that the power of the heat so obtained are together equal to from 74 to 80 per cent. of the heat value of the gas supplied to the engine—a very remarkable economy.

In the estimate of cost here given no account has been taken of the savings to be made through the recovery of by-products, and particularly sulphate of ammonia—from the producer-gas. There exists already a demand for sulphate of ammonia in Canada, and its manufacture is very profitable if it is made in large enough quantities, that is to say, if large enough quantities of producer gas are made. The plant originally used for the recovery was rather large and expensive, but it has been found that the process can be greatly simplified and cheapened.

As stated above, the use of peat is economical when the conditions are suitable. One of the most important of these conditions is, of course, the nature of the peat which is to be worked. To start work on a peat bog which has not been properly investigated is mere gambling. The work of investigating Canadian peat bogs is making steady progress under the Department of Mines; a number of good results have been obtained and there can be no doubt that many of the numerous bogs in central and eastern Canada will be found to give peat well suited for making fuel.

---

[*] Consulting chemical engineer, 409 Kent Building, Toronto.

NEW WESTMINSTER IMPROVEMENTS.

Definite announcement has now been made that the Great Northern Railway, or rather the Vancouver, Victoria and Esquimalt Railway, will establish their Canadian freight terminals adjoining the eastern boundary of New Westminster within the municipality of Coquitlam. At the last meetings of the New Westminster and Coquitlam councils the railway company asked for the co-operation of these bodies and also that of Burnaby in building a high level bridge over the proposed freight yards. The acreage purchased by them is apparently large, extending into Burnaby municipality.

With this development all the railways operating on the lower mainland of British Columbia have located their yards and freight terminals on the Fraser River. These include the Canadian Pacific Railway at Coquitlam, the Canadian Northern Railway at Port Mann, the British Columbia Electric Railway at South Westminster, and now the Great Northern Railway on the Brunette River, practically in New Westminster.

The mayor and council have recently been taking stock of the large amount of work accomplished on the city streets during this year. The board of works has had $500,000 for grading and macadamizing streets, laying wooden sidewalks and other various improvements, while contracts for $761,000 for paving, cement sidewalks and other permanent improvements have been let. The delay in selling the city bonds, which were finally disposed of at 92½, has prevented all the contracts from being completed this year and held up other work.

The city is starting on the sewer system for Sapperton at the east end. Contracts for the first section of the work, totalling over $200,000, have just been let.

TESTS OF LONG-LEAF PINE BRIDGE TIMBERS.

In line with the past policy of the American Railway Engineering Association to collect and disseminate useful information pertaining to the objects of the association, there has been edited and published recently under the board of direction, a bulletin containing the results of tests of long-leaf pine bridge timbers made by H. B. MacFarland, engineer of tests, for the Atchison, Topeka & Santa Fe Railway System. An abstract of the bulletin is given herewith.

The purpose of these tests was to fully investigate the effect of the full-cell creosote treatment on long-leaf yellow pine bridge timbers. The United States government engineers have demonstrated quite conclusively that the boiling process weakens timber to a very marked degree. Their explanation of this is that the high temperatures used in the steaming tend to break down the cell wall structure and thus weaken the timber.

Inasmuch as there is no steaming process connected with the full-cell treatment used at the Santa Fe treating plants, it has been the opinion of the men in charge of this work that the timber was not materially weakened by the treatment. It was, therefore, decided to make a thorough test of the treated timber and thus determine the facts. It is very important that the strength of treated timber be known, for it is now being used very extensively in bridges, and if the strength is decreased by treatment, proper allowance should be made for this decrease.

Specimens.—The standard stringer for the Santa Fe System is 7 in. x 16 in. x 28 ft. long-leaf yellow pine. This size was, therefore, selected for the tests. Thirty-two such timbers were picked from the stock at the Somerville plant. The stock was at this time quite low and it was, therefore, impossible to get as varied a set of specimens as was desired. None of them contained a large per cent. of sapwood. No attempt was made to pick out the best pieces, though it may be noted that all were in first-class condition. They all had been seasoned for approximately ten months. Each of these sticks was sawed in half, numbered and weighed. One-half of each stick was then creosoted by the full-cell process. The details of the treatment are given below:

Somerville cylinder No. 5.
Run No. 1761, December 2, 1910.
Oil transferred, 11:50 a.m.
Pump started, 12:10 p.m.
Temperature of oil in tank, 200 degrees Fahrenheit.
Temperature in cylinder, 170 degrees Fahrenheit.
Maximum pressure, 150 lbs. per sq. in.
Time of maximum pressure, 1:40 p.m.
Oil dropped to ground tank, 2:25 p.m.
Vacuum started, 2:45 p.m.
Maximum vacuum, inches, 26.
Vacuum broken, 4:15 p.m.
Run closed, 4:30 p.m.
Time consumed in run, 4 hours and 40 minutes.
Process, Full-Cell Creosote.

Specimens Tested in 1911.

GENERAL DATA								TRANSVERSE TEST					COMPRESSION PARALLEL TO GRAIN				COMPRESSION PERPENDICULAR TO GRAIN			
																		Load in Lbs. per sq. in. for Deflection of		
Specimen Number	Weight in Lbs. per Cu. Ft. Before Treating	Weight in Lbs. per Cu. Ft. After Treating	Moisture Per Cent.	Rings, per inch	Size at Center Inches	General Character	Remarks	Elastic Limit Lbs. per sq. in.	Modulus of Rupture Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Deflection at Failure Inches	Maximum Horizontal Shear Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Modulus of Elasticity Lls. per sq. in.	Maximum Load Lbs. per sq. in.	Deflection for 2000 Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	1-10 inch	3-16 inch	3-8 inch
11	41.5	......	17.1	17	16.20x7.05	Knotty......	....	3800	4980	1,429,000	0.82	387	3400	343,960	3996	0.07	900	700	900	1300
12	39.1	50.6	......	17	16.40x7.19	Knotty......	Treated	4200	5560	1,395,000	1.78	439	4700	707,410	5829	0.04	1100	700	1100	1400
17	43.8	......	20.4	13	16.20x7.20	Clear........	....	2800	3880	1,882,000	1.38	410	5600	840,000	6397	0.03	1400	950	1600	2150
18	40.5	61.8	......	10	16.00x7.00	Clear	Treated	5000	5050	1,749,000	0.93	388	4800	346,500	5279	0.08	1100	850	1300	1800
21	38.9	......	16.6	12	16.12x7.05	Small Knots	....	5000	6800	1,517,000	1.75	528	4200	385,000	4668	0.07	1500	1000	1700	2050
22	42.2	55.2	......	12	16.00x7.10	....	Treated	5400	5410	1,428,000	1.24	416	4300	556,850	5228	0.05	900	900	1200	1450
25	42.4	......	15.1	19	16.00x7.11	Small Knots	....	5800	6280	1,876,000	1.14	483	5700	758,720	6353	0.04	1200	700	1300	1850
26	46.5	57.5	......	19	16.10x7.15	....	Treated	4600	4880	1,600,000	1.00	378	5800	580,000	6860	0.05	1800	800	1400	2300
27	38.9	......	16 7	8	16.25x7.22	Sapwood....	....	3900	4500	1,505,000	0.98	352	5500	665,500	6754	0.05	900	550	900	1300
28	44.5	57.8	......	8	16.20x7.08	Small Knots	Treated	3100	3280	1,417,000	0.70	374	5300	706,660	6064	0.04	1000	900	1250	1600
29	38.4	......	13.5	8	16.06x6.98	Small Knots	....	5000	6160	1,612,000	1.40	468	5000	666,000	6126	0.04	1400	600	1050	1500
30	41.3	60.5	......	8	16.10x7.14	Small Knots	Treated	4800	6320	1,715,000	1.30	498	4800	720,000	5784	0.04	1000	750	1100	1500
35	39.5	......	20.6	6	16.25x7.18	....	....	3800	5100	1,344,000	1.34	399	4600	693,000	5473	0.03	900	700	950	1400
36	42.9	55.0	......	6	16.25x7.11	Small Knots	Treated	5400	6040	1,639,000	1.19	467	4300	275,000	4595	0.09	900	600	900	1200
51	40.3	......	8.5	9	16.25x7.42	Small Knots	....	3600	4000	1,435,000	0.91	348	3100	464,000	3951	0.05	800	850	1100	1250
52	38.3	49.9	......	9	16.60x7.35	Small Knots	Treated	3400	4160	1,718,000	1 16	332	4000	574,000	5177	0.04	800	650	900	1300
53	36.8	......	13.7	20	15.90x7.10	Small Knots	....	3800	4880	1,904,000	0.92	373	6200	786,000	7040	0.04	700	500	850	1100
54	37.8	48.5	......	20	16.00x7.10	Wane	Treated	4200	4900	1,600,000	1 04	410	4400	664,000	5172	0.04	800	400	700	1150
55	47.7	......	18.6	11	16.36x7 22	Knotty......	....	4400	5500	1,688,000	1.13	432	5800	772,000	6301	0.04	1100	650	1000	1550
56	50.7	59.8	......	11	16.60x7.25	Shake.......	Treated	4000	4460	1,670,000	0.87	387	5700	690,000	6698	0.04	900	500	900	1150
57	47.2	......	55.3	13	16.00x7.05	Clear........	....	4300	4670	1,636,000	0.94	395	6000	798,000	7248	0.04	1000	650	1100	1700
58	39 3	57.3	......	14	16.10x7.00	Small Knots	Treated	3800	4990	1,880,00	0.92	386	5200	450,000	5999	0.06	1100	900	1400	1750
59	38.3	......	5.1	13	16.25x7.03	Small Knots	....	4600	5540	1,362,000	1.41	4 3	4800	618,000	6176	0.05	1000	800	1100	1400
60	38.3	49.2	......	14	16.30x7.25	Cross Grain	Treated	3400	5210	1,359,000	1.44	409	4600	693,000	5876	0.04	800	700	1150	1550
61	42.7	......	16.7	9	16.25x6.91	Heart Shake	....	4600	4790	1,542,000	1.00	40	4000	283,000	4343	0.09	1000	800	1000	1300
62	45 8	58.6	......	9	16.18x7.06	Clear........	Treated	3800	4390	1,629,000	0.92	42	4000	405,000	4906	0.06	1300	600	1200	1850
Average Untreated								4260	5160	1,595,000	1.15	415	4920	621,000	5750	0.049	1031	727	1120	1530
Average Treated								4240	4980	1,600,000	1.12	408	4770	568,000	5650	0.052	1040	711	1107	1540

NOTE: Odd number is the untreated half of a stringer and the following even number is the treated half.

Each specimen was weighed after treatment, in order to calculate the amount of creosote absorbed per cubic foot.

The 64 pieces were loaded and shipped to the testing laboratory at Topeka immediately after treatment. It was desirable to study the effect of the creosoting on the timbers both immediately after treatment and one year after treatment. Therefore, the 34 untreated specimens and 16 of the treated specimens were tested immediately upon receipt at Topeka and the remaining 16 treated specimens were tested after one year, having been seasoned during the year by laying in an open pile in the yard at Topeka.

Two special specimens were prepared with the others, in order to compare the relative strength of the butt and top portions of the tree. Specimen 13 was the top end and 14 the butt end of one large stick. Both of these were left untreated. Specimen 40 was the top end and 39 the butt end of another large stick. Both of these were treated. All four were tested. It was impossible to determine which was the butt end of the regular specimens, but the two special sticks showed this by position of the sapwood and growth rings.

Methods.—In making the transverse test the stringer was supported on rocking knife edges placed 13 ft. apart on the bed of an Olsen 200,000 lb. testing machine. Six-inch flat plates were placed between the knife edges and the timber to prevent cutting. The load was applied at third points through knife edges and six-inch plates and rollers. An initial load of 500 lbs. was used in order to get a firm bearing on the plates. The deflections were measured by a mirror and adjustable scale and a fine wire, which was fastened at the centre of the beam directly above each knife edge. The load was applied with the machine running at a speed of 0.16 inch per minute.

The specimens tested in compression parallel to the grain were 5 in. x 5 in. x 12 in. A ball and socket plate was placed between the machine bed and the specimen in order that the load might be uniformly applied. Deflections were read by means of a deflectometer. The load was applied at a rate of 0.16 inch per minute.

In making test in compression perpendicular to the grain the specimens were 6 in. x 6 in. x 24 in., and the load was applied through a four-inch plate with slightly rounded corners. The machine speed used was 0.16-inch per minute. A deflectometer was used to measure deflections.

The moisture determinations were, in all cases, made immediately after transverse tests. The samples were obtained by boring nine one-inch holes, one-half inch deep, spaced uniformly, in the end of the specimen. The chips were carefully weighed on a balance and then placed in an oven and kept at a temperature of 200 degrees Fahrenheit for eight hours. The per cent. of moisture was calculated from the loss in weight The percentage is that of dry weight of specimen.

The data regarding number of growth rings per inch were obtained from the large specimens. The rings were counted, starting one inch from the heart and counting for a radius of three inches. The per cent. of sapwood was estimated from measurements of the end area.

The following formulæ were used in the calculations:

Transverse Test.—Load applied at third points.

Load in lbs. per sq. in.:

$$S = \frac{PL}{bd^2} \text{ where,}$$

P = Load in lbs.
L = Length of span in inches
b = Breadth of specimen in inches
d = Depth of specimen in inches
S = Stress in lbs. per sq. in.

Modulus of Rupture:

$$R = \frac{PL}{bd^2} \text{ where,}$$

P = Maximum load in lbs.
R = Modulus of rupture in lbs. per sq. in.
Other symbols as above.

Modulus of Elasticity:

$$E = \frac{PL^3}{4.7bd^3D} \text{ where,}$$

E = Modulus of elasticity in lbs. per sq. in.
P = Load at elastic limit in lbs.
D = Deflection in inches at elastic limit.
Other symbols as above.

Horizontal Shear at Neutral Axis:

$$V = \frac{3P}{4bd} \text{ where,}$$

V = Horizontal shear at neutral axis, lbs. per sq. in.
P = Maximum load in pounds.
Other symbols as above.

Specimens Tested in 1912.

GENERAL DATA									TRANSVERSE TEST					COMPRESSION PARALLEL TO GRAIN				COMPRESSION PERPENDICULAR TO GRAIN			
																			Load in Lbs. per Square Inch for Deflection of		
Specimen Number	Weight in Lbs. per Cu. Ft. Before Treating	Weight in Lbs. per Cu. Ft. After Treating	Weight in Lbs. per Cu. Ft. One Year After Treating	Moisture Per Cent.	Rings, per inch	Size at Center Inches	General Character	Remarks	Elastic Limit Lbs. per sq. in.	Modulus of Rupture Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Deflection at Failure Inches	Maximum Horizontal Shear Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Maximum Load Lbs. per sq. in.	Deflection for 2000 Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	1-10 inch	3-16 inch	3-8 inch
1	42.2	......	......	18.2	8	16.00x6.68	Knots.......	....	5000	5290	1,850,000	0.93	407	4200	360,000	6510	0.060	1100	925	1150	1625
2	43.8	54.4	50.4	......	8	16.19x7.06	Checks......	Treated	4775	6016	1,840,000	0.70	467	6000	630,000	7143	0.045	800	1000	1150	1400
5	45.5	......	......	18.5	8	16.30x6.97	Shakes......	....	4200	4880	1,480,000	1.24	383	5100	386,000	5904	0.072	1100	875	1400	1950
6	38.8	50.6	46.3	......	8	16.40x7.24	Checks.	Treated	4400	4517	1,380,000	1.12	356	5720	575,000	6460	0.042	700	1000	1100	1350
7	38.5	......	......	18.1	8	16.25x7.31	Knots.......	....	4000	4760	1,416,000	1.40	372	4000	585,750	5070	0.040	1000	700	1050	1400
8	44.5	56.2	54.8	......	8	16.13x7.38	Shakes......	Treated	4600	6658	1,640,000	1.68	505	5400	648,000	5997	0.041	625	800	1050	1450
9	42.9	......	......	17.8	19	15.95x7.14	Knots.......	....	5400	5480	1,591,000	1.22	448	5800	842,460	6571	0.035	1000	700	1050	1500
10	46.1	60.2	54.3	......	19	16.00x7.10	Shakes......	Treated	6000	6006	1,807,000	1.07	462	5800	703,000	6951	0.037	550	700	800	1000
15	46 2	......	......	18.4	7	16.20x7.20	Knots.......	....	1800	4870	1,918,000	1.60	367	7300	674,000	7410	0.037	900	900	1200	1600
16	42.3	56.2	51.8	......	7	16.30x7.55	Large Knots	Treated	3900	4406	1,690,000	1.03	346	5500	474,000	6263	0.052	700	900	1100	1350
19	45.8	......	......	8.5	21	16.25x7.11	Knots.......	....	2000	3820	1,820,000	1.28	384	5200	451,300	5659	0.063	1100	625	1050	1650
20	49.6	58.5	52.1	......	21	16.25x7.25	Shakes......	Treated	4325	4477	1,875,000	0.72	350	6200	835,000	7721	0.038	1400	1000	1675	2275
23	45.8	......	......	19.0	10	16.50x7.07	Small Knots	....	3800	4050	1,254,000	0.97	322	4600	551,310	5569	0.042	1000	675	1150	1550
24	37.2	52.2	52.2	......	10	16.75x7.18	Shakes......	Treated	3500	4850	1,206,000	1.39	392	5080	584,400	6410	0.044	1000	1000	1400	1825
31	47.1	......	......	16.4	14	16.00x7.17	Small Knots	....	4000	5440	1,726,000	1.15	419	5600	423,000	6253	0.059	.	....	......	......
32	51.3	58.3	56.8	......	14	16.87x6.94	Cross Grain .	Treated	5100	5294	1,632,000	0.94	430	7000	736,000	7768	0.031		....	......	......
33	41.8	......	......	19.3	15	16.00x7.23	Knots.......	....	4200	5390	1,600,000	1.21	415	5300	426,000	5918	0.062	900	700	1000	1300
34	45.5	64.2	61.4	......	15	16.00x7.15	Checks......	Treated	4425	6049	1,910,000	0.74	465	6300	711,000	6945	0.040	1250	1300	1600	2450
37	38.3	......	......	18.0	12	16.12x7.24	Knots.......	....	2900	3410	1,034,000	1.40	265	3700	633,000	4720	0.041	900	450	900	1300
38	36.2	51.8	51.0	......	12	16.25x7.32	Large Knots	Treated	4100	4035	1,090,000	1.20	315	5200	719,000	6012	0.037	1200	1400	1525	1750
41	41.8	......	......	35.6	6	16.60x7.37	Clear........	....	4500	4840	1,652,000	0.92	386	5500	734,000	6580	0.034	1200	500	900	1600
42	38.7	55.1	48.8	......	6	16.25x7.38	Clear........	Treated	4700	4800	1,576,000	0.99	375	3500	526,000	5604	0.048	1000	1000	1400	1750
43	43.0	......	......	18.3	17	16 20x7.35	Shakes......	....	2600	3640	1,433,000	0.88	263	5000	432,000	6063	0.060	900	600	850	1275
44	49.2	56.3	54.6	......	17	16.10x7.15	Cross Grain	Treated	4700	6737	1,542,000	0.96	520	5800	776,000	6656	0.038	700	800	1050	1475
45	39.0	......	.....	17.2	11	16.00x6.75	Pitch Pocket	....	4800	6060	1,808,000	1.16	466	4700	380,000	5492	0.041	900	700	1000	1400
46	38.4	54.2	46.4	......	11	16.25x7.24	Clear........	Treated	2800	4014	1,416,000	0.62	314	5300	653,000	5759	0.041	1350	1300	1650	2250
47	37.5	......	......	6.2	10	16.20x7.19	Warped......	....	3500	3900	1,454,000	0.93	341	5400	720,000	6450	0.039	1100	600	1050	1600
48	41.6	55.4	46.8	......	10	16 37x7.13	Cross Grain	Treated	3250	5312	1,470,000	2.90	412	6400	646,000	6905	0.040	800	950	1150	1400
49	38.4	......	......	18.0	7	16.00x7.15	Small Knots	....	4200	5200	1,511,000	1.28	400	5600	558,000	6310	0.045	700	700	1050	1300
50	42.3	58.1	55.8	......	7	16.06x7.09	Checks......	Treated	5900	7114	1,586,000	1.20	550	5800	539,000	6150	0.050	1400	800	2350	2750
63	39 2	.....	....	16.9	15	16 00x7.25	Large Knots	....	4700	4985	1,322,000	1.24	375	4200	316,500	4856	0 085	1000	600	1000	1200
64	36.4	52.4	51.1	......	15	16.25x7.36	Large Knots	Treated	2420	3737	1,055,000	1.40	365	3850	367,000	4292	0.064	850	900	1200	1400
Average Untreated									3850	4750	1,554,300	1.18	377	5075	529,400	5958	0.051	986	684	1052	1483
Average Treated									4305	5263	1,544,700	1 17	414	5553	633,000	6440	0.041	945	1056	1340	1691

NOTE: Odd number is the untreated half of a stringer and the following even number is the treated half.

Compression Parallel to Grain:

Load in lbs. per sq. in.:

$$S = \frac{P}{A} \text{ where,}$$

P = Applied load in lbs.
A = Area of section of test piece in sq. in.
S = Load in lbs. per sq. in.

Modulus of Elasticity:

$$E = \frac{PL}{AD} \text{ where,}$$

P = Load at elastic limit in lbs.
D = Deflection in inches at elastic limit.
E = Modulus of elasticity, lbs. per sq. in.
Other symbols as above.

Compression Perpendicular to Grain:

Load in lbs. per sq. in.:

$$S = \frac{P}{A} \text{ where,}$$

A = Area of compression plate in sq. in.
Other symbols as above.

The elastic limits were taken from the curves.

Data.—The results are shown in the tables. The summary sheets group the results of untreated specimens tested in January, 1911, with the treated specimens of the same timber tested in January, 1912. Specimens 13, 14, 39 and 40 were special tests made in January, 1911, and results obtained are not shown in the general summaries of specimens tested in January, 1911.

UTILIZATION OF SEWAGE SLUDGE.

It is only at rare intervals that an inventor has the good fortune of seeing a successful practical application of his idea within a few months of his experimental work. Among the few who may claim this honor is the name of Dr. J. Grossman, an eminent Manchester chemist.

His patented and simplified process for the utilization of sewage sludge (as described in some detail in The Canadian Engineeer of January 25th, 1912, page 210), has been installed in the Corporation of Oldham, near Manchester, and, as far as may be ascertained, is operating as a complete success, the sewage of the municipality being effectively disposed of and the by-products being not only marketable, but in brisk demand.

When this system is in operation the sludge is conveyed from settling tanks to the top of a three-story building by means of chain buckets, and is directed to six large cylinders on the top floor by the agency of several large sheet metal pipes. Each cylinder is encased with brick and heated, while revolving paddles within the cylinder move the sludge slowly along in order that the treatment may be effective. As the sludge moves along it is thoroughly dried, and may, if desired, be removed from the tanks at this stage as a dry, dark powder, highly inflammable, and entirely suitable for use as a crude fuel. The Corporation of Oldham do not consume their sterilized waste in this matter, but treat it further, and for this purpose each dryer has placed below on the ground floor a retort connected with the dryer by metal conduits. The dry matter falls to the retorts and is automatically mixed with a little acid and a quantity of superheated steam, which, in conjunction with the acid, re[illegible] the [illegible] [illegible] into the cooling towers, where it is condensed, and the grease, which floats on the water, is easily removed.

The process is automatic from the time the sludge is settled in the tank till the finished fertilizer leaves the retort, all the necessary labor consisting of a few men to attend the boilers and the fires under the drying machines and retorts. No fumes can escape into the atmosphere, and no features that might be considered a nuisance are found. The building in which the plant is housed has a length of 120 feet, a width of 45 feet and a height of 30 feet, and the cost of the plant for a population of 120,000 was only $60,000.

The matter removed from the retorts may be easily stiffened up into a high-grade fertilizer by the addition of potash and ammonia, and contains many advantages over raw sludge as a fertilizer, inasmuch as it is sterile and does not clog up the pores of the ground. Prize roses and other exhibition flowers have been grown in it with success in England, and other European countries are investigating sample shipments with a view of steady purchases. The grease recovered from the plant at Oldham has an estimated value of $6,000 per year.

THE BEARING POWER OF MOIST BLUE CLAY.

In a paper read before the Western Society of Engineers Mr. Edwin Hancock gives the results of tests in the Loop District of Chicago on the bearing power of moist blue clay.

The following tests were made in March, 1911, in the manner described:

Two openings about 8 ft. square were made in the concrete floor of the basement of the Federal Building, and the soil was excavated for a depth of 6 ft., so that there was a bearing on the original clay which had never been disturbed. On this clay a grillage was built up of planks 2 in. by 12 in., 2 ft. long. These planks were laid closely together so as to give a bearing of 4 sq. ft. This grillage was built up about 1 ft. high, and upon this was placed longer planks, upon which the load of pig iron was placed.

The settlement was taken by means of a wye level and rod. Readings were taken as soon as each load was put on, and then again after giving an hour for settlement. If no further settlement had occurred, a larger load was placed upon the plank. If the settlement had increased, readings were taken until they showed that the settlement had ceased.

The elevation above city datum of the street opposite this test was 14 ft., and the elevation of the clay upon which this test was made was 0.00. The lateral distance between the tests was 150 ft.

Following is a list of the loads and settlement:

Test No. 1.

Load per sq. ft. in lb.	Settlement.
1000	3/16 in.
2000	1/2 in.
3000	1 3/16 in.
4000	1 3/4 in
One-half hour later, 4:30 p.m., same load	1 7/8 in.
Next day; same load	1 7/8 in.

Test. No. 2.

500	No settlement.
1000	3/32 in
2000	7/64 in.
3000	3/16 in.
4000	3/8 in.
One hour later	7/16 in.
Two hours later	29/64 in.
Four weeks later, 4:00 p.m.	5/8 in.
Next day, 9:00 a.m.	15/16 in.
4:30 p.m.	15/16 in.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820 Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:
Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS
When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, NOVEMBER 21, 1912. No. 21

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Winnipeg Water 769
Toronto Harbor Improvements 769
The St. John River Improvements 770
The Road Board of Great Britain 770

Leading Articles:

Laying a Deep Sewer in Bad Ground 757
Roads of Saskatchewan 759
An Attractive Concrete Bridge at Methuen, Mass. .. 764
The Utilization of Peat Fuel 765
Tests of Long-Leaf Pine Bridge Timbers 766
Toronto Harbor Improvements 771
China Clay Production in Devon and Cornwall, Eng. 777
Design of Turn-Tables for Heavy Locomotives 778
Electrical Supply of Montreal 781
Improvement in Fire Hydrants 781
Coast to Coast 783
Personals 785
Coming Meetings 786
Engineering Societies 786
Market Conditions 24-26
Construction News 65
Railway Orders 72

WINNIPEG WATER.

It will be remembered that a short time ago Professor Slichter presented a report to the Public Utilities Commission on the water supply for the city of Winnipeg. An abstract of this report was presented in *The Canadian Engineer.* Professor Slichter, in a recent communication to the Public Utilities Commission, states that he will not be responsible for the increase of the city's water supply unless his recommendations as presented in his report are carried out. He adds that the City Engineer of Winnipeg is plainly aiming to extend the water system to Crystal Springs without regard to his recommendations.

Col. H. N. Ruttan has acted as City Engineer of Winnipeg for a number of years, and his administration throughout has been most able and efficient. It is, therefore, with a certain reluctance that we view Prof. Slichter's strictures on the City Engineer's course in the extension of the well system for the immediate supply of the city. Col. Ruttan points out many inconsistencies in the original report, and quotes from his own experience to show that the report is not based on facts. The question is too long and too involved to be taken up at any length here. It appears to us, however, that Prof. Slichter should proceed more cautiously and conservatively in his comments and criticisms of City Engineer Ruttan, whose past experience with the water situation at Winnipeg makes him eminently well qualified to deal with the question. The conviction is forced upon us from an analysis of the report and the comments of the City Engineer upon it, together with the added protests embodied in Prof. Slichter's letter, that the original report as presented by Prof. Slichter was hazy and contradictory, and his subsequent recommendations have not improved it.

◆

TORONTO HARBOR IMPROVEMENTS.

The plans for the improvement and development of Toronto harbor have been prepared and presented to the Government and the City Board of Control. A description of the work to be done under these plans will be found in this issue.

The Commission, with its engineer and secretary, are to be congratulated on the very thorough and comprehensive manner in which the whole problem has been analyzed and presented in their report.

As everyone who is at all acquainted with the conditions in the present harbor knows, there has been a great neglect in the past to realize the potentialities of its location and natural advantages. Nature has been kind in providing a magnificent natural harbor, almost perfectly protected from storms, and of easy access. The city officials in the past have been far-sighted enough to preserve the water front under public control. These facts, coupled with the conditions which exist at Ashbridge's Bay, where the shallow water and marsh provides an area easily reclaimable for industrial development, gave the Commission a magnificent opportunity, and this they have conserved to the full.

The Dominion Government grant, which has already been guaranteed, is $6,000,000. The city's expense, it is estimated, will total nearly $2,000,000; and the Harbor Commission will provide the balance, or $11,000,000, by issuing debentures. It is fully expected, and there is little question but what it will be realized, that the revenue from the rental for factory sites, dockage dues, etc., will be more than sufficient to carry the necessary interest charges and the expenses of administration.

The improvements fall naturally under two main divisions, industrial and aesthetic. The industrial development includes a uniform depth of twenty-four feet of water in the harbor, east and west end docks, piers, a most complete system of railway sidings at Ashbridge's Bay, and a ship canal and turning basin in the factory area. Facilities will be given for complete co-operation of railways and vessels in the handling and transhipment of freight.

The aesthetic features include boulevard drives, bridle-paths, eleven miles of sheltered waterways, parks, walks, terraces, and a magnificent lagoon treatment at the Island. From the extreme east side of the city to the extreme west, at the Humber, the waterfront will be protected, improved and developed to give the maximum of aesthetic and recreative features. The chairman of the Harbor Commission, Mr. Lionel H. Clark, has associated with him on the Board Mr. R. Home-Smith and Mr. T. L. Church, representing the city; Mr. R. S. Gourlay, representing the Board of Trade, and Mr. F. S. Spence, representing the Government. Mr. E. L. Cousins is the Engineer and Mr. A. C. Lewis, Secretary of the Board.

THE ST. JOHN RIVER IMPROVEMENT.

The International St. John River Commission, a body of men appointed by the governments of the United States and the Dominion of Canada to investigate and report upon the conditions and uses of the St. John River, has received from its Board of Consulting Engineers a report on the possibilities of water storage and channel improvement on the river. As is well known, the St. John River forms an important part of the south-eastern boundary of Canada. For some years past there has been considerable trouble along the river due to the fact that the river is used to a great extent for the lumbering industry.

We hope to publish an abstract of the report in an early issue of *The Canadian Engineer*. The report covers the area comprising the watershed of the St. John River, and suggests a system of water storage and channel improvements which, if the report is acted upon, will doubtless do much to improve present conditions. If the plans outlined by the Board of Engineers meet with the approval of the Commissioners, an outlay of some millions of dollars will be required, which would be jointly met by the Canadian and the United States governments.

It is expected that the International Commission will make their final report to their respective governments in a short time, and this report of the Board of Engineers will form an important part of the final report.

THE ROAD BOARD OF GREAT BRITAIN.

We note in a recent issue of an engineering contemporary in the Old Country some rather severe criticisms of the Road Board and its consulting engineer. The facts as outlined appear to justify criticism.

In answer to certain questions raised in the House of Commons on October 17th, the Chancellor of the Exchequer replied that the salary paid to the consulting engineer to the Road Board is $3,300 a year, out of which he provides his own office and staff. It was also stated that he carries on his business as a consulting engineer on his own account; that he has no interest in the two road companies which were named, but that he frequently acts as consulting engineer for them; that he had invited a party of road engineers to inspect the work of road construction being executed by a certain company, which invitations were printed on paper with the heading, "The Road Board." The Chancellor explained that as consulting engineer to the Board, Colonel Crompton's advice was taken on technical questions, but that he had no executive or general duties.

As our contemporary holds, it is manifestly impossible to expect that an impartial judgment can be given by the Road Board regarding the experimental roads which have been laid by different manufacturers and contractors for the Board, now that it is known that the consulting engineer for the Board also acts for one or more of their competitors, that he is also a patentee for a road-surfacing method, and has, moreover, laid down a length of road to his own specification for the Board.

With the facts as stated, the journal in question is to be congratulated on giving publicity to the fact. It is quite probable that no intentional harm was intended is allowing such a state of affairs. At the same time, such irregularity of administration should be corrected at once.

EDITORIAL COMMENT.

A writer in The Saturday Evening Post describes the trials and troubles of a technical man whose stenographers, and he had several at one time and at different times, insisted on transcribing their notes incorrectly. He would say: "The tube wall is stressed circumferentially," and the letter would read: "The tube wall is dressed reverentially." Or, "A wattmeter in use" would come out as, "What's the matter with us." "Synchronizing force" appeared as "A singing icicle farce"; and "Helical reducing gears" showed up one day disguised as, "Hellish reducing tears." The editor of the paper has had his troubles with the rest of them, but he doffs his hat to the above.

* * * *

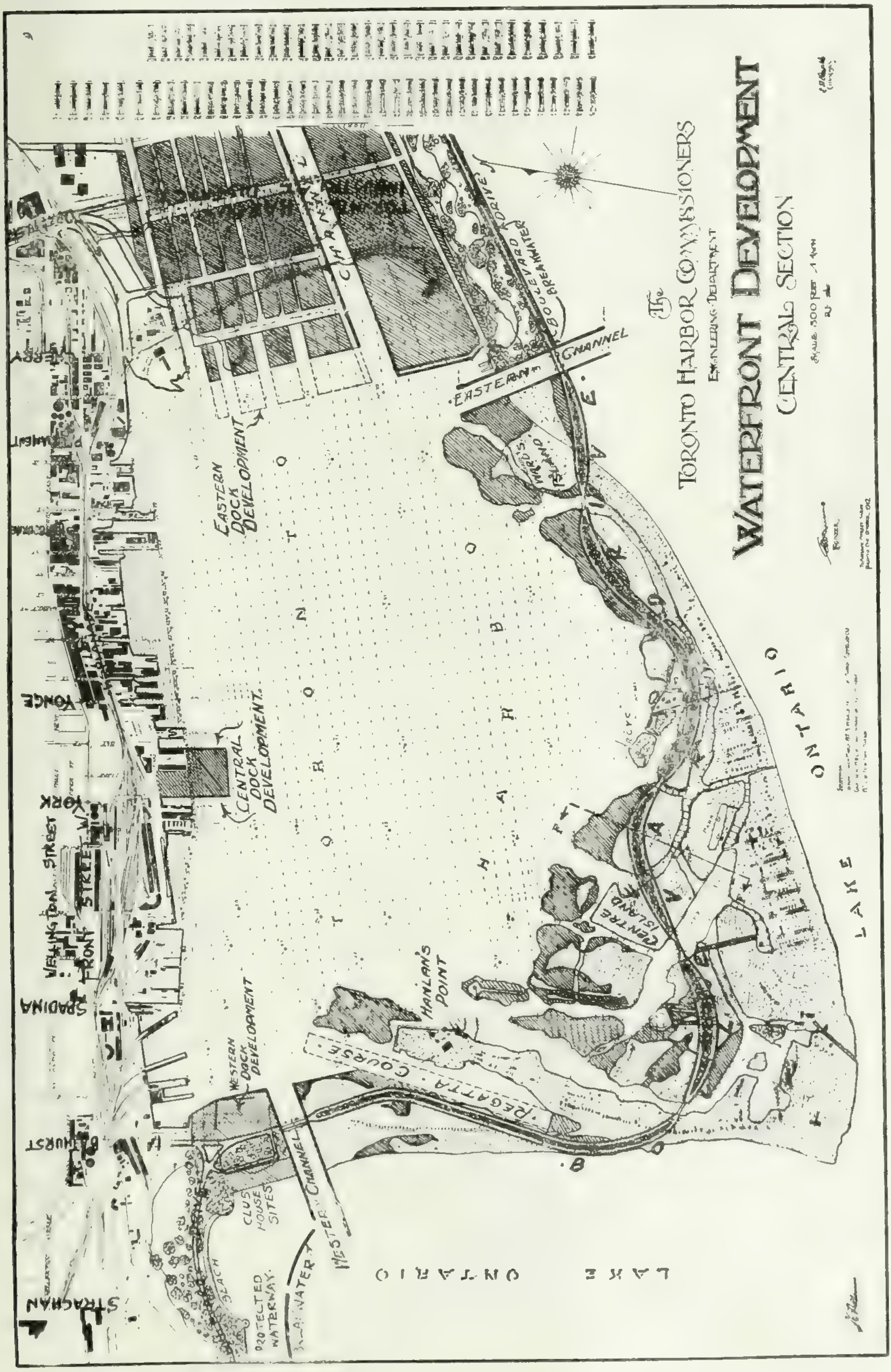
Two special offers deserving of editorial mention are those made by *The Canadian Engineer* to old and new subscribers. The balance of the copies of the paper for 1912 will be forwarded free of charge to all new yearly subscribers who mention this special offer. And, in conjunction with this, the book offer, outlined on another page, holds good. To present subscribers who send in new subscriptions, which may have the advantage of the above terms, will have their subscriptions extended three months without charge for each new subscription they add to the list.

INDUSTRIAL ACCIDENTS.

According to the record of industrial accidents maintained by the Department of Labor, there were 104 workmen killed and 324 injured during the month of October. Compared with the record for September, this is an increase of fifteen in the number killed and a decrease of ninety-five in the number injured. The greatest number of fatal accidents occurred in steam railway service, there being 28 employees killed. The building trades come next with 18 fatalities. Of the non-fatal accidents, the greatest number occurred in the metal trades, the number recorded being 85, followed second by building trades with 40 injured, and third by steam railway service with 37 injured.

TORONTO HARBOR IMPROVEMENT.

The Toronto Harbor Commissioners have presented to the city council the plan prepared by them for the improvement of the harbor and waterfront.



The plan, as finally adopted by the commissioners, provides for the proper treatment of the harbor, both from a commercial and industrial point of view, and also for the development of the aesthetic features of the waterfront.

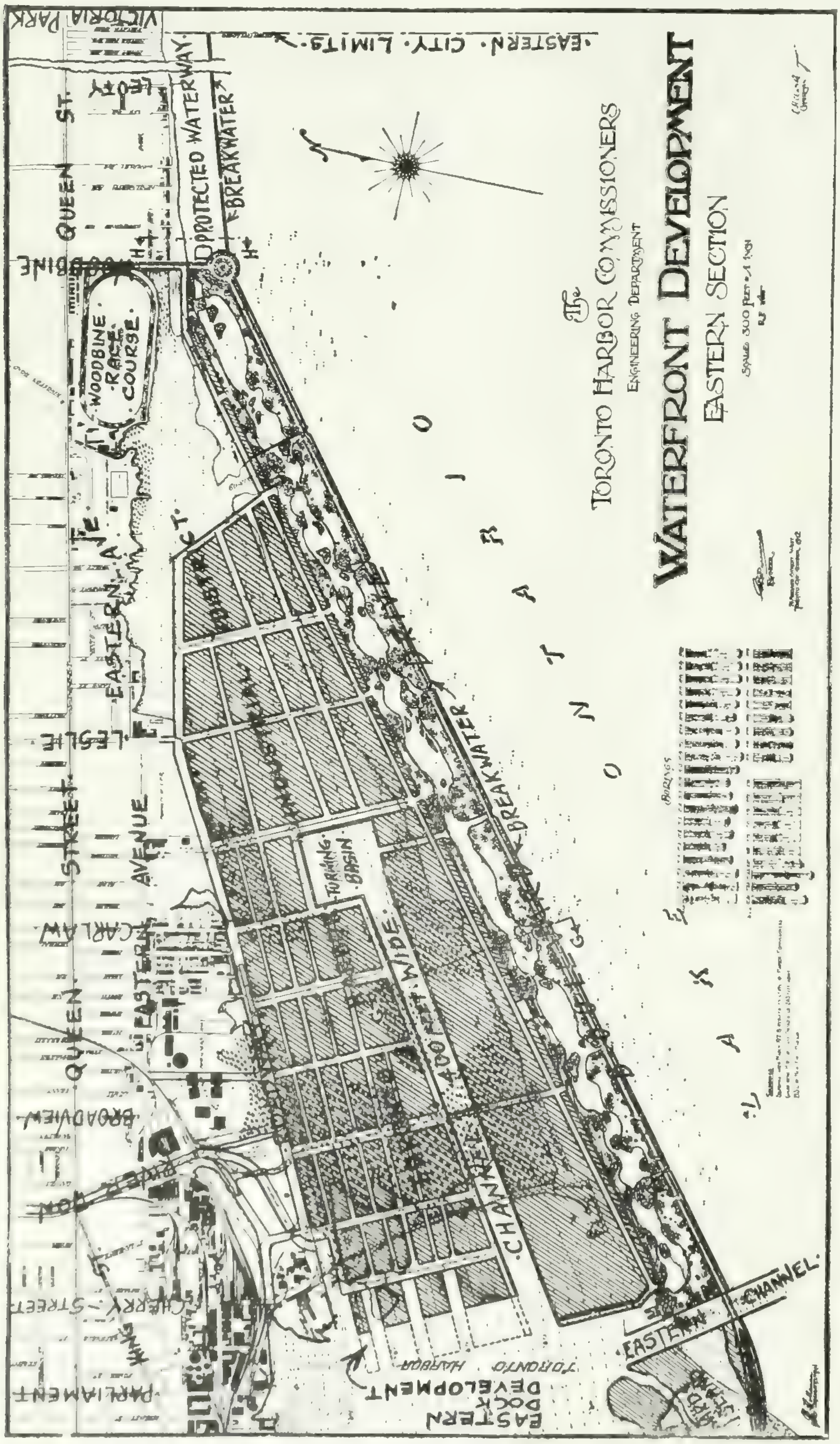
The commissioners, on taking office at the latter end of the year 1911, found themselves in charge of one of the finest land-locked harbors in the world, certainly the finest natural harbor on the Great Lakes, of which natural position very little advantage has been taken, and for the development of which no equipment had been provided.

The one redeeming feature in the past history of the harbor was afforded by the foresight of your city council and those councils which preceded it in securing for the citizens the ownership of 80 per cent. of the entire waterfront within the boundaries of the city, including a large portion of the waterfront on the inner harbor and all of the beaches and waterlots to the east and west of the Island.

With the object of securing definite information on which to formulate proper plans, the commissioners secured the services of Mr. E. L. Cousins as harbor engineer, and since the 1st of February he has energetically pushed forward the necessary preparatory work, a large staff of engineers and draughtsmen having been constantly employed. The sum of $27,000 has been spent in securing a complete survey of the waterfront from Victoria Park to the Humber River, and a hydrographic survey of the harbor, including 8,000 soundings to show the depth of water and borings to rock all along the waterfront and throughout the bay to determine the ultimate depth available and the nature of the material in which the various projected works will have to be constructed.

Upon the completion of the plans the city of Toronto will possess:

A modern harbor with a uniform depth of water capable of accommodating any vessel with a draught of 24 feet. Modern, permanent docks on the central waterfront served by 24 feet of water and equipped with the best of freight sheds, warehouses and appliances. A dock and industrial district at the foot of Cherry Street equipped with freight sheds, warehouses and the first of a series of factory buildings to serve the needs of the east end. A similar area at the foot of Bathurst Street to take care of west end business. Proper co-ordination of rail and water traffic at all three of the above points in order to properly develop the port. An industrial area containing 644 acres of available land in the Ashbridge Bay district, which will be known in the future as the Toronto Harbor Industrial District, capable of accommodating factory buildings with a value of $30,000,000 and producing a ground rent revenue of $500,000 per year. A ship-channel 6,800 feet long, 400 feet wide and 24 feet deep, with turning basin 1,000 feet square at its east end serving the Industrial District and the eastern portion of the city generally, and equipped with three miles of dockage. A dock area on the west face of the Industrial District capable of development so as to provide an additional dock frontage of three miles. A new lakefront park and waterway extending from the Eastern Channel to the foot of Woodbine Avenue, and containing 352 acres protected by a breakwater three miles long. Inside the breakwater will be ample accommodation for east end aquatic clubs. A protected waterway with an average width of 600 ft. behind a breakwater from Woodbine Avenue to the east city limits. Additional park areas on the Island totalling 352 acres. New park areas in the district from Bathurst Street to the Humber River containing 190 acres and fronting on a protected waterway 500 feet wide which is separated from the lake by a breakwater. A total area of new park lands of 894 acres. A bathing beach one and one-third miles in length, from Sunnyside to the Humber. A similar beach four and one-quarter miles in length from the Eastern Channel to Victoria Park. A lakefront boulevard system of driveways, bridle paths and walks across the waterfront for eleven miles. A protected waterway twelve miles in length, from east to west along the city front. A terrace promenade 6,880 feet in length and 55 feet wide, from Sunnyside to the Humber. A double-deck combined traffic and recreation pier 300 feet long and 20 feet wide in front of the Exhibition Grounds. A location for aquatic clubs 1,000 feet long and 300 feet wide north of the new Western Channel with an anchorage basin of absolutely protected water covering 42 acres. A similar location at the foot of Roncesvalles Avenue, 800 feet long and 250 feet wide fronting on the protected waterway formed by the western breakwater. A public playground covering 3½ acres east of the foot of Roncesvalles Avenue. A public square 600 x 300 feet west of Roncesvalles Avenue. A reservation, 80 feet wide, from the Humber River to Sunnyside crossing as a right-of-way for radial lines. A new Lakeshore Road, 66 feet wide, to the south of the radial railroad reservation.



In order to facilitate the handling of the work when active operations are commenced, the waterfront and harbor has been divided into three sections. The eastern section takes in the Ashbridge Bay district and the sandbar in front of it, the central section takes in the central waterfront from Parliament Street to Bathurst Street, the inner harbor and bayshore of the Island, while the Western section covers the waterfront from Bathurst Street to the Humber River.

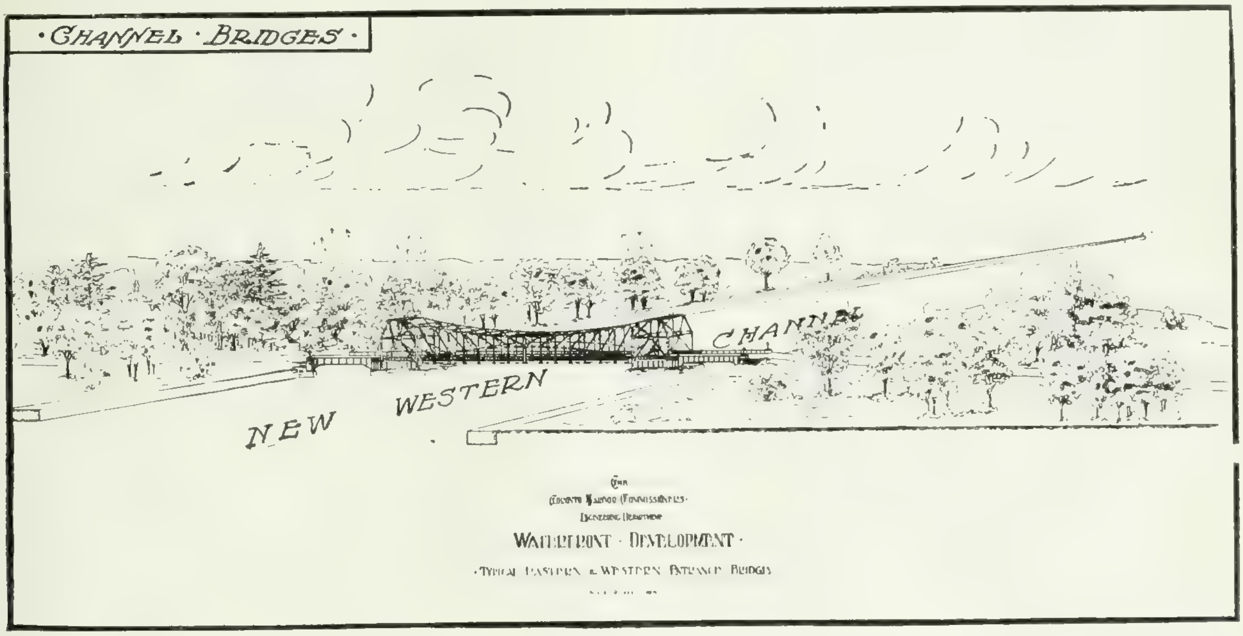
Eastern Section.—In the eastern section the development planned covers three phases, commercial and dock development, industrial development and park treatment on the laketront. A breakwater will be constructed an average distance of seven hundred feet out in the lake from the present shore and reaching from the eastern harbor entrance to the east city limits at Victoria Park. To fill the space behind this wall up to eight feet above mean water level, including the 1,000 acres in the industrial district, will require twenty-five million cubic yards of material. This material can all be secured from the bay and the bed of the lake and outside the breakwater, and the two large hydraulic dredges will be employed on this work.

The dredging operations will be on a larger scale than ever before attempted in Canada. Each dredge will be capable of dredging either sand or clay from a depth of 50 feet and pumping it for a distance of 4,000 feet through pipe lines from which it will be distributed to the area to be filled. The dredge will be built of steel and will be propelled by twin screws, and controlled by steam steering gear.

The machinery will be of 2,000 horse-power of the latest improved type and complete electric light and search-lights will be fitted so that work can be carried on at night as well as day. Twenty-five thousand tons of sand and clay per day can be dredged and delivered a mile distant by this dredge. This will be the most powerful dredge in America. Up to the present the largest Canadian hydraulic dredge is the "Tarte," built in Toronto in 1901, and working on the St. Lawrence ship-channel below Montreal, but this new dredge to be built will be double the power of the "Tarte."

Notwithstanding its great size and power, the dredge with its machinery will be under the control of one man on the bridge deck. Here will be located not only complete apparatus for navigating the ship, such as steering wheel, binnacle, engine-room telegraphs, etc., but also a battery of levers controlling all the movements of the dredging apparatus, with gauges indicating the depth of working and the amount of sand which is being picked up.

The dredge will be built from the designs and under the supervision of A. W. Robinson, M.Can.Soc.C.E., the well-known dredge expert, of Montreal, consultant on dredging to the British Admiralty.


·CHANNEL ·BRIDGES·

NEW WESTERN CHANNEL
The
Toronto Harbor Commissioners
Engineering Department
Waterfront · Development ·
·Typical Eastern & Western Entrance Bridges

A ship-channel will be constructed for the purpose of extending the inner harbor into the new industrial district. This channel will be 6,800 feet long, 400 feet wide and 24 feet deep, and will terminate in a turning basin 1,000 feet square, and the sides of both the channel and turning basin will be so constructed as to form three miles of dockage accommodation. The industrial area, when completed, will contain 644 acres of land for factory sites, 235 acres of streets and railroad reservations, and 130 acres of waterways.

The roadways will have a minimum width of 75 feet and a maximum width of 175 feet. The district will be served by railway tracks connecting with all the railways and the railway layout has been so arranged that every alternate street will be free from tracks.

The western, or bay face of the district will be developed for dock purposes as the district grows, and will ultimately add 2½ more miles to the dock frontage of the areas, as shown on the plan. One large dock is now being constructed and will be equipped with modern freight sheds and one storage warehouse and the beginning of a series of factory buildings will be erected back of the dock.

The mouth of the Don will be diverted from its present outlet to a new outlet into a slip at the foot of Cherry Street, and the original Don Channel, now filled up, will be utilized as the location for a highway entrance to the industrial area.

The area north of the ship-channel will be reserved for light manufacturing plants, the area to the east will be the home of heavier plants which do not require direct water service, and the area south of the channel will be utilized for the heaviest class of manufacturers requiring a frontage direct on navigable water. The width of the channel, 400 feet, will allow a vessel of the largest type to safely pass through it between two vessels of equal size tied up at each side.

Along the south portion of the reclaimed land a park area 1,000 feet wide will be reserved, fronting directly on the breakwater. Immediately to the north of the breakwater will be the lakefront boulevard drives and walks with a park and lagoon treatment north of the boulevard, and a fine beach to the north of the lagoon. Bridges at reasonable intervals will carry traffic across the lagoon to the lakefront.

and forty-foot openings in the breakwater at intervals of 2,000 feet will allow seawall craft to pass through from or to the lake. Inside the breakwater fronting on the lagoon will be ample sites for aquatic clubs and a strip of land will also be laid out, north of the park area, as a location for summer homes.

East of Woodbine Avenue there will be no park treatment, but the seawall will be carried to the east city limit, leaving a protected waterway for the use of the residents of this district and the public generally.

Central Section.—In the central section the work planned consists almost entirely of commercial and park development with some industrial land provided at the foot of Bathurst Street. The commissioners plan to spend the sum of $2,194,000 in the construction and equipment of proper docks in the area from Bay Street to York Street, and at the foot of Bathurst Street, but the details of construction for the central development cannot be worked out until the question of separation of railway and highway grades has been definitely settled.

At the foot of Bathurst Street a dock and industrial area of 17 acres will be provided north of the new Western Channel and east of the boulevard drive. This area will be served by 800 feet of dock with 20 feet of water and will be accessible to all railway lines.

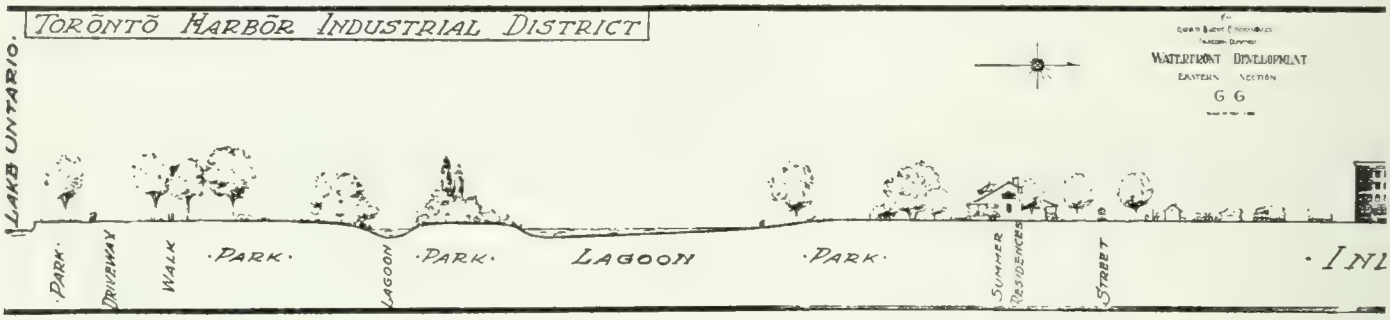
The commissioners propose to construct at this point modern freight sheds and storage warehouses and a factory building similar to the one planned for the eastern section. The balance of the work in the central section consists of the reclamation of 352 acres of additional park lands on the Island, a portion of which will serve as a location for the boulevard drive and the balance will improve the present unsightly portion of the Island. The boulevard drive will be carried from the east across the Eastern Channel by means of a roller lift bridge giving a clear entrance for boats of 200 feet.

Western Section.—From Bathurst Street to the Humber River the treatment is entirely along park lines, there being no provision for commercial development. A breakwater will be constructed from a point of 200 feet west of the new channel to a point at the mouth of the Humber River and distant an average of 900 feet from the existing shore line. Inside this breakwater will be a protected waterway with an average width of 500 feet reaching from the Humber to Bathurst Street and linking up with the Island lagoon system and the new lagoon system planned for the eastern section to form a complete protected waterway across the entire city front.

The western breakwater will be broken every 2,000 feet by forty-foot openings to permit of the egress or ingress of sailing or other craft.

From Bathurst Street to the Exhibition Grounds and from Cliff Road to the Humber the sand pumps will be utilized to reclaim areas of property for park purposes and from Sunnyside to the Humber over a mile of fine sand bathing beach will be made and a bath-house erected at its east end. In the same district sufficient land will be reclaimed to provide for an 80-foot reservation for a radial railway entrance to the city along the location of the present Lakeshore Road with a new 66-foot commercial road to the south of the reservation. This roadway will replace the Lakeshore Road and will serve as the business entrance to a tier of lots reserved for building purposes. In front of this tier of building lots and 8 feet above the boulevard proper will be a terraced boulevard and walks 55 feet wide, faced by a parapet wall and with steps at intervals leading onto the boulevard proper. Outside the boulevard and bridle paths will be the bathing beach and protected waterway with the breakwater as its southern boundary.

The Cost.—The total cost of all the work planned by the commissioners amounts to $19,142,088. This expenditure it is intended to spread over a term of years, the expectation of the commissioners being that the work will be completed within ten years.



The city is asked to undertake the expenditure of $146,500 as its share of the general work for the purpose of constructing the highway bridge across the Don Channel into the Industrial District and the construction of a retaining wall and balustrade along the front of the Exhibition Grounds in order to separate the grounds from the boulevard. This expenditure will have to be followed later on by an expenditure of $1,656,383 by the city if the lakefront boulevard plan is approved and the city undertakes to complete it by constructing walks, roadways and park features after the commissioners have reclaimed the site. This makes a total expenditure allotted to the city of $1,802,883 as its share of completing within ten years the work shown on the plan.

The Dominion Government has been asked to undertake the expenditure of $6,123,284 in the construction of the eastern breakwater, the western breakwater, the ship-channel in the industrial district, the bridges over the eastern and western harbor entrances and the bridge over the ship channel and protection piling near the eastern channel.

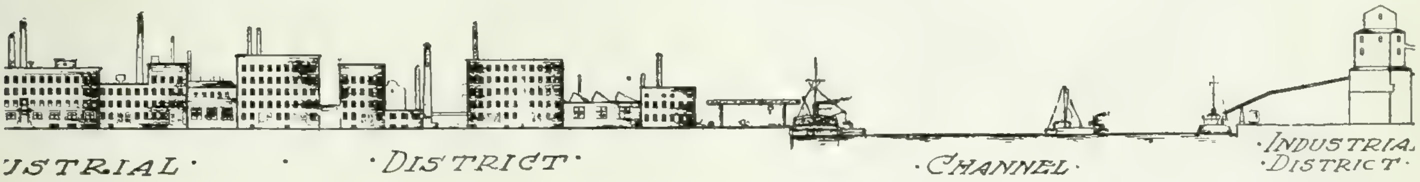
The balance of the projected work will be undertaken by the commissioners at an estimated cost of $11,215,920. The money will be raised by the issue of debentures by the Harbor Commissioners and a careful estimate of the business possibilities of the plan warrant the assurance that the ultimate annual revenue from the property entrusted to the commissioners and created by them will be such as to meet the interest and sinking fund charges on the money borrowed and to leave a handsome surplus to be handed over to the city to aid in the reduction of the tax-rate.

The city is asked to undertake the portion of work allotted to it and to intimate its intention of joining in the construction of the boulevard drive.

If the city joins in the boulevard construction the commissioners will create the land necessary as a location for the drive and will ask the city to pay for the use of this location an annual rental equal to the interest and sinking fund charges on this part of the work.

The city is asked to intimate its intention of taking over the areas reclaimed for park purposes on a similar arrangement. It has been estimated that the total annual rental to be paid by the city for these park areas and the boulevard location will amount to $153,833 and in return for this the city will receive an addition to its park area of 894 acres.

The plans of the commissioners provide for the extension of Bathurst Street southerly in a straight line from Front Street with a width of 100 feet and an arrangement has been made with the Canadian Pacific Railway Company under which they join in this extension and consent to the south ramp of the necessary bridge being carried over their property. This will provide also for an adequate eastern entrance to the Exhibition Grounds and it will be necessary for the city to undertake the expropriation of the property north of the Canadian Pacific Railway property necessary for the street extension.



SUMMARY OF FILLING, PILING, ETC.

Filling.—Eastern section industrial eastern entrance to Woodbine Avenue, 22,714,144 cubic yards.

To be reclaimed to 8 feet above mean water level property, 9 per cent. of which is now under water, reclaiming 900 acres.

Eastern section, park and lagoon treatment, eastern entrance to Woodbine Avenue: Filling 5,042,045 cubic yards to 8 feet above mean water level, reclaiming 352 acres.

Central or Island section, Parliament Street to Bathurst: Filling 4,267,600 cubic yards to reclaim 350 acres of park lands to elevation 6 feet above mean water.

Western Section, Bathurst to Humber River: Filling 3,942,649 cubic yards to make 190 acres of park lands.

Summary.

	Cubic yards.
Industrial	22,714,144
East Park	5,042,045
Central	4,267,600
West	3,942,649
	35,966,438
Say,	36,000,000

Available material between eastern entrance and Woodbine Avenue	27,535,486
Available in Toronto Bay	18,000,000
In vicinity of Humber Bay	4,447,476

Summary.

East	27,535,486
Centre	18,000,000
West	4,447,476
	49,982,962

Composite Steel and Concrete Piling, Dock Work and Retention Piling for Boulevard Treatment.

Eastern Section: Four miles of retention piling and dock work, including ship channel, turning basin, marginal way on bay face and north slip.

East Section, Park and Boulevard: Breakwater and composite pile protection work.

Eastern entrance to Woodbine Avenue	17,350 ft.
Woodbine Avenue to east city limit	6,600 ft.
Total	23,950 ft.

Western Section, Bathurst Street to Humber River:

Retaining wall	6,880 ft. long
Exhibition dock	300 ft. long
Breakwater and composite pile protection work	20,000 ft. long

Bridges.—Suggested eastern and western entrance bridges are of the Scherzer roller lift or Strauss bascule type, 60 feet wide, providing for street railway, vehicular and pedestrian loading, a similar type of bridge is contemplated for the crossing of the ship-channel, excepting that this bridge will provide for steam railway, street railway, vehicular and pedestrian traffic, with width of 60 feet.

One bridge over the River Don diverted 80 feet wide.

Eastern Section—Boulevard Drive:

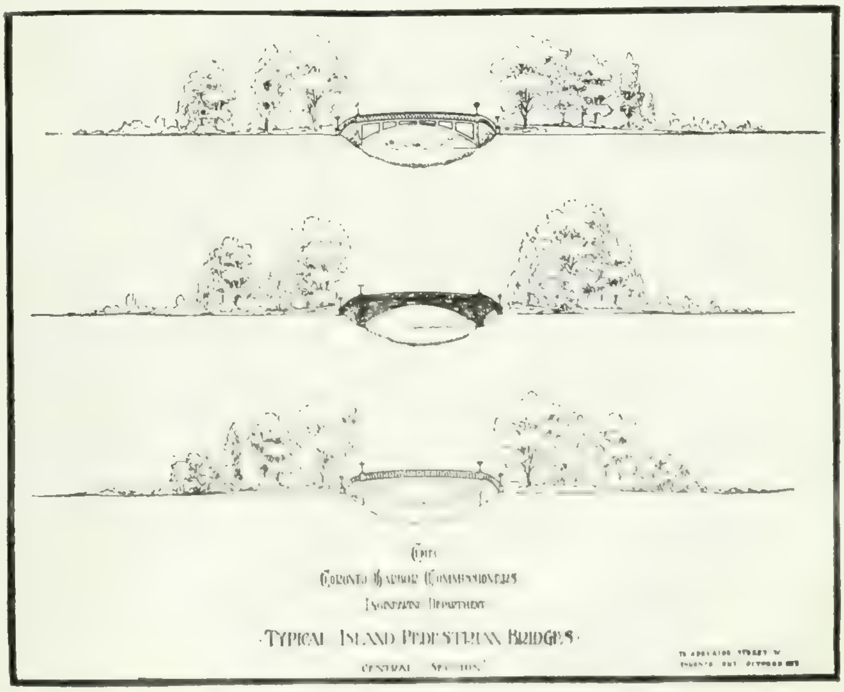
Seven vehicular bridges, 40-ft. span, 80 ft. wide.

One 100-ft. span, 80 ft. wide, vehicular.

One 100-ft. span, 56 ft. wide, vehicular.

One 40-ft. span, 56 ft. wide, vehicular.

Seven foot bridges, 50-ft. span, 10 ft. wide, for crossing lagoons.


The
Toronto Harbor Commissioners
Engineering Department
·Typical Island Pedestrian Bridges·
Central Section

Central Section:

Ten 50-ft. pedestrian bridges (arch).

Three 120-ft. arch pedestrian bridges.

Three bridges 180 ft. over all consisting of two 50-ft. arch spans and one 80-ft. arch span, providing for street railway, vehicular and pedestrian traffic.

One 100-ft. arch span, providing for street railway, vehicular and pedestrian traffic.

Four 40-ft. spans for boulevard drive over lagoons.

Western Section:

One 400 ft. concrete arch foot bridge connecting main land with proposed Exhibition dock; bridge to be 10 ft wide with 30-ft. arch spans.

◆

MONTREAL'S WATER DEPARTMENT

The charges which the Canadian Fire Underwriters of Montreal recently made against the city's water department have been the subject of considerable discussion at the city hall. The charges were of a somewhat serious nature, and accompanying them was a request for an investigation of a thorough character to be made into the conduct of the water department generally.

Alderman Lapointe, one of the oldest members of the city council, in referring to the charges made by the underwriters, said:

"It is stated in this resolution that in the management of the water department there has been incompetency; faulty construction of engines; faulty workmanship; acceptance and use of inferior materials, and continued dilatory work and repeated disaster to the city water plant. Such a list of charges are serious, and there is no other course open to the city but to grant the investigation the underwriters desire. The charges are sweeping, and the allegations are direct. Whether or not they are justified we shall know when experts are appointed to look into the matter."

Alderman Lapointe admitted that there had been many accidents to the water system, but claimed that of recent years the facilities had been improved considerably, and he considered that the best way to proceed on the charges would be to ask the board of control to study the subject and to report the results.

At a later meeting of the council the board of control reported that it could not see any advantage in having the investigation. Controller Godfrey said that some of the accusations were certainly not correct, and that the pump which the underwriters stated had arrived in June, and had been left lying around for months, was now almost ready to be operated. The fact was that the works where the pump was being manufactured had met with an accident and portions of the machinery had not been received until a short time ago. It was this which delayed the setting up of the pump and not any fault of the city or water department. He did not consider that there was any necessity for a commission as the situation was well known to them.

When the council came to consider the matter, however, they decided by a vote of twenty-three or four to have an investigation carried out. This action meets with general approval. The condition of affairs which has existed here during the past three or four weeks has certainly been anything but of a character to inspire confidence in the department, more especially when it is remembered that for years past, something of a more or less dangerous character has been frequently taking place.

The Worthington pump, the breakdown of which caused the recent water famine, has been repaired and is in operation. It has a capacity of 12,000,000 gallons daily so that this will go a long way towards putting the reservoirs in a condition once more to supply not only the necessary household consumption, but to provide against any lack of pressure, in case of fire, such as was so serious recently in Montreal. The new pump, to which the underwriters referred, will shortly be ready to operate. It has also a capacity of 12,000,000 gallons per day. The situation should then be much better in Montreal, as if one pump fails, the other will be ready to take up the work. The claim is frequently heard that the trouble arises very largely through provision not being made in advance for the increased requirements of the city. These increases have been great of late years, and the investigation will now show whether foresight has been lacking or whether the department has been alive to the city's requirements.

◆

ONTARIO'S LARGE MINERAL OUTPUT

Ontario continues to make important mining history According to the returns for the nine months ended September 30th, 1912, furnished to *The Canadian Engineer* by the provincial bureau of mines, the production has been as follows:—

Product.	Quantity.	Value.
Gold, ounces	53,488	$ 1,117,335
Silver, ounces	22,231,451	12,707,826
Copper, tons	8,019	1,142,076
Nickel, tons	15,907	3,368,437
Iron ore, tons	37,265	101,284
Pig iron, tons	452,021	6,051,978
Cobalt in crude material, pounds	711,180	176,786
Cobalt and nickel oxides, pounds	711,180	176,786
White arsenic, pounds	2,944,104	66,316

The yield of gold for the first nine months of 1912 is more than double in value that of any preceding twelve months. The bulk was from the Hollinger and Dome mines. Other contributors were the McIntyre and Vipond at Porcupine, and the St. Anthony at Sturgeon Lake. The Cordova mines in Hastings county and the Olympia at Lake of the Woods also turned out bullion.

As compared with the corresponding period of 1911, the production of silver was 963,601 ounces less in quantity, but $1,114,090 more in value, silver being now much higher in price than last year. The productivity of the silver mines of Cobalt is being well maintained. The shipments comprised 15,408 tons ore, 7,859 tons concentrates and $2,239,124 in bullion. South Lorrain contributed 616,692 ounces to the total and Gowganda, 449,281 ounces.

The mines of the Sudbury district yielded 15,907 tons of nickel as compared with 12,711 tons during the same period last year, and 8,019 tons of copper as against 6,769 tons. Both these metals are estimated in the form of Bessemer matter produced by the blast furnaces, constituting together about 80 per cent. of the matter by weight.

Considerably less iron ore was shipped during the nine months of 1912 than during the same period of last year, the reduction amounting to 135,603 tons. The Helen mine was the principal producer. On the other hand, the output of pig iron shows a large increase, being 452,021 tons as against 296,856 tons last year.

The refining works in Ontario produces arsenic, cobalt crude materials or residues, and the oxides of nickel and cobalt. Shipments amounted in value to $300,716 as compared with $125,907 for the corresponding period of 1911. Both the European and American market for cobalt oxides are now for the most part supplied by the product made from the ores of Cobalt.

CHINA CLAY PRODUCTION IN DEVON AND CORNWALL, ENGLAND.

By W. S. Harvey, A.M.Can.Soc.C.E., A.M.Inst.C.E., A.M.I.M.E.

[Mr. Harvey, who is assistant to the City Engineer of Lethbridge, Alberta, has prepared this paper on the collecting and treating of China clay in England. As China clay has lately been discovered in British Columbia, this discussion will, no doubt, be of interest to our readers.—EDITOR.]

The Industry.—The china clay industry is carried on in Devon and Cornwall to a very great extent, in fact china clay production and lead and tin mining are Cornwall's largest industries. It is well known that grey granite has been quarried in these two counties for many years, and the felspar in this granite, when in a state of decomposition, is in reality the infant state of that valuable commercial product known as kaolin or china clay. This decomposition is caused by the granites becoming dissolved by rainwater which is charged with carbonic acid, collected as it passes through the various substances, such as decayed vegetable matter, etc., forming the surface or overburden. The following is a brief description of the various stages through which it passes before reaching the potters' hands.

Sinking Clay Pits.—In these two counties the decomposed granite lies about five or six feet below the surface, the first operation in sinking the clay pits being to remove the overburden. This is usually carried out over an area of about half an acre for each proposed pit. A pumping shaft is then sunk to the full depth of the clay beds, often approaching one hundred feet; from the bottom of the pumping shaft, adits or tunnels are driven horizontally in various directions and for varying distances. At the ends of these adits, upcast shafts are driven to the surface. The adits are driven on a slight upgrade, so that the clay liquid may drain to the sump of the main pumping shaft. Upon completion of the driving of the upcast shafts, a large wooden launder is built to the full depth of each shaft; these launders are constructed of three-inch planking, in the sides of which holes are bored from top to bottom, and stopped with moveable plugs. When the launders are in position the shafts are filled in round about. A leat or ditch is now dug surrounding the site of the proposed pits, being fed with water from adjacent streams and provided with penstocks at points around the pits.

Washing Clay.—Twenty or thirty men are employed at each pit and as the water is allowed to run over the clay beds, the clay is scraped and worked with tools, the clay liquid finding its way through the launders and adits to the main pumping shaft. As the pits get deeper the plugs are removed from the launders. The clay pits, after being worked for about ten years, will increase in area to many acres and develop into one large pit, the overburden being removed as required. The clay liquid is pumped, by means of a Rocker pump, through a rising main, thence through a vitrified pipe line it gravitates to the mica drags.

Mica Drags.—These consist of a series of shallow tanks, their duty being to arrest the mica, sand and other foreign matter from the clay liquid, which enters the drags at a sand bay provided with screens and baffles; here the greater part of the sand is removed. The sand bay is divided into two compartments so that cleaning may be carried on without stoppage of the flow. The liquid next enters the mica drags proper; these are usually about one hundred feet long and fifty feet wide, being divided longitudinally into narrow channels, each eighteen inches wide; the division walls being of brick on edge and faced with two-inch lumber. The channels are separated from the sand bay by hand sluices. The mica drags are not baffled in any way as the velocity of the liquid is so reduced that any particles of mica and remaining sand will deposit themselves on the floor of the drags. The drags are cleaned out about once every week, the sand and mica being sold for plastering and other building purposes.

Concentrators.—Upon leaving the mica drags the liquid continues on its journey through the pipe line to the concentrators. These are circular tanks about forty feet in diameter with granite masonry walls and a conical bottom of granite pitching. The concentrators are, as a rule, built in a battery of 8 or 10, and are so arranged that the liquid can be drawn off from any one or all of these as required; there is also a by-pass and valve on the pipe line to shut off all the tanks, the liquid then flowing to other concentrators further down the line. The duty of the concentrators is to take off the surplus water, this being accomplished by means of a floating valve. When pumped from the clay pits, the liquid contains on an average 5 per cent. of clay and 2 per cent. of mica and sand in first quality clay, and about 4 per cent. of mica and sand in clay of second quality. Concentrators are, therefore, placed wherever convenient along the pipe line to take off all the surplus water possible.

Clay Silos.—The silos are of rectangular form, built with granite masonry walls and a granite pitched bottom sloping down from back to front. At the bottom of each front wall is a large aperture provided with a penstock operated from a platform above. The silos are built in a battery of 15 or 20 arranged in tiers, the number being of course governed by the required output of dried clay. The clay liquid now having passed through the concentrators, on arriving at the silos, is greatly reduced in its percentage of water. It now enters the silos and as a silo becomes filled it is allowed to settle for two or three weeks, when as much as possible of the remaining water is drawn off, this being done by means of peg launders, the pegs being removed as the clay settles and the top water drawn off.

Kilns.—The kilns are situated in immediate proximity to the lowest tier of silos, the kiln floors being on a level with the apertures in the silo walls. These are from one hundred to one hundred and fifty feet long with the furnaces at one end, and the flues running to a stack at the other end of the building.

As soon as the clay in a silo is ready to be dried, the penstock is opened and the clay allowed to run over the kiln floors, the clay at this stage containing about 30 to 35 per cent. of water. It is now heated and when dried sufficiently is cut by wooden tools into convenient blocks for handling, the heating process still continuing until thoroughly dry, when the clay is removed by a belt conveyer and stacked under cover, or loaded direct into cars for shipment to the potteries. The kilns are provided with an ample supply of ventilators to take off the steam during the drying process.

It will be noticed that from the clay pits to the kilns it is a process of gravitation with the exception of the pumping and in some clay works, where sufficient fall from the pits can be obtained, even this is disposed of. Several of the Devon clay pits are situated five or six miles from the kilns, in fact one of the latest works opened up has a pipe line of nine miles in length.

All hand sluices, weirs, baffles and other details are constructed of galvanized metal or wood to prevent any possibility of the clay being discolored by rust, as it is absolutely essential that china clay of first quality should contain no traces of discoloration.

DESIGN OF TURNTABLES FOR HEAVY LOCOMOTIVES.

Recent developments in the design of locomotives, accompanied by great increase in weights and changes in the distribution of weight on long wheel-bases, have introduced elements into the design and operation of turntables materially different from the problems of a few years ago. In view of these changes an exhaustive study has been made of present practice by a committee of the American Railway Bridge and Building Association, of which Mr. C. E. Smith, bridge engineer of the Missouri Pacific Railway, is chairman, and the results have recently been presented in a report to the association. A large amount of descriptive data regarding turntable design, construction and operation on fifty-seven railroads, aggregating 175,000 miles of line, is included in the report, and from this information the committee has formulated a number of general principles underlying present practice.

Length and Type of Table.—The committee found that in the past it has often been the practice to build turntables only long enough for engines actually in use, with the result that frequent enlargements have been necessary. Turntables now actually in use were studied in connection with the loading diagrams of the heaviest locomotives of the principal builders. It was found that for standard-gauge roads no future turntable should be built shorter than 75 ft., and that roads expecting to use the heaviest engines should adopt 90 ft. as standard. For engines having wheel bases longer than 90 ft. wye tracks should be provided unless special local conditions compel the use and justify the expense of a longer table.

The committee feels that the deck type of table is preferable to any other on account of low first cost, ease of operation and economy of maintenance, but sees no serious objections to through tables where conditions demand their use. Where through girders are used the best practice seems to favor providing supports for the ties by means of steel stringers and floor beams instead of using deep ties resting on shelf angles. The deep ties are expensive in first cost and maintenance and promote corrosion of the girder webs and shelf angles. The steel cross girders at the centre of the turntable require a depth at least as great as a standard floor system, so the depth of pit need not be increased for the floor system.

The depth of pit for the shorter tables will probably never be sufficient to compel the use of short through tables, say, less than 75 ft. The advantage of using through tables for the greatest lengths is indicated by the pit for the Pennsylvania 100-ft. deck turntable, in which the depth from base of rail to top of catch basin is 11 ft. 2 in., while for the Norfolk and Western 100-ft. through turntable the depth is only 7 ft. 6 in. Where through girders are used they should not be placed less than 15 ft. between centres, as with a closer spacing the danger arises of men getting caught between an engine and the girder flanges.

Loading and Stresses for Design.—Loadings and unit stresses used in the design of turntables are found to be greatly diversified. Cooper's loadings are believed to be unsuitable for this purpose on account of their short wheel-bases.

Turntables should be so designed that the deflection of the ends will not cause both ends to drag while turning heavy engines, and it should not be necessary to place the rails on the table too high above the approach rails to accomplish this, as that will result in too great a drop of the ends when an engine reaches the end of a table. In general the rails on the table should not be more than ¾ in. above the approach rails and should come down level while engines are passing on or off. A deflection of ½ in. at each end, then, will leave ¼ in. clearance over the circle rail while turning. The unit stresses should be so chosen that the deflection of each end will be not greatly in excess of that amount.

Although a bridge designed for Cooper's loading will support, without any increase in stress over that used in the design, modern engines considerably heavier than the Cooper's loading, on account of the longer wheel-base distributing the load over a greater length of bridge, the same engine on a turntable will cause the stresses that affect the deflection of the ends to exceed very materially those used in design, for the reason that the longer wheel-base increases the negative bending moment on a turntable.

The tables should be designed for the heaviest actual engine that could use them. The unit stresses should be chosen low enough to keep the deflection down to a minimum, 10,000 lbs. per square inch for tension and compression and 6,000 lbs. per square inch for shear being reasonable values. With those stresses, it is not necessary to add for impact except at the ends, where live-load stresses in parts subject to pounding should be increased 100 per cent.

Construction of Pits.—Drainage of pits is always important, and becomes a larger problem with long tables and deep pits. The most satisfactory drainage is provided by catch basins and gravity drains, where the highest water in the outlet is lower than the bottom of the pit. Where this condition does not obtain, the problem of drainage can be simplified by use of through type of table, decreasing the depth of pit; use of shallow, non-tipping tables; waterproof pits, with sumps and pumping.

Little has been done to handle the situation by waterproof pits, sumps and pumping, and it appears that the extra expense and the neglect that may be expected, combined with the very deep pits for modern deck turntables, is so great as to indicate the desirability of through girders, provided direct gravity drainage can be secured for the through pits. A careful comparison of expense should be made before the through table is adopted.

The old practice of flooring over the entire pit has almost disappeared. Standard bridge ties are now used on the stringers of through tables or on top of deck tables, with occasional ties long enough to support footwalks outside of the locomotives. The width of the floor is 14 to 16 ft., and sometimes foot railings are provided. In a few cases pipe handrails are used on each side.

Great care is necessary in constructing the centre foundation. Most roads use bases 12 ft. square on 16 piles, rock or pile foundations usually being required. The top or bottom of the concrete centre is reinforced in many cases, and sometimes both. Settlement of centres is often stopped by excavating a trench around the footing, extending down 2 or 3 ft. deeper than the footing to permit underpinning, and increasing the base by filling the trench with concrete, sometimes on piles.

Operating Details.—The committee finds no necessity for locks where tractors are used, the power brakes being considered sufficient. In all cases where tables are turned by hand, locks should be provided. The simple I-shaped forging, sliding between the webs, answers the purpose well. Although it is convenient to have such a lock connected so that it will slide by the manipulation of a hand lever, it can be satisfactorily operated by hand, rings being attached for ease of handling. At outlying points it might be advisable to provide a locking attachment to keep boys from playing with the table and getting injured.

Electric power has the preference on practically all roads, and turning by air motors next for outlying points where tables are not much used and where current cannot be obtained, and where trouble, necessitating turning the table by hand, will not be serious. Gasoline engines are recommended where electric current cannot be obtained and where liability of freezing renders the use of air motors objectionable.

Turntables of the non-tipping type, having supports at other points in addition to the centre, were considered by the committee, but it was found that they have given much difficulty to the principal users.

Approach and Circle-Rail Supports.—The committee recommends providing a support for the ends of the approach rails on creosoted coping timbers, not less than 12 in. wide at the narrowest point, and preferably 8 in. thick, with two heavy standard tie plates under the end of each rail, where the space permits this, or a special plate not less than 1 in. thick, 12 in. wide and long enough to pass under the two near rails of adjacent tracks, the plates to be drilled for track spikes or screw spikes and for lag screws for attaching them to the coping timber. The coping timber should be attached to the concrete by anchor bolts. Supports should also be provided for the circle rail by short creosoted ties about 15 in. centre to centre under main tracks and 24 in. elsewhere, with tie plates and screw spikes where available. To hold these ties in position and to prevent the accumulation of dirt and cinders, the space between them and between their outer ends and the parapet wall should be filled with concrete sloped to drain under the circle rail to the pit.

It is customary at present to build the circle walls of concrete, except at such points as timber walls are used to effect economy or for temporary installations. Where timber walls are used over hardpan or rock, blocking can be used, but care must be taken to break joints and in drifting the timber together to keep the wall from crowding forward. Where the foundation is not firm enough, piles should be driven as long as possible to refusal, spaced about 3 to 4 ft. centre to centre. Timber walls have been built, and can be built, in such a manner that they will be entirely satisfactory.

Where a concrete circle wall is used, great care must be taken to secure a sound foundation for the wall and for the circle rail in order to avoid settlement. The footing should be extended to hardpan or rock or supported on piles driven to refusal. The piles should be placed directly under the parapet and circle rail. Great care must be taken in placing the bearings of the approach rails and in placing the circle rail to get a perfect level. Some roads make the cross-section of the circle wall equal to that of a gravity abutment, but this is not necessary if a complete circle be constructed, as the arch effect permits the use of a considerably lighter wall.

It is of great convenience to have a recess in the parapet wall at some point and a concrete pit constructed around the recess through which access may be gained to the end of the table.

Practically all railroads report the use of concrete or brick paving for pits in standard installations at the most important points, concrete having the preference, but the majority also report many pits with no paving, the floor of the pit being finished with earth, cinders or gravel. Concrete or brick paving gives a much better appearing pit, but there is a question whether the expense is justified. The cost will be close to $1,000. A layer of cinders or gravel 6 to 12 in. thick will absorb all water and oil and will prevent the occurrence of mud. The growth of vegetation should be very easy to stop.

Conical Roller and Disc Centres.—The difference in cost between a poor centre and the best centre is so slight compared to the importance of avoiding trouble that the best centres available should be used. The conical roller centres appear to be satisfactory if properly designed, constructed and maintained. Improper attention to these features has caused much trouble and much criticism of this type. One of the principal faults with the design of former conial roller centres was the small length of the rollers, which created unit pressures greater than they should have been. This resulted in the wearing and flattening of the rollers and in the wearing of the rollers into the surfaces of top and bottom castings, requiring renewal of the entire centre. Rollers have now been lengthened and track plates provided on the castings, so that only the plates require renewal. The rollers and plates should be of hardened steel and the castings of steel.

In the earlier designs no means was provided for keeping the rollers a constant distance from the centre. Their working in resulted in rubbing on one another with consequent increase in difficulty of turning. Their crowding out resulted in the castings coming together and in the outer ends of the rollers working against the rough inner surface of the castings with damage to rollers and castings and increase in difficulty of turning. In later designs means are provided for holding the rollers in line. The most approved practice consists in placing a steel ring around the rollers, set screws or lugs projecting from the end of each roller or bolts passing entirely through the length of the rollers and through the live ring. Phosphor bronze frictionless washers or ball bearings are provided in many designs between the ends of the rollers and the live ring.

A large majority of the roads favor conical centres for turntables, though several report very successful results with disc centres. The committee recommends that properly designed disc centres be given serious consideration.

In the preparation of standard layouts the committee recommends the avoidance of frogs in approach tracks as far as practicable.

Relative to maintenance of turntables, it is believed that proper design and construction, together with frequent inspection, will simplify the work. They should be frequently cleaned and painted, with patch painting when necessary. At least once each year and as much oftener as centres are submerged by floods or turn hard for any reason, the table should be jacked up and the centre thoroughly cleaned and refilled with oil. To facilitate jacking, many roads provide steel brackets riveted to the table and concrete foundations for the support of the jacks on one diameter of the pit.

SOUTH AFRICAN WATER POWER

The Cape Times weekly edition of September 18th states that Mr. Charles Weidner, of Oudtshoorn, Cape Colony, has formed a strong syndicate which has acquired 100,000 acres of land with a frontage of some thirty miles on the Orange River, upon which it is proposed to erect power stations to generate electric energy from the volume of water falling over many cataracts.

This hydro-electric power is to be utilized in various ways:—

(1) To drive powerful pumps by which water may be raised to higher levels, in order that wide areas may be irrigated.

(2) To operate flour mills and other manufacturing plants which are to be established by the syndicate.

It is hoped that Canadian manufacturers may be interested in the above; and the subject is also interesting to persons engaged in irrigation work, as showing what is being done in South Africa.

ELECTRICAL SUPPLY OF MONTREAL.

Considerable interest has been aroused here in power and financial circles, and among the citizens generally, in the report which has come from Quebec to the effect that the National Hydro-Electric Company, with head offices at Montreal, is making application at the present session of the Quebec Legislature for the necessary powers to enable it to make use of the streets and roads of Montreal and, in fact, of the streets and highways generally in about a score of counties of this province.

The National Hydro-Electric is the company which owns the Carillon Falls power, of which considerable has been heard from time to time during the past few years. The Falls are situated some thirty-five miles up the Ottawa River from the city of Montreal, and they mark the head of navigation so far as the larger steamers are concerned. From Montreal to Carillon and return is the round trip of the line of steamers of which Mr. R. W. Shepherd, who died last week, was the manager.

The statement was made that the falls are capable of producing 160,000 horse-power, and that it would cost $10,000 to develop them. Manifestly, one or two cyphers must have been dropped off the sum mentioned, inasmuch as $10,000 would not commence to develop a power of any consequence, and the company would not be applying for powers to issue $12,000,000 bonds, as it is doing, if it could get along with just $10,000.

So far as concerns the report that 160,000 horse-power can be developed at the Falls, this would seem to be confirmed by the report of the Conservation Commission, it being therein stated that the Falls have a total possible capacity of 200,000 horse-power, when the Georgian Bay Canal has been completed. By this is no doubt meant that the storage reservoirs planned for the watershed near French River must be also brought into play before the total of 200,000 horse-power will be available. The head of water for the complete development would be about 40 feet.

Under present conditions, the conservation report gives Carillon Falls a possible development of 26,000 horse-power, at a head of 13.5 feet. Whether, by the expenditure of considerable money, any more than this can be developed previous to the actual completion of the canal or not, is not stated.

Mr. Henry Miles, the president of the company, is a well-known man in Montreal, having a few years ago been president of the Montreal Board of Trade. He says:—

"We believe that Montreal wants more power, and we want the privilege of bringing it in. The small plant we already have will shortly be in operation, and it will supply the neighboring municipalities with their requirements, as well as the company with what it requires while carrying out the work on the larger installation. Montreal wants more electric power, and if they give us the opportunity we will supply it."

Montreal should certainly be well supplied with electrical power very shortly. Already several companies are sending in current from different hydraulic developments, great and small, within one hundred miles of the city. The Montreal Light, Heat and Power Company is supplying from its developments at Chambly, Lachine Rapids and Soulanges Canal somewhere around 30,000 to 35,000 horse-power, and in addition to this it has auxiliary steam plants within the city. The principal interests in the company, as well as in its old partner, the Shawinigan Water and Power Company, have lately acquired the Cedar Rapids power. This is situated near the Soulanges development just referred to, and is probably the largest power obtainable anywhere near [illegible]. It is claimed that in a very few years the Cedar Rapids Manufacturing and Power Company will be sending in 150,000 horse-power to the city of Montreal, or to the surrounding district. It seems likely, however, that a very considerable portion of this will be taken by certain large special industries which it is claimed will be established here by the time the power is ready. The Montreal Light, Heat and Power Company is also bringing in a large amount of power from Shawinigan Falls, it having contracted to deliver all the power for the Shawinigan Company required on the Island of Montreal. The present contract is for about 63,000 horse-power, though it is said that not all this is being asked for as yet. The Shawinigan Company is able to develop about 175,000 horse-power. Of this, 45,000 is sold at the Falls as hydraulic power, while the installation is prepared to deliver 85,000 horse-power, and the development is completed for 45,000 more, although the electrical machinery has not been installed for it. All the power previously mentioned, including 63,000 of the Shawinigan Company, is virtually in the hands of the Montreal Light, Heat and Power Company, and it is generally the ambition of each new power concern to compel the "monopoly" to buy it out.

The Canadian Light and Power Company is the one concern which is in opposition, and is likely to remain in opposition. Just what its development is, is difficult to say. It has been variously estimated from 7,000 horse-power to 25,000 horse-power. The statement is made on excellent authority that the company is actually disposing of and receiving pay for over 13,000 horse-power, so that ought to dispose of the 7,000 estimate. On the same authority it is stated that the company has a connected load of upwards of 20,000 horse-power. This does not include what is being generated in the city and district of Montreal, by the company's own plants or by those of its subsidiary companies. The Saraguay Electric and Water Company, which is a subsidiary of the Canadian Light and Power Company, is applying at the present session of the Quebec Legislature for authority to change its name to the Montreal Public Service Corporation, and to increase its capital to $5,000,000, and to extend its borrowing powers. All these companies, together with the Montreal Tramways Company, are subsidiaries of or component parts of the Montreal Tramways and Power Company which operates the street railway system of the city and island.

From the above it would seem that the power companies of Montreal are in a position to supply at all times from 100,000 to 125,000 horse-power. Should there be occasion, the Shawinigan Water and Power Company can provide 45,000 more, and it is understood that the Canadian Light and Power Company is making an effort to increase its capacity. The capacity of the Cedar Rapids Manufacturing and Power Company, within thirty miles of the city, may be counted on, and if the National Hydro-Electric, with its Carillon Power be added, it would seem that the requirements of the city of Montreal may double without pressing unduly upon the producing capacities of the companies mentioned.

◆

The C.P.R. bridge across the Saskatchewan River at Outlook has been completed. The last girder was put into place recently and immediately the work of laying the rails was commenced. This bridge is one of the biggest in Western Canada, being over three thousand feet in length, and 156 feet in height. The construction work was commenced in 1909, and is conceded to be one of the biggest undertakings ever attempted to cross the Saskatchewan River. There are nine piers of solid concrete and the piers are 110 feet above the water level with a steel superstructure 46 feet high.

IMPROVEMENT IN FIRE HYDRANTS.

Every city engineer and fire chief is well acquainted with the cost of fire hydrants, and would welcome any efficient method that would allow of economy and certainty in this matter, but the question does not lend itself to an easy solution, owing to the increased pressure that is constantly being demanded from these hydrants by firemen in their improved methods of fire-fighting.

It has long been the ideal of fire fighters to secure some appliance that would automatically regulate the pressure of the stream, and several valves for this purpose have been devised, but their cost was prohibitive to their application to every hydrant. The problem has been solved by the portable hydrant head illustrated by Fig. 1.

This portable hydrant head may be quickly attached to any existing hydrant opening and contains a number of hose taps, each furnished with an automatic valve. In a city where the system is operative each hose wagon carries one hydrant head, and the connection with the main is made immediately upon arrival.

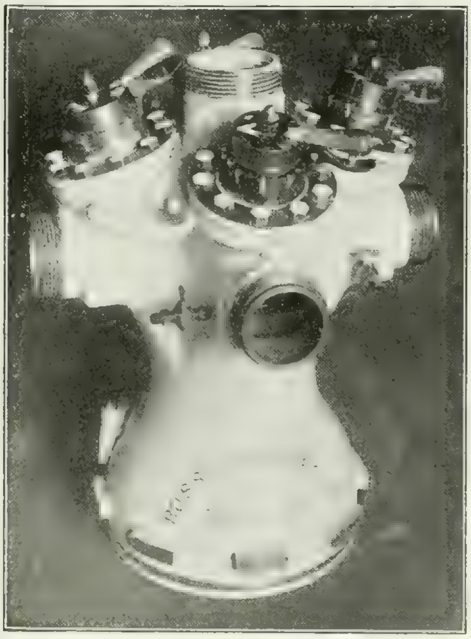


Fig. 1.—View of Portable Fire Hydrant Head.

This system was recently introduced in the high-pressure area of Baltimore, the hydrants being constructed for that municipality by the Ross Valve Manufacturing Company, of Troy, N.Y.

When attached to the main each hydrant sets flush with the pavement, and in order that many points of contact will be at the option of the firemen the means of connection with the water supply is greatly simplified; consisting of a cutting in the main with a section of 8-inch pipe welded in. The hydrant itself is of semi-cast steel resting on a concrete base in a concrete chamber with the upper end constructed to receive the portable head which is secured by a slight turn and may be placed firmly in position in a few seconds. When the special head is removed a grating covers the hydrant top and tap, giving a neat and unobstructive finish. The portable head has five hose taps and weighs about 110 pounds; four of the taps are fitted to take 2½-inch hose couplings and the fifth is fitted for a 3-inch hose. The tap handles are so placed and weighted that they balance the entire structure.

RAILROAD NOTES.

Work has been suspended on the Providence extension of the Central Vermont. The work has been stopped, it is said, owing to the unsettled condition of the money market in England. It was the first intention of the company to have the road from Palmer, on the Central Vermont, to Providence, a distance of 57 miles, completed by the end of the year. It is stated that thirty per cent. of the grading has been accomplished.

The Canadian Northern Railway will probably seek legislation this season providing for its maritime outlet for through traffic from the West. The final eastern link of the Canadian Northern system from Sudbury to Quebec now under construction, will be completed within a year or so. There is no provision for further outlet to the seaboard, and the road wants to be in a position to secure the through haul, instead of having to turn its traffic over to the rival roads at Montreal or Quebec when the St. Lawrence navigation season closes. The alternative schemes are running rights over the Intercolonial, or connections with the Boston and Maine.

The company is applying for legislation authorizing the construction of a line from Montreal to Levis, with a branch running down from St. Hyacinthe to Sherbrooke. At this latter point the road will make connections with the Boston and Maine line, giving a through outlet for export grain and other commodities via Boston. Thus the Canadian Northern Railway would be in a good position to compete with the Canadian Pacific Railway and the Grand Trunk Railway from coast to coast, and would be independent of these roads or their allies for the Atlantic outlet.

Important changes are to take place in the agreement between the Grand Trunk Railway system and the Wabash Railway, in connection with the Air Line branch, over which the Wabash has running rights. President Chamberlin, of the Grand Trunk, and General Manager Deland, of the Wabash, recently made an inspection of the Air Line division, so that there is indication that the Wabash Railway will increase its interests in Canada.

The Wabash Railway has completed arrangements for the purchase of three of the old Michigan Central car ferries for use on the Detroit River. Heretofore, the Wabash has used the Grand Trunk car ferries to handle its trains across the river.

Twenty miles of steel of the Temiskaming and Northern Ontario Railway on the new Elk Lake branch have been laid, leaving about ten miles to be completed. While a service may be inaugurated by Christmas, the Montreal River has yet to be crossed. The piers and coffer-dams are all ready, and the steel work is now being assembled at the factory. With fair conditions the work ought to be completed late in December.

The Chatham, Wallaceburg and Lake Erie Railway has been bonded by the Canadian Northern interests. The sum of $25,000 has been paid to secure the option. The action of the Mackenzie and Mann interests in securing this line is regarded as further evidence that the Canadian Northern Railway means to push through with the work in Western Ontario to Windsor.

◆

The Peace River and Great Western Railway Company has opened offices in Edmonton and construction will be pushed next season. In the meantime preliminary work will be done. It is stated that surveys will be completed, ties cut along the right-of-way, and supplies sent forward during the winter for construction camps to be established in the spring.

LOSS OF HEAT FROM STEAM PIPES.

A paper was read by Prof. Petavel and Dr. C. N. Lander before the Engineering Section of the British Association (Dundee, September, 1912), in which they gave results of an experimental investigation to determine the relative importance of convection, conduction and radiation in promoting the loss of heat from hot wires and from hot pipes. They found that a bare 1-in. steam pipe in free air lost heat at the rate of 3 B.T.U. per sq. ft. per hour per deg. F. of temperature difference. Of this total, 15 per cent. was due to radiation, 4 per cent. to conduction, and the remaining 81 per cent. wholly to convection. In insulating a pipe it is necessary to determine the best density of the packing material. The best of such materials have thirty times the conductivity of air, so that, were it not for convection, clothing a pipe would increase the loss of heat. What actually happens is, that covering a pipe greatly diminishes the convection, but by an amount which depends on the closeness of the packing. If too tightly packed, the efficiency will be low, owing to an increase in the conductivity; while if too loosely packed, a large proportion of the convection still continues. Hence there is in each case a certain best density for the packing. In the case of slag wool, this is one-fourteenth of the actual density of the individual fibres. In this case the loss by conduction will rise from 0.1 to 0.4 B.T.U. per sq. ft. per deg. F. per hour, but the loss by convection will fall from 3.2 B.T.U. to 0.1 B.T.U. per sq. ft. per hour, the net loss being one-seventh of what it will be with a bare pipe.

With bare metal pipes the character of the surface has a distinct influence, but it affects only the loss by radiation. With a good machined surface this loss is reduced from 15 per cent. of the total to about 7 per cent.; polishing the pipe to a mirror-like surface will reduce this loss still further to between 3 and 4 per cent. of the total. Little, however, is to be gained by polishing in the case of ordinary steam-pipe temperatures, as the main loss—by convection—is not affected in any way by the condition of the surface. When the pipe radius is small, the conduction loss becomes the more important, so that the total loss varies with the pipe diameter. For pipes larger than ½ in. in diameter, however, this increased loss by conduction is unimportant. For bare pipes of about 1 in. in diameter the total loss, as stated above, is about 3 B.T.U. per sq. ft. per deg. F. per hour; for pipes above 4 in. in diameter the loss becomes nearly constant at 2 B.T.U. per sq. ft. per deg. F. per hour, irrespective of diameter.

◆

RELATION OF RAILWAYS TO DEVELOPMENT

President Finley, of the Southern Railway, in an address before the Transportation Club, of Indianapolis, spoke on "The railway and the shipper." He said in part: "The railway and the shipper are each dependent upon the other. It is recognition of this dependence upon the shipper that has led the railways of the United States to adopt policies having for their purpose the enlargement of the business of shippers on their lines and the multiplication of the number of shippers. These helpful policies are based on sound business principles, for if we look beyond the immediate present, it is apparent that the ultimate prosperity of the railway is dependent upon the lasting prosperity of those upon whom it must rely for its traffic.

"In my opinion it is equally true that the shipper is dependent for his ultimate prosperity upon the lasting prosperity of the railway."

Mr. Finley pointed out that not only wages, but materials and supplies used by railways have advanced in price, and that their taxes, levied by government, have increased $80,000,000, or 167 per cent., since 1900, and amount for the fiscal year 1912 to about $130,000,000.

These facts were presented in order that some conception of the railway situation of to-day and of the problems with which railway managers must contend in their efforts to provide facilities for serving the shipper might be formed. Looking to the future development of the country and the growth of agriculture and manufacturing, it is clear that an increase in carrying capacity will be needed. Leaving out of account the new construction that should be undertaken in some localities, generally speaking, the policy of the railways should be that of keeping their existing plants abreast of requirements.

The practical question confronting those responsible for making these improvements is that of providing the necessary capital. The ability of the companies to attract the investment of new capital on reasonable terms will be measured by their net earnings capacity. Railway credit is dependent upon net income, and it is essential to the continued development of the American railway system that units of revenue shall bear a proper economic relation to units of cost.

The shipper who takes this broad view of the railway situation in all of its far-reaching economic bearings will be led to the conclusion that some rate reductions that are asked for are unreasonable and hurtful to the best interests of all concerned, and that some rate advances proposed by the railways would be helpful in their ultimate effects to the railways and the shippers alike.

When the time shall arrive that the shipper shall take the same lively interest in the railway by which he is served —when he shall study its reports and understand its needs and its resources, and when he shall look upon its progress as an indispensable factor in his own prosperity, the solution of the railway problem of the United States will be arrived at and the interests of the railway and the shipper have been promoted.

This is an opportune time for the railways and the shipper to draw closer together in mutually helpful cooperation. We have entered upon a period of general prosperity which is reaching all classes of our people, and it has come to stay.

◆

ELECTRIC SMELTING IN CANADA

That a report demonstrating that electric smelting of Canadian ores is now a commercial possibility will be issued early in the year by the Mines Branch of the Department of Mines is announced in conservation. It will cover the results obtained from the use of the 100-ton electric furnace that was installed at Sault Ste. Marie, in 1906, for experimental purposes. In addition, the perfecting of the process as carried out in Sweden will be dealt with.

Such an announcement is of great importance to Canada, and especially to Ontario. Hitherto, the extensive iron deposits in Ontario have been scarcely touched, for two reasons: First, Ontario has to import all its coal; second, Ontario iron ores contain a relatively high percentage of sulphur, which could not be removed by the blast furnace. The new process will eliminate both these objections. Electricity will not only smelt the ore, but, by means of the greater heat that it will provide, it will volatilize and drive off practically every particle of the sulphur. The country surrounding the important iron deposits possesses valuable water-power resources, which, for the most part, have not yet been developed. It is thus easily seen that the introduction of an economical electric smelter will make possible an industry of vast importance to Canada.

COAST TO COAST.

St. Lawrence River.—The Minister of Marine and Fisheries, has ordered a strict enquiry into the recent shipwrecks that have occurred in this river.

Saskatoon, Sask.—The announced opening of the street railway for December 1st will likely be delayed owing to the non-arrival of the power house generators.

Ottawa, Ont.—The Board of Railway Commissioners for Canada will hold a sitting on Saturday, December 3rd, to discuss the protection of car repairers.

Ottawa, Ont.—Plans for the new Welland Canal are nearing completion, and from the estimates now available, it is expected that this work will cost $50,000,000 and take five years in building.

Calgary, Alta.—A recommendation made to the city council in a report submitted by the joint committee of council, park board, school board, and city planning commission, calls for a $600,000 system of parks, boulevards and playgrounds.

Province of Alberta.—At a meeting of municipal representatives recently held in Regina, the system of bonusing industries was condemned and a resolution introduced to have the governments of the other western provinces pass a law in conjunction with the authorities of this province, to have this evil reduced.

London, Ont.—Ald. Ashplant has made an estimate of expenditures upon the West London Embankment since the year 1898. During this space of time the sum of $31,000 has been spent on this work to keep the breakwater in proper condition. He will introduce a motion before the council to spend $45,000 and make the affair permanent.

Stratford, Ont.—Some items extracted from the Board of Trade report are of interest. The capital invested in local factories is reported as $3,597,913, with an annual output of $5,807,148. A wage bill of $1,323,199, and an army of 2,337 male and 553 female employees, with a total assessment of $9,708,780. The city has 12.81 miles of paved and macadam roadways, and 38.74 miles of concrete sidewalk.

Hamilton, Ont.—In January the ratepayers will vote on the new hydro-electric commissioners, and also vote on by-laws which, if carried, will authorize an expenditure of $910,000 for various civic works. The principal by-law will be to provide for the building of a storm sewer at a cost of half a million. Another is to raise $130,000 for the purpose of purchasing mountain face properties for park purposes.

Province of Saskatchewan.—The amount of construction of telephone lines in this province accomplished since March 1, 1912, is approximately 800 pole miles, and 1,572 wire miles. This gives a total for the province of 2,964.07 pole miles, and 9,744.3 wire miles. The number of toll offices opened and purchased to date is 228, and the total number of exchanges built and purchased to date is 80, with 12,802 subscribers.

Ottawa, Ont.—A report demonstrating that the electric smelting of Canadian ores is now a commercial possibility will be issued shortly by the mines branch of the Department of Mines. It will cover the results obtained from the use of the 100-ton electric furnace which was installed at Sault Ste. Marie in 1906 for experimental purposes and will also deal with the perfecting of the process as carried out in Sweden.

British Columbia.—The annual report of the Minister of Mines of British Columbia shows that taking the province as a whole there were 546 tons of ore mined per year for each man employed about the mines. In this respect, however, the districts vary materially as follows: Slocan District, 113 tons; Nelson District, 130 tons; Trail District, 372 tons; and in the Boundary District 1,201 tons were mined per man employed.

Victoria, B.C.—Creditors of the defunct Midway & Vernon Railway, a considerable part of which undertaking was taken over at the chartering of the Kettle River Valley Railway by that company, are to receive in the near future full settlement of their legitimate claims for labor, material, teaming, etc. Upon the incorporation of the Kettle River Valley line with government assistance in its financing, such aid was made conditional upon the payment of outstanding claims as against that portion of the line which they will utilize.

Dauphin, Man.—At the Board of Trade meeting held last week it was decided to approach the city council to further investigate the water power scheme at Meadow Portage with a view to approaching the government to connect the two lakes by a canal and secure the right to install and operate hydro-electric power plant. There being a fall of 18 feet between Lake Winnipegosis and Lake Manitoba, it is anticipated 40,000 h.p. can be generated there at little cost. This would give Dauphin a fine power supply at comparatively small cost.

Galt, Ont.—Ald. Dakin, chairman of the local Hydro-Electric Commission, will apply for power to inaugurate underground wiring, thus compelling the Bell Telephone Co. and C.P.R. and G.N.W. telegraph companies to transfer transmission lines to conduits. The policy to be followed is that conduits shall all be laid by the corporation, primarily for hydro-electric wires, but the extra cost to accommodate the lines of private companies shall be paid by them, according to the space used. This places the construction of the conduits entirely in the hands of the municipality.

Hamilton, Ont.—The matter of placing all wires in the down-town section of this city, as mentioned in *The Canadian Engineer* of last week, has been settled by the Hydro-Electric Power Commission issuing an order for the placing of all wires in the down-town district underground. This order involves the Cataract Power Company, the Hamilton Hydro-Electric service, and states that provision shall also be made for the telephone and telegraph wires. This is the first order of the kind to be issued under the legislation of last session under which the Hydro-Electric Commission could hold joint sittings with the Dominion Railway Board.

Province of British Columbia.—As the lines of the Grand Trunk Pacific Railway are pushed farther and farther westward several croppings of coal are found in unexplored portions of the province. Among the best so far found is the property on Kitseukla Creek, 12 miles from the railway and nearly south of Hazelton on the Bulkley River. Advices from British Columbia state that there are 31 seams of coal outcropping on this land and that of these two have been partially developed, one of them being 7 feet in thickness and the other 4 feet. The coal, according to recent assays, yields 68.5 per cent. of coke in addition to being a high-grade steaming and domestic fuel.

Collingwood, Ont.—The energy consumed by ratepayers from the civic power plant shows a steady increase. The monthly totals for last year and this are shown:

	1912	1911.
January	$2,069	$1,011
February	1,848	1,759
March	1,391	1,392
April	1,270	1,518
May	1,118	1,126
June	1,011	910
July	974	991
August	839	663
September	1,066	905
October	1,561	1,250

London, Ont.—Adam Beck, chairman of the Ontario Hydro-Electric Commission, has submitted a report to the council of London, Ont., recommending the electrification of the municipally owned London and Port Stanley Railway at an approximate cost of $890,000. The report recommends the adoption of the overhead system and the double-tracking of the entire line between London and Lake Erie. The intention is to maintain a high-speed half-hourly service between London and St. Thomas. A fifteen-minute shuttle service between St. Thomas and Port Stanley would also be maintained for especially heavy traffic. The estimated gross revenue for the first year under electric operation is $261,500. Of this $140,000 would come from freight and $121,500 from passenger traffic. The estimated disbursements are $220,545, consisting of $130,000 for operating expenses and $90,545 on capital expenditure, leaving net earnings of about $41,000.

Edmonton, Alta.—Further extension of municipal ownership at Edmonton, Alta., was indicated when the commissioners directed City Engineer Latornell to report upon the cost of installing a paving plant of not less than 100,000 square yards capacity during the building season, also to engage a construction engineer qualified to take charge of of the city's paving work. The plant is to be in operation early next spring. The cost is estimated at between $40,000 and $50,000. The office of construction engineer is a new one in the city's service. His duty will be to take charge of the plant and supervise the paving work. The city will compete with private firms in all municipal work, taking contracts to keep the plant running at full capacity throughout the season. Five hundred thousand square yards of new pavement will be laid by the city next year, as against about 250,000 square yards put down during the season of 1912. It is expected that the specifications will be announced in January or February, giving ample time for contractors to assemble men and materials.

Niagara Falls, Ont.—The Ontario Power Company has filed an application with the Queen Victoria Park Commissioners for permission to install another turbine and generating unit, to be known as wheel No. 13. The necessity of installing this additional unit is the natural result of the greatly increasing load of the hydro-electric, which has assumed such large proportions that it has been found next to impossible to supply the demand for electric energy with the present machinery. The last two units installed, Nos. 11 and 12, have not yet been completed, but probably will be put in operation on or about January 15, but unit No. 13 will probably be placed in commission by July 1. With ten units already in operation, approximately 125,000 electrical horsepower is being generated, and this will be greatly increased with the completion of the three additional units. All of the exterior excavation work on the new wheel and Nos. 11 and 12 will be entirely completed by April 15, in compliance with an agreement between the power company and the park commission.

Province of Saskatchewan.—The large amount of work which has devolved upon the Department of Public Works in connection with the laying out of the grounds of the numerous government buildings in the province has necessitated the employment of an expert in this line, and Mr. Malcolm Ross has been appointed to take charge of this very important work. The grounds of the parliament buildings, of the university, the normal schools, the provincial asylum and the court houses will all be under his care. In some of the larger works such as the university and parliament buildings grounds where the architectural features of the buildings will have to be considered, Professor Mawson has been retained to assist Mr. Ross. Mr. Ross, who was until recently Parks Superintendent of the City of Regina, is a man with high qualifications for his new position. He is a Bachelor in Scientific Agriculture, a graduate of Guelph Agricultural College, with a post graduate experience in the several parts of the United States, and was in the employ of Mr. George Vanderbilt on the Viltmore estate in North Carolina.

Edmonton, Alta.—One hundred thousand dollars is the estimated cost of a three-story market building to be erected by the municipality of Edmonton, Alta., early in 1913. The plans, prepared by City Architect Jeffers, show a structure of horseshoe shape, built of reinforced concrete and brick with stone trimmings. The site chosen for the building is the present hay market in First Street, which is served by the municipal street railway and is within easy distance of the Grand Trunk Pacific, the Canadian Northern and the Edmonton, Dunvegan & British Columbia Railroads. The last named line is under construction and will serve the north country. Provisions have been made for stores and offices in the wings of the building, which will face First Street and Queens Avenue. An arcade entrance will lead to the market proper, consisting of long rows of stalls, where market gardeners and growers will be able to display their products and deal directly with the consumer. It is probable that a refrigerating system will be installed in the butter and egg and fowl and meat departments. The building to be erected next spring will form part of the general market. It is expected that a by-law to provide funds will be submitted to the ratepayers in a short time. Commissioner Chalmers, who has charge of the plan, states that the market is to be the central point for the street railway system, as well as for all the suburban lines on the north side of the Saskatchewan River. The suburban roads will become express lines within the city limits, running direct to the central station. This will facilitate the handling of products from the suburban communities and will be the means of settling the close-in districts.

◆

EXPERIMENTS ON REDUCTION OF STRESS.

A description of and data from experiments made at the testing laboratory of the Darmstadt Technical High School on the reduction of stresses in metal members by rounding off sharp angles are given in a recent issue of the Journal of the American Society of Mechanical Engineers. The author states that although the fact that the stresses are particularly large at sharp angles was known for a long time, there are practically no experiments available showing numerically the precise influence of the radius of curvature on the stress at and near the point of flexure. Fig. 1 shows graphically how the change in the radius of curvature affects the distribution of lines of equal stresses. Among other things, these experiments have established the fact that the neutral point of stresses as found from actual measurements does not coincide with that determined theoretically.

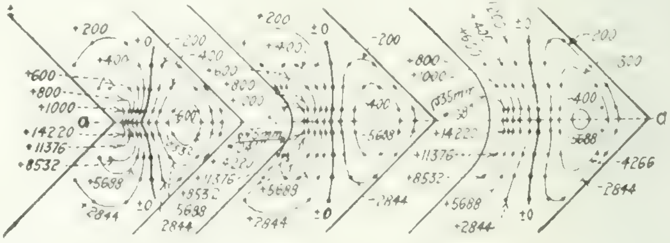


Fig. 1.—Distribution of Lines of Equal Stresses for Various Radii of Curvature.

+ Tensile stress; — Compression; o Points constructed from Measurements: above Line *aa* in kg/qcm, below in Lb. per Sq. In

PERSONAL.

W. COLIN EWING has been appointed junior assistant to Mr. F. G. Goodspeed, district engineer of St. John, N.B.

R. H. FLAHERTY, of Port Arthur, Ont., has returned from an exploration of Ungava district, in the interest of Mackenzie and Mann.

A. E. ROSEVEAR, assistant general freight agent of the Grand Trunk at Montreal, has been appointed assistant to vice-president, with office at Montreal.

HON. LOUIS CODERRE, M.P. for Hochelaga, Que., has become Secretary of State and head of the Department of Mines, which has been transferred from the Minister of the Interior to the Secretary of State.

R. S. LEA, the well-known consulitng engineer, of Montreal, is on a five-week Western trip. He will visit Medicine Hat, Edmonton, Kamloops and Vancouver, in all of which cities he has been retained in connection with large engineering undertakings.

Mr. E. L. Cousins, B.A.Sc.

EDWARD L. COUSINS, B.A.Sc., engineer to the Toronto Harbor Commission, is a graduate in civil engineering of the University of Toronto. The Harbor Commission, who were appointed last fall, chose him as their engineer in January of this year. Mr. Cousins was appointed divisional engineer for the Grand Trunk Railway, with headquarters in Toronto, on graduation. In July, 1910, he became Assistant City Engineer in charge of railways, bridges and docks. He was born in Toronto, and received his early education at St. Andrew's College. The plans of the Toronto harbor improvement, which appear in this issue, were prepared under his direction.

DR. FRANK D. ADAMS, dean of the Faculty of Engineering, McGill University, was recently the guest of honor at a dinner given at Albany, N.Y., by Dr. John M. Clarke, the state geologist, to celebrate the dedication of the new State Survey and Museum Building.

DAVID WHITE has been appointed by the secretary of the interior as chief geologist of the United States geological survey to succeed Waldemar Lindgren, who leaves Washington to become Rogers' professor of geology and head of the geological department of the Massachusetts Institute of Technology.

FRED. A. ROBERTSON ('08 Science, University of Toronto) who has been in charge at the Toronto office of the cement and reinforced concrete departments of the Canadian Inspection and Testing Laboratories Company, Limited, has severed his connections with the above concern to join the selling forces of the Canada Cement Company, Limited, out of Toronto.

ROC MAC CONSTRUCTION.

During 1911 a 1,200-ft. section of Yonge Street, at Toronto, Ont., was reconstructed for 30 ft. of its width with broken stone and the preparation "Roc Mac." The method of construction, as described in the last annual report of the city engineer, was as follows: The surface of the old macadam was first swept thoroughly in order to remove as much of the mud as possible. Upon this prepared base a paste consisting of a mixture of limestone dust and Roc Mac solution was then spread to a depth of about 1½ or 2 ins. The proportions of this mixture were ⅓ cu. yd. of dust to 5 gals. of the solution. Granite crushed to about a 2-in. size was then evenly spread to a depth of from 3 to 4 ins. The pavement was then rolled until the paste worked through the stone from the bottom and formed a slurry on top. All surplus slurry was always swept forward to the head of the work. This character of work depends for its existence largely on the care with which the rolling is done, it being necessary to carry on the rolling constantly until all voids are absolutely filled. Yonge Street carries perhaps a larger volume of traffic entering and leaving the city than any of the other main entrances, and during the progress of the work described above, this traffic was not interrupted for a moment, all vehicles being allowed to drive over the work no matter what stage it was in. It was found that the roadway when completed, although roughly used, had a very hard, compact surface, and for the few months subsequent to its completion it has carried all traffic without receiving any apparent impression other than that shown in the thin film of mud covering it in wet weather. The cost of the work was about 78 cents per square yard.

THE NOBEL PRIZE.

The Nobel Prize for physics has been awarded Gustaf Dalen, a Swiss engineer, who is head of the Stockholm Gas Company.

The Nobel Prize for chemistry has been divided between Prof. Grignard, of Nancy University, and Prof. Paul Sabatier, of. Toulouse University.

The value of these prizes is $38,600 each

ELECTRICAL MEETING IN MONTREAL.

Mr. Fred Thompson gave an interesting paper before the Electrical Association recently on "Some Early Electrical Installations in Montreal." In 1883, he said, it was considered necessary to give an exhibition, and it fell to his duty to show some of the wonders of electricity in heating, cooking and lighting. The cooking demonstrations on electric stoves were, however, faked, and the tasty beefsteaks, fried eggs, tea and toast that were so praised were spirited from a back room, where they had been cooked on a gas stove, while those tried on an electric stove were badly frizzled.

The lighting of McGill University in 1884, when the British Association, headed by Lord Kelvin, visited the city, and how they had to run wires over citizen's front doors, trees and shutters, and how citizens were unable to open their doors, and threatened legal proceedings, was told in a most interesting manner by the speaker, who said that the ladies had taken a fancy to learn electricity, but their ardor cooled when they were put to covering wires, which was a very dirty job.

The establishment of connection between Montmorency Falls and Quebec, the running of wire across Victoria Bridge, and the railway experiments in 1892 were also referred to by the lecturer.

OBITUARY.

MR. PETER LYALL, well known in Canadian contracting circles, died at his home in Montreal recently. He was president of the Peter Lyall Construction Company, and connected with many other interests. Mr. Lyall was born in Caithness, Scotland, seventy-one years ago. He was early apprenticed as a stone mason and after thoroughly mastering his trade he came to Canada in 1870, beginning business under the auspices of his cousin, Peter Nicholson. Six years later he founded the contracting business which bears his name, and with which his three sons, William, Traill and Peter, Jr., are associated. This firm has developed until to-day it is unquestionably the largest construction company in the Dominion.

MR. GEORGE CRADDOCK, a well-known architect of London, Ont., died at his home in that city on November 16th last. He designed many of London's buildings.

COMING MEETINGS.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Meeting of the Electrical Section will be held in the rooms of the Society, 413 Dorchester St., West, Montreal, Nov. 21st at 8.15 p.m. Paper on "Transmission Line Design," by Mr. Julian C. Smith, M.C.S.E.E., will be read by the author. Chairman, L. A Herdt

THE CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lecture, Nov. 23rd, at 8 o'clock. "The Prevention of Sewage Pollution relative to Water Supply," by T. Aird Murray, C. E., Toronto. Secretary, J. Patterson.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh. Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

UNION OF MANITOBA MUNICIPALITIES.—Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg. Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago. Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St,, New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE · Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre: Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex Mayor of Westmount

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose Secretary Treasurer G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man. Secy Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr, G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Candaian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
12-10	—400,000 sq. yds. Asphalt and Bitulithic Pavement, Edmonton, Alta .... (P. & S.)	11-21

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to

Place of Work.	Tenders Close.	Issue of.	Page
Fredericton, N.B., bridge, Reversible Falls	Dec. 2.	Nov. 7.	74
Fredericton, N.B., substructure of bridge	Dec. 2.	Nov. 14.	74
Fernie, B.C., drill hall	Nov. 21.	Nov. 7.	65
Humboldt, Sask., boiler house, boilers, etc., ...	Nov. 21.	Nov. 14.	65
Kerrisdale, B.C., steel pipes...	Dec. 2.	Nov. 7.	76
Montreal, P.Q., railway ties	Dec. 20.	Nov. 14.	65
Ottawa, Ont., gasoline launches .	Nov. 20.	Nov. 14.	65
Ottawa, Ont., metal naval stoves	Dec. 3.	Nov. 14.	65
Ottawa, Ont., conveyance of H.M. mails	Nov. 29.	Oct. 24.	74
Ottawa, Ont., conveyance of H.M. mails	Dec. 13.	Nov. 7.	76
Point Grey, B.C., steel pipes..	Dec. 2.	Oct. 17.	74
Peterborough, Ont., interior post office fittings	Nov. 20.	Nov. 14.	65
Quebec, P.Q., grain elevator...	Nov. 30.	Oct. 17.	76
Toronto, Ont., sewers	Nov. 19.	Nov. 14.	65
Toronto, Ont., engines and boilers	Dec. 10.	Oct. 31.	74
Three Rivers, Que., public building	Nov. 25.	Nov. 7.	65
Victoria, B.C., cable	Nov. 25.	Nov. 7.	66
Wallaceburg, Ont., public building	Nov. 20.	Nov. 7.	66
Winnipeg, Man., plans for city hall	**Feb. 15.**	**Sept. 26.**	**68**
Winnipeg, Man., machinery ...	Nov. 20.	Nov. 14.	65
Winnipeg, Man., turbine pumps and motors	Nov. 20.	Nov. 14.	66
Winnipeg, Man., manhole grates	Nov. 22.	Nov. 14.	66

◆

TENDERS.

Dunnville, Ont.—The time for receiving tenders for a turbine pump installation for domestic and fire purposes in the town of Dunnville, has been extended to Thursday, 28th November, 1912. Allan Mair Jackson, Superintendent of Water Commission. (See Advt. in The Canadian Engineer.)

Edmonton, Alta.—Tenders addressed to the City Commissioners, will be received until noon of November 25th, 1912, for the construction of the substructures of the 5th St. Bridge. Plans and specifications may be obtained at the office of the City Engineer, 623 2nd Street.

Edmonton, Alta.—Tenders for approximately 400,000 sq yds. of asphalt and bitulithic pavement, will be received at the office of the City Commissioners, Edmonton, until noon of December 10th, 1912. Plans, specifications, etc., may be obtained at the office of the City Engineer. Plans and specifications are also on file at the office of The Canadian Engineer, and the Contract Record, Toronto. A. J. Latornell, City Engineer. (See advt. in The Canadian Engineer).

Kamloops, B.C.—Tenders will be received until noon of December 5th, 1912, for 1,000-h.p. steam, pumping and electrical equipment of the new power station for the city of Kamloops. Plans and specifications may be seen at the office of J. J. Carment, City Clerk, and at the offices of DuCane, Dutcher & Co., Consulting Engineers, Vancouver, B.C., and R. S. Lea, New Birks Building, Montreal. (See advt. in The Canadian Engineer).

Montreal, P.Q.—The Central Railway Company of Canada invites tenders for supplying railway ties in lots of five to one hundred thousand, for delivery at a number of different points. Specifications, etc., at the office of F. Stuart Williamson, Chief Engineer, 44 Beaver Hall Hill, Montreal. Tenders will be received until noon of December 20th, 1912. (For full particulars see advertisement elsewhere in The Canadian Engineer.)

Moose Jaw, Sask.—Tenders will be received at the office of the City Commissioners, Moose Jaw, up to noon of December 6th, 1912, for construction and erection of a steel bridge of One Hundred forty-five foot span across Moose Jaw River at Moose Jaw. Plans and specifications on file at the office of the City Engineer. (See advt. in The Canadian Engineer.)

New Westminster, B.C.—Tenders will be received by A. O. Powell, Harbor Engineer, 514 Westminster Trust Bldg., until December 2nd, 1912, for upwards of three thousand linear feet of cedar pile quay wall construction, and one million cubic yards of back filling with rock revetted slope. Plans and specifications may be examined at engineer's temporary office at Room 22, 26 Lorne Street, New Westminster. (See Advt. in The Canadian Engineer.)

Rock Island, P.Q.—R. C. Desrochers, Esq., secretary, Department of Public Works, will receive tenders for the erection of a post office and customs and inland revenue office, also interior fittings for the same up to 4 p.m., December 2nd next. Plans and specification to be seen on application to Mr. Jas. Lowell, Clerk of Works, Rock Island, P.Q.; Mr. H. N. Lymburner, Supt. of Buildings, Montreal, and at the Department of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received by the Secretary of the Ontario Jockey Club, 6 Leader Lane, until noon of November 26th, 1912, for demolishing the brick building and addition on the grounds of the Ontario Jockey Club, known as Woodbine Park Hotel, Queen Street, East.

Toronto, Ont.—Bulk tenders, or tenders for the several trades mentioned below, in connection with a fire hall, will be received by registered post only, addressed to the undersigned, up to noon on Tuesday, 3rd December, 1912: 1, Mason; 2, carpenter; 3, plumbing; 4, heating; 5, roofing; 6, plastering; 7, electric wiring and light fixtures; 8, painting. Plans and specifications may be seen and forms of tender and all information obtained at the office of the City Architect, City Hall, Toronto.

Victoria, B.C.—The provincial public works department will receive tenders for the erection of a 4-roomed, brick schoolhouse at Black Mountain. All tenders to be in by noon, November 27th.

◆

CONTRACTS AWARDED.

Dunnville, Ont.—The Des Moines Bridge and Iron Company, of Des Moines, Iowa, U.S.A., were the successful tenderers on the construction of a steel elevated tank. Their price was $5.550.

Welland, Ont.—Messrs. W. G. Somerville & Sons have been awarded the contract for the construction of a sewer to the Empire Cotton Mills at a price of $5,446.90. The other tenders were: Excelsior Construction Co., $5,915.20; Peter McMurray, $5,826.91; Geo. Reid, $5,533.15. The Engineer's estimate of the work set the amount at $5,213.00.

Victoria, B.C.—Messrs. Hutchinson Bros. will be awarded the contract for the installation of primary feeders for cluster lighting on Government Street South, the company's bid of $1,856 being the only one received by the city.

◆

RAILWAYS—STEAM AND ELECTRIC.

Central Canada.—Messrs. Lewis and Smellie, Ottawa, state that an application will be made to the Parliament of Canada at its next session for an Act to incorporate a railway company under the name of "All Red Line Railway Company," with power to construct, lay out and operate a line of railway from a point at or near the easterly boundary of the Province of Quebec, thence in a westerly direction by the most feasible route through the Provinces of Quebec, Ontario and Manitoba to the city of Winnipeg, with branch lines.

◆

LIGHT, HEAT AND POWER.

Lower Ontario.—The Hydro-Electric Commission has signed power contracts with Brantford, Paris, Port Dalhousie, Brockville and Prescott.

Mirror Lake, B.C.—The members of this municipality have subscribed sufficient capital to cover the erection costs of an electric light plant. Mr. A. Link is one of the directors.

North Bay, Ont.—The politicians advocating the adoption of the hydro-electric by-law have been met with record audiences, and judging from present appearances the matter will be carried by the ratepayers.

Toronto, Ont.—Hon. Adam Beck, in an address before the Ontario Municipal Electrical Association, intimated that a reduction in Hydro-Electric power might be looked for by several municipalities.

Winnipeg, Man.—The municipal Fire, Water and Light Committee have ordered the extension of the Main Street cluster lighting system to the northern limits of the city.

◆

GARBAGE, SEWAGE AND WATER.

Berlin, Ont.—Chairman Piper, of the sewer committee, has reported on the cost of a trunk sewer for this city. According to his estimates the expenditure will be about $90,000.

London, Ont.—The report of Mr. A. E. Macgregor, who has been engaged for some time in preparing a topographical map of the city, is before the board of works. The maps, drawings, etc., showing the proposed storm sewers, were enclosed with the report, and gave the aldermen a definite idea as to what is needed. The estimated cost of the storm sewer construction is placed at $500,000.

Vancouver, B.C.—Mr. R. S. Lea, consulting engineer on the sewerage scheme, states that his report will be submitted this year. He states that sewage matter turned into English Bay will not prove a nuisance.

◆

BUILDINGS AND INDUSTRIAL WORKS.

Berlin, Ont.—A company taking the name of the Fibre Products Company has been organized with Mr. J. Walter as factory manager. The products of this firm will be furniture trimmings, electrical insulators and lavatory fittings.

Edmonton, Alta.—The Board of Governors of the University of Alberta will erect a new students quarters at a cost of $[illegible]

Edmonton, Alta.—It is reported that the directors of the Canadian General Electric Company are considering the erection of a branch plant at this point.

Edmonton, Alta.—The management of the Presto Heater Company, will erect a $50,000 factory in this city to house the manufacture of their products.

Guelph, Ont.—It is reported that Mr. Alex. Simmers, of Winnipeg, will consider the erection of a sheaf loader factory in this city.

Hamilton, Ont.—A company, financed by John Alden and Charles Palmer, of Rochester, N.Y., will erect a factory in this city for the manufacture of porcelain. The company will be known as the Canadian Porcelain Company, Limited.

London, Ont.—The management of the Findlay Electric Porcelain Company will locate in this city if given financial assistance.

London, Ont.—The management of the Dennis Manufacturing Company are making arrangements for the extension of their plant at a cost of $25,000.

Moose Jaw, Sask.—Mr. W. B. Sherman has submitted a set of theatre plans for the ratification of the building inspector.

New Denver, B.C.—The directors of the New Denver Fair are considering the enlargement of their present buildings. Mr. H. S. Nelson is chairman of this committee.

New Westminster, B.C.—The municipal council will erect a new jail and storehouse at a cost of $20,000. Ald. White, Lynch, Kellington and Curtis compose a committee that will deal with the matter.

Port Arthur, Ont.—Messrs. Seamen-Kent are making arrangements for the enlargement of their plant.

Port Arthur, Ont.—The Eureka Match Company will establish a plant at this point. Mr. Edward Stewart, New Westminster, is interested in this company.

Regina, Sask.—The municipal Finance Committee will assist Mr. M. B. Stein, of Montreal, to locate a factory in this city. The Board of Trade are interested in the matter.

Saskatoon, Sask.—The Massey-Harris Company, of Toronto, will erect a large warehouse in this city, Sir Lyman M. Jones, is president of this company.

Vancouver, B.C.—Messrs. Klaw and Erlanger announce that they will erect a theatre in this city at a cost of $500,000.

Vancouver, B.C.—The management of the Standard Dairy Company will erect a four-story building in this city at a cost of $70,000.

Winnipeg, Man.—The officers of the 34th Fort Garry Horse have purchased a building and will have the property altered for use as an armory. E. M. Fisher, is adjustant of this regiment.

◆

BRIDGES, ROADS AND PAVEMENTS.

Galt, Ont.—The ratepayers will vote on several paving by-laws at the next election.

London, Ont.—The Guest Bridge, over the Thames, has been completed at a cost of $20,000.

London, Ont—The municipal council have decided that the tenders for the West London bridge were too high and have ordered their return. New plans will be prepared with a view of cost reduction, and an invitation will be extended for other tenders. The prices as submitted ranged from $40,000 to $45,000.

St. Catharines, Ont.—A report states that the Federal government will consider the granting of $50,000 toward the cost of a bridge on King St.

South Vancouver, B.C.—The Board of Works will spend the sum of $14,845 on sidewalks and box drains. W. A. Clement, municipal engineer.

West and North Vancouver.—The councils of these municipalities are considering the erection of a bridge on the Keith Road at a cost of $30,000.

Victoria, B.C.—A deputation from the Doukhobor settlement at Brilliant, have requested that a bridge be erected and the Provincial Department of Public Works will, in all probability grant the request.

Victoria, B.C.—A new concrete bridge erected by the city over the ravine on the Gorge Road is completed at a cost of $25,000.

Barrett Specification Roofs

Shove Mills, Fall River, Mass. Roofed along the lines of the Barrett Specification in 1876.

Low Cost—Long Service

METAL roofs require painting every few years; most ready roofings require coating regularly, but with Barrett Specification Roofs *there is no maintenance expense.*

Barrett Specification Roofs are roofs of coal tar pitch and tarred felt, with a top surface of slag, gravel or tile, *laid according to the Barrett Specification.*

This specification is simply the standard formula for building a first-class roof of this character.

It is possible, of course, to make an inferior roof of these materials either by poor workmanship or by using insufficient and poor goods. But if the Barrett Specification *is followed absolutely and the materials called for are used*, you are certain of getting the best value in roof coverings.

Such roofs usually last twenty years and over without leaks or repairs.

Barrett Specification Roofs are almost universally used on factories and buildings of large roof areas and where costs are carefully figured. They are equally good for city dwellings, warehouses, railroad buildings, etc.

Copy of the Barrett Specification, with diagrams, mailed free on request to nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

CURRENT NEWS.

Brandon, Man.—Several of the civic officials and prominent citizens are agitating for a new post office.

London, Ont.—Among the money by-laws to go before the ratepayers, is one for $6,000 to be used for the purchase of factory lands and industrial sites.

New Glasgow, N.S.—John Underwood, mayor, and James Roy, clerk, of this municipality, will receive applications for the position of "Town Engineer." Applicants will state salary required, experience, and furnish testimonials. Parties who have specialized in permanent street building and hydraulic work will receive preference.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner of Canada, 17 Victoria Street, London, S.W., during the week ending November 4th, 1912:—

A Scottish firm make inquiry for names of Canadian importers of cement, building material and mining machinery.

Inquiry is made by a Belgian firm for the names of Canadian importers of iron and steel, wire nails, wood screws, barbed fencing wire, window, plate and table glass, woolen, cotton, linen and silk goods, cement, linseed oil, matches, white lead, etc.

From the branch for City trade inquiries, 73 Basinghall Street, E.C.

A London firm who are open to purchase considerable supplies of compo board invite offers from Canadian manufacturers.

A London firm manufacturing a specialty in office pastes seek representation in Eastern Canada and in British Columbia.

◆

CANADIAN PATENTS.

The following is a list of patents recently issued through the agency of Messrs. Ridout & Maybee, 59 Yonge Street, Toronto:—S. A. Horstman, spring wheels for road vehicles; F. Orbell, sheaf carrier for harvesting machinery; Birmingham Small Arms, Limited, air pistols or guns; Cooper Cap Co., caps; Tower Canadian, Limited, waterproof coats; E. S. Luard, steam superheaters; H. P. Roberts, beating and mixing devices; Harold Jarvis, nut lock; J. G. Robinson, steam superheater (transverse compartment header); J. G. Robinson, (two compartment header;) Bernard Hausheer, can filling machines; Wesley Castles, excavating machinery; Jerome C. Dietrich, hand saws; Jerome C. Dietrich, crosscut saw handles.

◆

IMPROVED PISTON PILE HAMMER.

A piston ram with very few moving parts has been placed on the market by the McKiernan-Terry Drill Company (Canadian representatives Canada Foundry Company), and would appear to have many points of interest to persons engaged in pile driving and other similar work. The moving parts consist of a spool valve, a check valve, the auxiliary accelerating piston and the main piston, all of a specific design which, according to the manufacturers results in an increase of efficiency of about 30 per cent. over many now on the market. They are made in sizes varying from 145 pounds to 4 tons.

◆

A CONTRACT IN THE BALKANS.

A report which is of unusual interest is made by Messrs. Laurie and Lamb, Montreal. This firm have been advised by Messrs, Heenan and Froud, Manchester, England, that one of their patent refuse destructor plants are to be placed at once in the town of Turn Severin, Roumania. This little news note suffices to show that the government authorities are not giving all their attention to the Turk, and are wisely disposing of waste matter at a time when such work is most called for.

NEW INCORPORATIONS.

West Vancouver, B.C.—West Vancouver Lumber Company, $10,000.

Haileybury, Ont.—Walsh Mines, $100,000. J. Walsh, W. R. Earle, V. Walsh, Cobalt.

Berlin, Ont.—Berlin Fibre Products, $40,000. J. Walter, D. Hibner, W. H. Schmalz.

Dryden, Ont.—Cleveland Gold Mining Co., $100,000. D. I. Grant, G. Grant, G. A. Urquhart.

St. Catharines, Ont.—Packard Electric Co., $1,000,000. R. B. Hamilton, G. C. Rough, M. J. McCarron.

Midland, Ont.—Simcoe Construction Co., $50,000. P. T. Murphy, Midland; A. J. R. Melville, J. Walmsley.

Pelee Island, Ont.—Pelee Island Navigation Co., $50,000. H. A. Henderson, F. W. Harris, E. Dieffenbach.

Burlington Junction, Ont.—Vera Chemical Co., of Canada, $150,000. G. H. Sedgewick, A. G. Ross, A. E. Langman.

Magog, Que.—Compagnie de Fonderie de Magog, (foundry), A. Tourigny, G. A. Brown, G. H. Patuo.

Ste. Elizabeth, Que.—Guilbault Freres & Compagnie, (cement products), $10,000. A. Guilbault, Ste. Elizabeth; W. Guilbault, Montreal; O. Guilbault, Ste. Elizabeth.

Hanover, Ont.—Fisher Machinery Co., $50,000. D. Knechtel, J. S. Knechtel, H. Peppler. Wilt Twist Drill Co., of Canada, $150,000. H. A. Springle, S. C. Robinson, W. Chater.

Vancouver, B.C.—Ceramics, $50,000. Middle West Lumber Company, $100,000. British Building Company, $250,000. Master Builders' Company, $1,100,000. S. Murchison & Company, (railway contractors), $50,000.

Toronto.—Bulldog Tires, $1,000,000. W. G. Moffatt, A. H. Crichton, J. Moffatt. Ontario Stone Co., $125,000. G. A. Hegy, T. A. Nicholson, W. S. McNamara. Park Feed Milling Co., $40,000. R. L. Westcott, L. Macaulay, J. E. Anderson. Dominion Wheel and Foundries, $250,000. G. Ruel, R. H. M. Temple, S. P. Biggs. Merrill Company, (manufacturing chemists), $500,000. F. W. Merrill, G. M. Miller, R. A. Somerville.

Montreal.—Belfour, Morris and Willcocks, (manufacturers agents), $200,000. W. R. L. Shanks, F. G. Bush, G. R. Drennan. Invention and Promotion, (mining), $100,000. A. J. Lavoie, R. Chenevert, F. Callaghan. Butters Salvador Mines, $750,000. J. J. Meagher, H. N. Chauvin, H. E. Walker. Franey Gold Mining Company, $500,000. E. Desmarais, J. Lacroix, D. Therriault. Ontario National Brick Company, $2,000,000. E. R. Parkins, W. Taylor, S. Greenshields Dixon. Domestic Brick and Tile Company, $500,000. H. Lampard, Westmount; J. A. Major, Verdun; H. M. G. Bellew, Montreal. Montreal Bed and Mattress Factory, $250,000. E. A. Mumford, S. W. Hicks, R. T. Stackhouse. Manitou Iron Mining Co., $100,000. M. A. Phelan, W. Bovey, R. Fleet.

◆

HIGH ELASTIC LIMIT.

We have pleasure in publishing the following letter from Mr. W. A. Cook, manager of the Steel Products Department of Steel and Radiation, Limited, Fraser Avenue, Toronto. The many merits of Steelcrete are well known, and we are glad to note that one of the leading features of the reinforcement is even better than had been supposed:

"With reference to our advertisement appearing on page 75, your issue of November 14, it is stated:

"'The high elastic limit of Expanded Metal—60% of its ultimate strength.'

"Will you kindly change this in your next issue and place the percentage as equal to 85% of its ultimate strength. This has been satisfactorily proven by exhaustive tests made in various laboratories, and we are not claiming too much in rating it at this percentage."

◆

AIR COMPRESSORS FOR I. C. R.

Six air compressors have been purchased for the Intercolonial Railway from the Jenckes Machine Company, of Sherbrooke, P.Q. The cost is $12,300.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire
Machine Banded

WOOD
STAVE PIPE

CONTINUOUS
STAVE PIPE

RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

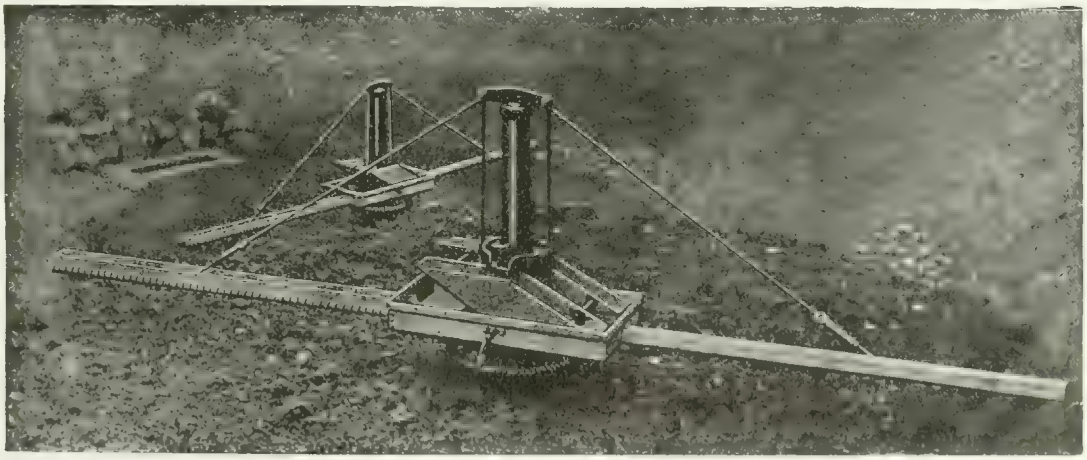
Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

THE "IDEAL" DISTRIBUTOR
FOR BACTERIAL SEWAGE FILTERS

Just
a
Moment
Please
!
FACTS
Prove Them



AS A DISTRIBUTOR, gives an even and gentle distribution from the serrated edges of the arms.
AS A MOTOR, obtains greater power from the liquid head for propulsion than any other type of machine, and will revolve in any wind.
AS AN AUTOMATIC MACHINE, having no orifices to choke, does work for weeks without attention.

SEWAGE LIFTS & EJECTORS

WRITE NOW FOR OUR NEW 140 PAGE CATALOGUE OF SEWAGE FITTINGS

PATENTEES & MANUFACTURERS **TUKE & BELL LTD.,** 69 LEADENHALL ST. **LONDON,** ENGLAND.

AGENTS FOR CANADA **LAURIE & LAMB,** ENGINEERS, **MONTREAL**

ALBERTA, PEACE RIVER & EASTERN RAILWAY.

A new railway from the Pacific to the Hudson Bay is the ambitious project of the Alberta, Peace River and Eastern Railway. The length of the proposed line is 1,600 miles. The management of the new company in Canada is under Mr. H. Muskett King, who will make his headquarters in Ottawa, and Mr. E. G. Rykert, of Montreal. This board will shortly be increased by several. A feature in connection with the new railway is a colonization scheme, whereby it is proposed to introduce into the Dominion a large number of experienced agriculturists with their families, a special recommendation for whom will be that they are British subjects with a certain amount of capital. The English directors, in addition to being connected with the railway project, are also closely identified with several other companies which will work in affiliation with the new railway, [illegible] a land company, a flour milling company, a colonization, a freight motor and agricultural implement company.

◆

CANADIAN RAILWAY CLUB.

The members of the Canadian Railway Club, Montreal, were addressed on the occasion of their last monthly meeting by Professor V. I. Smart, of McGill University, who read a paper on "Preventable Accidents."

Professor Smart's main contention was that it was shown by statistics that under present conditions in Canada travellers stand eighty-nine chances of being killed in railway accidents and twenty of being injured to one chance in Great Britain, and one-fourteenth of a chance in New South Wales, while in the United States they stand over twenty chances of being killed and sixteen of being injured. A comparison of conditions in the various countries was instructive. He divided the causes of accidents under three heads, firstly, malicious interference of chance obstruction, which source of danger could be largely lessened by strict enforcement of the law of trespass; secondly, failure of the track or equipment, which lead to numerous mishaps, and thirdly, mistakes or negligence on the part of those in charge of trains.

He was in favor of the installation of the hand operated block system, which, he said, would not be any more expensive than the automatic, in spite of the additional number of signalmen, as the plant was far cheaper. Since the introduction of the automatic, there had been no diminution in the total casualities, and this was due to the introduction of the block system on top of the time table system, and a certain confusion resulting. A well-nigh perfect system would be produced if the apparatus in use in England was introduced, with certain improvements and additions which are new features of the automatic.

In the discussion that followed Mr. C. W. Parker, of the Canadian Pacific Railway, said the block system was more adapted to double tracks than to single, while Canadian railways were mostly of the latter description. Also that the long mileage of the Canadian tracks and the consequent long blocks that there would have to be, would make it difficult to dispatch traffic regularly.

Mr. Ord, of the Canadian Pacific Railway, emph[illegible] the fact that weather conditions were an important factor in the working of a railway, and that in the winter months the number of accidents due to failure of equi[illegible] large compared with the summer. Again, if the railways spent as much in Canada in equipment as in England the cost of travelling would be prohibitive, and population would not increase. The expense of the block system in Canada would not secure a corresponding increase in safety.

REASONS FOR BULK SHIPMENT OF CEMENT.

Some reasons for the shipment of cement in bulk are given in a circular recently sent out by one of the large United States Portland cement companies. They are:

IT WILL COST LESS TO FINANCE THE JOB.—The initial outlay for bulk cement will be 40 cents per barrel less than for cement in cloth sacks and 10 cents less than for cement in paper. Every cloth sack on a job, or in transit to or from a job, whether filled or empty, represents an investment of 10 cents. Every paper bag used represents a fixed loss of 2½ cents.

IT WILL GET TO YOU IN BETTER SHAPE.—There will be no fuss or argument over sacks received in torn condition. If rain should get into the car, there will only be one or two lumps of set cement to be lifted out; there will be no partially damaged sacks to handle and no lumps of set cement to be pried out of sacks.

IT WILL COST LESS FOR LABOR.—No matter how cement is bought, it is bulk cement that goes into the mixer. Therefore, labor employed in emptying sacks, that is, reconverting sacked cement into bulk cement, is wasted labor. So is the labor that is spent in shaking, counting, bundling, shipping and keeping track of empty sacks, for there is no real reason why there should be any sacks on the job.

IT WILL COST LESS FOR MATERIAL.—In computing the total cost of cement used on the job, the various sack losses and expenses must be added to the invoice price of the material—therefore, eliminate this loss and expense and reduce the cost of cement. If sacks are used some of them must surely be destroyed, through carelessness, wilful abuse and natural wear and tear, and some of them will probably be stolen. All these destroyed and stolen sacks cost money; why not get along without sacks?

IT WILL COST LESS IN THE WAY OF MISCELLANEOUS EXPENSES.—There will be no freight to pay on returned sacks. The sack shed can be used for storing something that is really needed on the job—or need not be built at all. The team can be doing something worth while instead of hauling sacks to the depot. The bookkeeper and clerks won't need to be keeping tab on a lot of sacks which run into big money and don't do the job any good. After they have put in part of the time formerly devoted to this kind of work in figuring the profits resulting from the use of bulk cement, they can spend the rest of the time in figuring further ways of cutting costs and increasing profits.

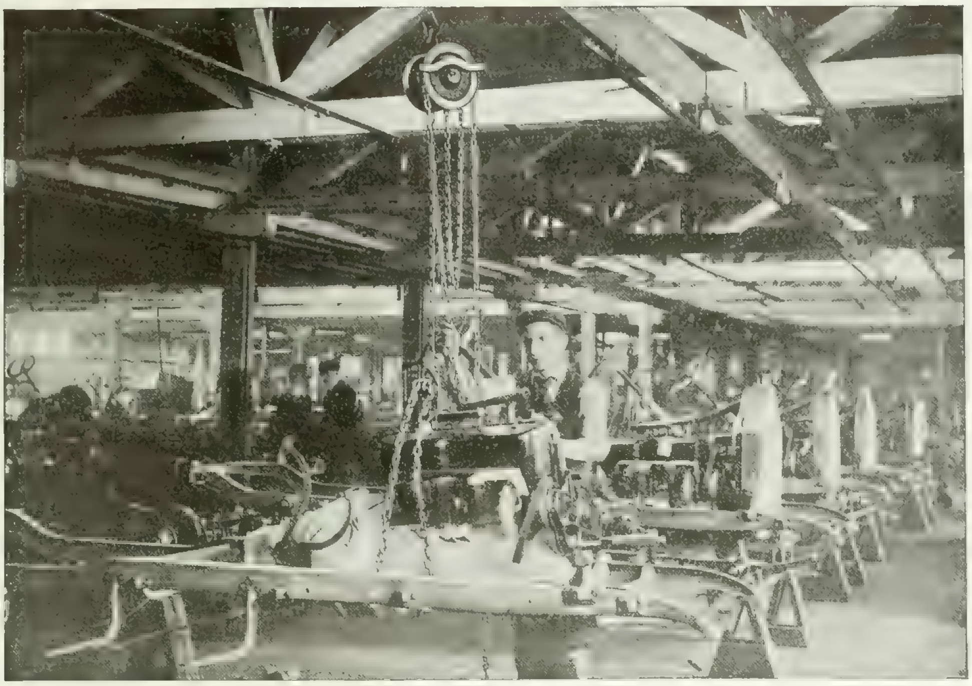
IT WILL IMPROVE THE DISCIPLINE ON THE JOB.—Cement sacks are very attractive to men. Split open, they make good aprons. If a man is working in mud, a couple of sacks wrapped around his feet will protect his shoes. In rainy weather a sack will keep his shoulders dry. Sacks are handy as tool bags and for carrying nails, rivets, etc. Lots of them are stolen. All these sacks cost the user of the cement 10 cents each, and, furthermore, if the men are allowed to get into the habit of misappropriating one kind of property they won't stop there. Soon, belting will be cut up for hand shields, tools will be misused and other valuable property made away with.

◆

HONOR FOR SANITARY OFFICIAL.

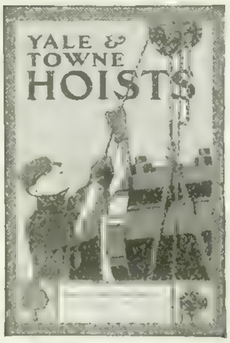
The Royal Society of England recognized the sanitary administration of the works of the Panama canal by awarding its Buchanan medal to Col. William G. Georgas, U.S.A., chief sanitary officer of the Panama canal zone.

THE TRIPLEX BLOCK



Placing engine in chassis with a half-ton Triplex Block.

A 100-page Book on Hoists



Practical engineers are all agreed that radical cuts in cost can be brought about by solving hoisting problems. Such problems are not solved satisfactorily by heavy cranes which do not give continuous service. A load that is waiting to be moved is costing money just as much as a load which is taking a gang of workmen to move.

A hoisting problem is not solved until each workman can readily lift and transport any load, single handed, that comes to him.

The new Book of Hoists shows examples of hand and power hoisting and overhead apparatus for conveying in model plants, here and abroad. The information is the most complete we have ever published. We will be glad to send a copy free on request.

Triplex { **16 Sizes:** One-quarter of a ton to forty tons. } **Every Block Tested**
Blocks; { **300 Active Stocks** all over the United States. } **to 50% Overload.**

The Canadian Fairbanks-Morse Co., Limited

SOLE AGENTS FOR CANADA

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

17929—November 2—Directing G.T.R. repair and extend to the highway, the centre platform at Bulstrode Station, Que., and that the culvert be put in a proper state of repair.

17930—November 4—Approving revised location Central Ry. Co. of Canada from mileage 0 to mileage 5, in city of Montreal, P.Q., on condition that grade at crossing at St. Michel Road be eliminated.

17931—November 4—Authorizing C.N.O.R. to cross jointly with the Lachine, Jacques-Cartier and Maisonneuve Ry., under the tracks of the C.P.R., near Jacques-Cartier Jct., Que.

17932—November 5—Authorizing C.P.R. to open for traffic its Wilkie Southwesterly Branch from Wilkie, mileage 0, to Anglia, mileage 35.3.

17933—November 5—Approving proposed location G.T.P. Branch Lines Co., station at Beiseker, on its Tofield-Calgary Branch, in Sec. 12, Tp. 28, R. 26, W. 4 M.

17934—November 4—Authorizing C.P.R. to construct across fifty-eight (58) highways from mileage 22.7 to mileage 106.2 on its Pheasant Hills Branch.

17935—November 5—Directing C.P.R. (Havelock Subdivision) to install improved type of automatic electric bell at crossing at east end of its yard at Sharbot Lake, Tp. Oso, Co. Frontenac, Ont.

17936—November 6—Authorizing G.T.R. to construct siding, commencing north of Port Robinson Station, to the premises of the Standard Steel Construction Co., Ltd., Welland, on part of Lot 203, Tp. Thorold, Co. Welland, Ontario.

17937—October 24—Authorizing the town of Pointe aux Trembles, Que., to extend at its own expense, St. Jean Baptiste St., across Can. Nor. Que. Railway.

17938—October 24—Authorizing the town of Pointe aux Trembles, P.Q., to extend, at its own expense, First Ave., across the Can. Nor. Que. Railway.

17939—November 7—Directing that the cost of installing the gates at the crossing of Main St., Victoriaville, P.Q., be divided as follows:—20 per cent. out of "The Railway Grade-Crossing Fund," 30 per cent. by the Municipality of Victoriaville, and 50 per cent. by G.T.R.; and that cost of maintaining same be borne and paid, 70 per cent. by Railway Company and 30 per cent. by the Municipality.

17940—November 7—Authorizing C.N.Q.R. to construct across two (2) highways on its St. Eustache-St. Jerome Line, in County of Two Mountains, Quebec.

17941—November 6—Authorizing C.P.R. to open for traffic its second track from Secretan, mileage 44.9 to Chaplin, mileage 54.

17942—November 9—Authorizing G.T.R. to take certain lands in St. Antoine Ward, city of Montreal, Que., for the convenient accommodation of the public and the traffic carried over its railway.

17943—November 9—Approving by-laws passed by the Marconi Wireless Telegraph Company of Canada, Ltd., authorizing J. H. Lauer, general manager of the company, to prepare and issue tariffs of tolls to be charged by said company.

17944—November 7—Directing G.T.R. to install an improved type of automatic electric bell at crossing just west of Vineland Station, Ontario.

17945—November 7—Authorizing C.P.R. to construct spur for N. K. Fairbank Co., Ltd., on original Lot Cadastral No. [illegible] (now known as Lot Cadastre No. [illegible]), Parish of Lachine, Co. Jacques Cartier, Quebec.

17946—November 7—Authorizing C.P.R. to reconstruct bridge No. 13.9, Owen Sound Sub. Div., Ontario Division.

17947—October 19—Authorizing N. St. C. & T. Ry. to construct its Beamsville Extension across five (5) highways, Twp. of Louth, Co. Lincoln, Ont.

17948—November 5—Authorizing N. St. C. & T. Ry. to construct across twelve (12) highways, Twps. Grantham and Niagara.

17949—November 8—Authorizing C.L.O. & W. (C.P.R.), to construct across Front St., town of Trenton, Ont., mileage 88.14 from Glen Tay ,by means of a bridge.

17950—November [illegible]—Refusing application of the Municipality of Borden, Sask., to extend Sheppard St. across C.N.R.; and authorizing said municipality to cross C.N.R., just east of west switch in the village of Borden, Sask.

17951—November [illegible]—Refusing application C.P.R. for approval of station at mileage 17.5, Virden-McAuley Branch, on S.W. ¼ Sec. 3, Tp. 13, R. 27, W. 1st M., Manitoba; and approving location at mileage 21.5, Virden-McAuley Branch.

17952—November 8—Authorizing C.P.R. to divert highway adjoining West Boundary of [illegible], Tp. 11, R. [illegible], W. 4 M., in a southwesterly direction, to connect with highway adjoining South Boundary S.E. [illegible], Sec. [illegible], Tp. 11, R. [illegible], W. 4 M., Alberta.

[illegible]—November [illegible]—Approving C.L.O. & W. (C.P.R.) plan showing bridge proposed to be erected at mileage 129.68, across road allowance between Lots 16 and 17, Con. [illegible], Tp. of Hope, Co. Durham, Ont.

[illegible]—November 8—Authorizing G.T.R. to construct additional track across [illegible] Road, Tp. [illegible], Co. Welland, Ont.

[illegible]—November [illegible]—Authorizing G.T.R. to alter and extend existing siding to premises of Vineland Canning Co., Ltd., Vineland, Ont.; and to construct additional siding for said Vineland Canning Co., Ltd., on part Lot [illegible], Con. [illegible], Tp. Louth, Co. Lincoln, Ont.

[illegible]—November [illegible]—Authorizing N. St. C. & T. Ry. to construct its Beamsville Extension across eight (8) highways, Twp. of Clinton, Co. Lincoln, Ont.

[illegible]—November [illegible]—Approving revised location [illegible] Bay and [illegible] tern [illegible] station [illegible] Tp. of [illegible], Co. Lake [illegible] mileage [illegible] from [illegible].

17958—November 8—Authorizing C.P.R. to take, for the purpose of securing the efficient construction, maintenance, and operation of its railway, certain lands in Notre Dame de Grace Ward, city of Montreal, Que.

17959—November 5—Directing V.V. & E. Ry. & Nav. Co. to protect that portion of railway between Ocean Park and White Rock as follows: one night-watchman between mile posts 123 and 125, and one night-watchman between mile posts 125 and 127; company's sectionmen to protect park during the day time by going over the ground at least twice a day.

17960—November 9—Approving loaction C.N.R. through Tp. 2, Rgs. 6-8, W. 2 M., Sask., mileage [illegible] to mileage 8.02.

17961—November 8—Directing G.T.R. to provide an electric bell at Woodbine Avenue, Toronto, Ontario.

17962—November 8—Authorizing the North American Smelting Company, Limited, to construct an aerial tramway and an electric power transmission line over and across C.N.O.R. on Lot 16, Con. 9, Tp. Loughborough, Co. Frontenac, Ontario.

17963—November 9—Authorizing C.P.R. to construct sewer and water pipes across East Kildonan Road or Kelvin Avenue and Bird's Hill Road or Panet Road; and amending Order No. 17391, dated August 30th, 1912.

17964—November 7—Authorizing C.P.R. to construct spur for J. H. Preston Planning Mills Company, city of Medicine Hat, Alta.

17965—November 8—Relieving M. C. R.R. from providing further protection at Sixth Concession Road, near Leamington, Tp. of Mersea, Ontario.

17966—November 8—Approving G.T.P. Branch Lines Co., location of proposed station at Frobisher, Regina-Boundary Branch, Sec. 13, Tp. 3, R. 4, W. 2 M., Saskatchewan.

17967—November 8—Approving revised grade of G.T.P. Branch Lines Company, from mileage 21 to mileage 23, Rural Municipality of Cornwallis, Dist. Brandon, Man., and rescinding Order of the Board No. 17758, dated October 14th, 1912.

17968—November 8—Approving location and detail plans of G.N. Ry. Co's. proposed station and detention house at city of Rossland, British Columbia.

17969—November 5—Extending, until April 30, 1913, the time within which the C.N.O.R. install the permanent interlocking plant where is crosses G.T.R. and C.P.R., near Ottawa.

17970—November 5—Refusing application C.P.R. for an Order rescinding Order of the Board No. 16838, dated June 20, 1912, dispensing with services of night watchman where C.N.O.R. crosses St. Lawrence and Ottawa, east side of Rideau River, near Ottawa.

17971—November 11—Approving location C.N.O.R. station grounds at Chisholm, Twp. Chisholm, Ont., mileage 210.

17972—November 8—Relieving G.T.R. from providing further protection at highway three miles East of Brighton, at mile post 238, Municipality of Smithfield, Co. Northumberland, Ontario.

17973—November 11—Authorizing C.P.R. to construct its Swift Current Southeasterly Branch across highways adjoining North and East boundaries, Sec. 10, Tp. 11, R. 6, W. 3. M., at mileage 69,29; and to divert highway adjoining North Boundary in a southeasterly direction to connect up with highway adjoining East boundary, Sec. 10.

17974—November 11—Amending Order No. 17921, dated October 31, 1912, by striking out the words, 'subject to the terms of the said consent', in first line of operative part of Order.

17975—November 11—Authorizing C.N.O.R. to construct across Cormanville Street, town of North Bay, Dist. Nipissing, Ottawa-Capreol Line.

17976—November 14—Extending until November 28th, 1912, the time within which the British Columbia Electric Railway Company appeal to the Supreme Court of Canada from Order No. 17840, dated October 14th, 1912, and in the meantime staying all proceedings under said Order.

17977—November 12—Authorizing G.T.P. Branch Lines Company to construct extension of industrial spur into town of Yorkton, Sask.

17978—November 12—Approving revised location G.T.P. Ry. mileage 108.8 to mileage 111.29, east of Prince Rupert, Rge. 5, Coast District, through Chin de Mash Indian Reserve, B.C.

17979—November 12—Approving revised location G.T.P. Ry. from mileage 157.51 to mileage 170.84, east of Prince Rupert, Cassiar Dist., through Kitsegucla No. 1 and Andimaul Indian Reserve, B.C.

17980—November 12—Approving G.T.P. Branch Lines Company station site and station at Duff, Melville-Regina Branch, Sec. 8, Tp. 22, R. 8, W. 2 M.

17981—November 12—Approving location G.T.P. Branch Lines Co., station at mileage 142, Regina-Boundary Branch, Sec. 26, Tp. 2, R. 3, W. 2 M., Sask.

17982—November 12—Authorizing G.T.R. to construct siding for the Canadian Billings & Spencer, Ltd., Lot 23, Con. 4, Tp. of Crowland, Co. Welland, Ont.

17983—November 13—Authorizing C.N.O.R. to construct across Sixteen Mile Creek, Tp. Trafalgar, Co. Halton, Ont., mileage 23.45 west from Toronto.

17984—November 12—Authorizing C.N.O.R. to construct across public road, between Con. 2, Tp. of Westmeath, and Con. 2, Tp. of Pembroke, Co. Renfrew, Ont.

17985—November 12—Authorizing C.N.R. (Vegreville-Calgary Extension), to construct over and across Secondary Canal "A," Sec. 2, Tp. 24, R. 28, W. 4 M., mileage 247.5.

17986—November 12—Authorizing C.N.R. (Vegreville-Calgary Branch), to construct over and across Secondary Canal "B," South Branch, Sec. [illegible], Tp. [illegible], R. 27, W. 4 M., mileage [illegible].

17987—November 12—Authorizing C.N.R. to construct Calgary Southerly Branch across public road between Secs. 6 & 7, Tp. 21, R. 28, W. 4 M.

17988—November 12—Authorizing C.N.R. to construct Calgary-Southerly Branch across public road between Sec. 25, Tp. 21, R. 29, & Sec. 30, Tp. 21, R. 28, W. 4 M., by means of undercrossing.

17989—November 12—Authorizing C. L. O. & W. (C.P.R.) to construct bridge No. [illegible], Tp. Richmond, Co's. Lennox and Addington, Ontario.

17990—November 13—Approving revised location C.L.O. & W. (C.P.R.), from mileage [illegible] to mileage [illegible].

17991—November 12—Authorizing C.P.R. to construct spur for the McPherson Fruit Co., Calgary, Alberta.

Volume 23. Toronto, Nov. 28, 1912 Contents of this issue on page 781

The Canadian Engineer

An Engineering Weekly

THE VANCOUVER ISLAND POWER COMPANY, LIMITED, JORDAN RIVER DEVELOPMENT.

PART I.

Western Canada is growing with such rapidity, particularly the southern coast districts of British Columbia adjacent to the cities of Vancouver and Victoria, that in these communities it has been for some time a serious problem with the public utilities companies to keep pace with the rapidly increasing demand for service.

The British Columbia Electric Railway Company, Limited, owning and operating the traction, lighting, and power systems of Vancouver and Victoria, and territories adjacent thereto, has been for the past five years laboring with this problem. The growth and expansion of the districts which this company is serving have been phenomenal, and the demand for power has been multiplied several times within that period. The capacity of British Columbia Electric Railway Company's plants has been increased constantly, both in steam and water power, and generally in time to anticipate requirements.

As early as 1907 it was realized that material increase in power capacity would be required by the Victoria branch, but that this could be met within a period allowing adequate investigation of the available water power resources on the southern end of Vancouver Island, and the installation of a modern, well equipped hydro-electric power system.

At the time the Jordan River development was actually begun, the British Columbia Electric Railway Company was serving Victoria and adjacent territory with electricity from a steam station in Victoria of 800 kilowatt capacity and a hydro-electric station of 2,000 kilowatt capacity at Goldstream, about ten miles out of the city. The latter plant was operated with surplus water purchased from the Esquimalt Water Company, and could run at full capacity only during a part of the year on account of water shortage.

Mr. Wynn Meredith, then consulting engineer for the British Columbia Electric Railway Company, was authorized to investigate the available power possibilities, and under his direction an exhaustive series of investigations were carried out, which included practically all the sources of water power within a radius of commerciably feasible transmission to the city of Victoria. This preliminary work was continued for upwards of a year, and was accomplished under the most extraordinary difficulties, the investigation in many cases being more properly explorations of an unmapped and practically unknown region, untraversed, except for a narrow fringe of coast line, beyond the occasional visit of trapper or timber cruiser. Pioneer work in the forests of British Columbia can only be properly appreciated by those who have undertaken it. Water powers are abundant, but the wild, rugged and inaccessible character of the country renders it difficult in the extreme to acquire even very limited preliminary knowledge of a possible water power development. Most of the virgin country is covered with heavy timber, sometimes cruising 600,000 feet, board measure, per acre; and whether timbered or not the ground is covered with a dense growth of brush and fallen and rotting trees.

The Jordan River Development, Bear Creek Dam.

The hardships endured by the engineers on reconnoissance work, their heart-breaking conquest of the jungles, struggling with pack on back through the proverbial "impenetrable" British Columbia forest, blazing many paths in order to insure safe retreat in case further advance was impossible, or to retrace the course if promising conditions were discovered, have become a part of the history of the "job," and to the preserverance and hardihood of these pioneers the successful culmination of the investigation is largely due.

An examination of the upper watershed of the Koksilah River in the latter part of 1907 led to the first consideration of a possible power development on the Jordan River, the head waters of which lie adjacent to, and only separated by a few hundred yards from the source of the Koksilah. A visit to the mouth of the Jordan on the west coast of the island, a few weeks later, disclosed a large and rapid stream, further exploration of which was prevented at the time by the absence of trails and prevailing wet season, which renders pioneer work in this country almost impossible. A gauging station was, however, established near the mouth of the stream, and a series of observations of run-off instituted.

Early in the spring of 1908, a party of engineers was engaged to explore thoroughly the river and all its branches, investigate the possible reservoir sites, and ascertain in a preliminary way the head or fall obtainable.

This information was gathered during the summer, and in November, 1908, Mr. Meredith, who had in the meantime entered the firm of Sanderson & Porter, engineers, of New York, then made a formal report on the project, having determined that the watershed with the run-off observed, and the use of certain storage reservoirs which had been discovered would, with the head available, amply warrant development for power purposes. Sanderson and Porter were then retained as engineers for the British Columbia Electric Railway Company, Limited, to design and construct the Jordan River power development.

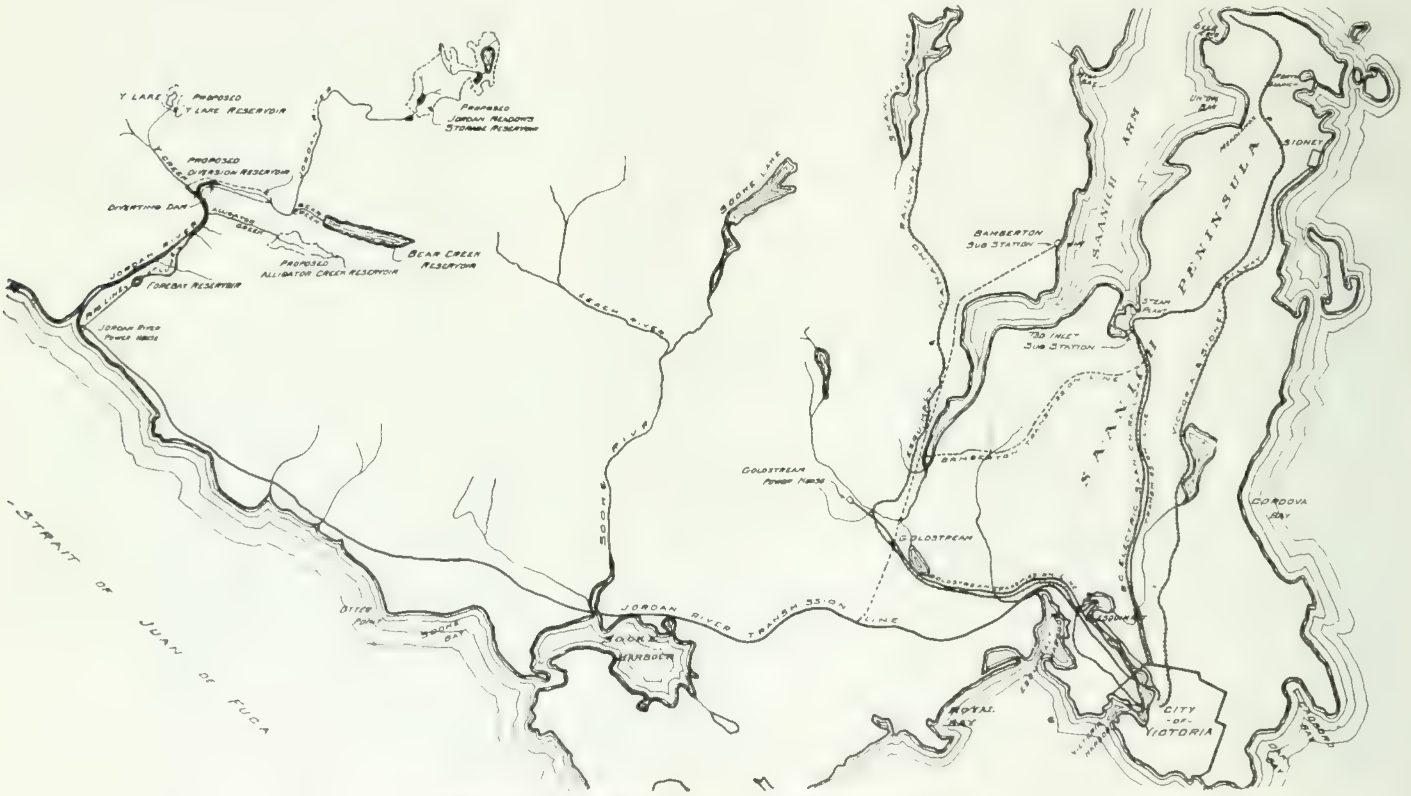
A subsidiary corporation, known as the Vancouver Island Power Company, Limited, was formed under the auspices of the British Columbia Electric Railway Company to finance and otherwise assume charge of the project.

The Jordan River flows into the Straits of Juan de Fuca at a point about 40 miles west of the city of Victoria. It is one of the large streams on Vancouver Island, the drainage area being about 75 square miles, the greater part of which lies above an elevation of 1,200 feet. The source of the main river is at Jordan Meadows, which lies about midway between the east and west coasts of the island at an elevation about 1,700 above sea-level.

Three large tributary streams join the main river in the upper 10 miles of its course, Bear Creek and Alligator Creek from the east, and "Y" Creek from the west, forming a high level watershed, the entire run-off from which is available for power purposes.

The entire watershed is covered with a very heavy growth of timber, and at the higher levels receives each year a covering of snow from 4 feet to 7 feet in depth, which is gradually melted in the spring, but does not, as a rule, entirely disappear until June or July.

British Columbia is noted for excessive precipitation, and great changes in amount of precipitation in short distances. On the mainland near Vancouver an annual precipitation of 160 inches has been observed, and a variation of 100 per cent. in annual precipitation has been noted in the same season at points only a few miles apart.



Map of the Southern End of Vancouver Island.

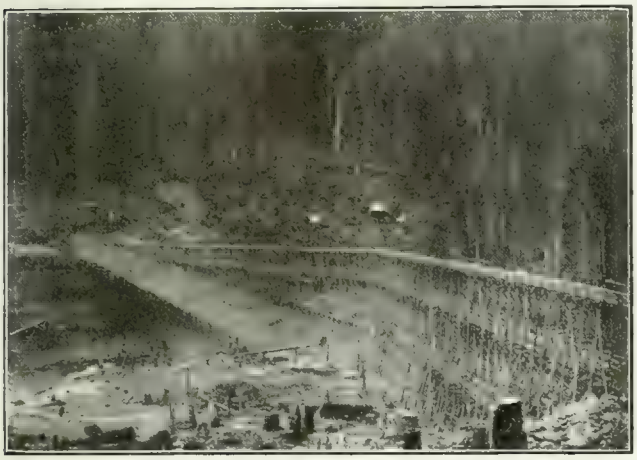
Showing the Jordan River Development in relation to the City of Victoria.

The average precipitation over the entire Jordan River watershed, as shown by observations extending over a period of four years, is about 80 inches.

The development has the usual features of storage reservoirs, diverting dams, flumes, forebay reservoir, pressure pipes, power house, transmission lines, and sub-station, but the extraordinary conditions under which the work was accomplished, the development of special methods of meeting the abnormal conditions governing the work, and the details of the execution under these conditions possess more than passing interest.

The Jordan River has a wide variation between summer and winter flow. The highest portion of its watershed is not more than 2,700 feet in elevation. The area possesses features especially calculated to conserve the precipitated waters, more particularly in the dense jungle of forest and underbrush with which it is clothed, the mat of forest floor from 1 foot to 2 feet in depth overlying the soil, the retarded melting of the snow due to the dense shade of the forest, and the moderate transverse slope of the mountain sides. All of these features, however, do not prevent a period of extremely low water, for some 60 to 90 days in the summer and fall of each season.

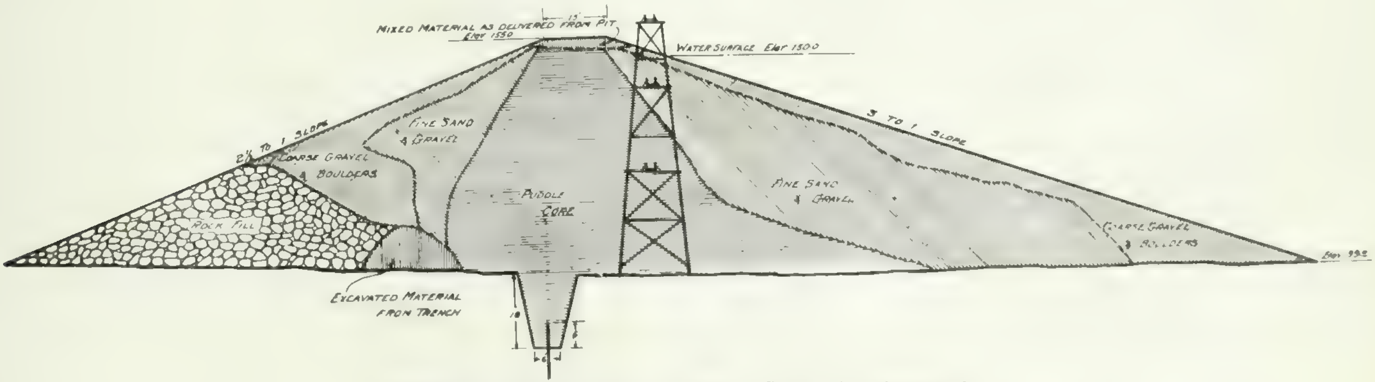
The stream flow has been systematically observed since 1907, and the results obtained more than sustain the findings of the original report in which the maximum power production of the watershed, based on a 50 per cent. load factor, was placed at 24,000 horse-power, with the commercially feasible storage available.



The Bear Creek Dam Nearly Completed.

It was seen at the beginning of the investigation that a large storage capacity would be required to impound flood waters for use during the dry season. Five favorable reservoir sites were found in the flats and meadows along the upper reaches of the river and its branches. The capacities of these storage basins and the sizes of the impounding dams required have been determined, and the results show that ample storage capacity is available, within reasonable cost, to provide for an ultimate maximum plant output of 24,000 to 36,000 horse-power. These reservoir sites are as follows:

	Height dam.	Capacity, cubic feet.
Bear Creek (initial developent)	55 ft.	320,000,000
Bear Creek (ultimate development) ..	75 ft.	608,000,000
Alligator Creek	35 ft.	95,000,000
"Y" Creek	35 ft.	110,000,000
Jordan Meadows	35 ft.	179,000,000
Diversion Storage	85 ft.	250,000,000



Section of Earth Dam on Jordan River Development.

The 12 . 40 lb. Carnegie steel sheet piling, shown at the bottom of the dam, goes down to bed rock.

One impounding dam is now completed at Bear Creek reservoir and the other storage sites can be developed as additional generating units are installed to meet the increasing power requirements.

Bear Creek Reservoir.—This reservoir site lies near the head waters of Bear Creek, the dam being about a mile above the junction of that stream with Jordan River, about 4½ miles by wagon road from the diverting dam, and some 13 miles from the power station at the beach.

The impounding basin is formed in the long and comparatively narrow valley of Bear Creek, through which the stream winds in a succession of sluggish pools for a distance of some two miles above the site of the dam. The sloping sides of the valley are chiefly of broken and partially metamorphosed slate, covered with soil to a depth of from three to six feet. As the flat bottom of the valley is approached, the bed rock dips gradually from either side toward the centre of the valley, and is topped with a layer of hard-pan—a semi-cemented glacial gravel mixed with clay. This attains a depth of 87 feet in the ancient bed rock channel, which at the dam site is some 300 feet north of the present stream bed. The entire reservoir area supports a heavy growth of fir, spruce, hemlock, red cedar and yellow cedar timber.

The drainage area above the dam is about 8 square miles in extent, gently sloping, and rising to an altitude of about 2,300 feet.

The average precipitation observed at the site during the past two seasons is about 85 inches. In the winter months this precipitation takes the form of snow, which accumulates at times to a depth of 7 feet in the reservoir area.

Until the preliminary construction work began this site was unexplored, except for the rough preliminary survey which had been made in 1908 to determine the general features of the project. In September, 1910, the construction of a wagon road from the diverting point to the dam site was begun, and it was only after its completion late in November of that year that a permanent camp could be installed, and steps taken to determine with certainty the nature of the material underlying the dam site, and the quantity and quality of the material available for the construction of the dam.

The winter and spring of 1911 were spent in investigating the dam site, and the sites for borrow pits. A series of test pits were sunk and borings taken, and in May, 1911, complete data was obtained from which the construction details could be planned.

The principal dimensions of the dam and reservoir are:

Greatest height above bottom of valley	57 ft.
Greatest height above bottom of sheet piling curtain	127 ft.
Length of crest of dam	1017 ft.
Greatest depth of cut-off trench	31 ft.
Top width of dam	15 ft.
Width of spillway	50 ft.
Depth of spillway below high-water level	10 ft.
Upstream slope of dam	3 to 1
Downstream slope of dam	2½ to 1
Total volume of dam (embankment measurement)	148,390 cu. yds.
Capacity of reservoir above outlet gates with high-water level 5 ft. below crest of dam	320,000,000 cu. ft.
Area of reservoir at high-water level	284 acres
Drainage area above dam (approximate)	8 sq. miles

The Intake Tower in Forebay Reservoir.

In prospecting the site of the dam to determine the nature of the underlying material, a trench 16 to 20 feet in depth was excavated along the entire length of the dam axis, and following the top of the bed-rock as far as the depth of the trench would safely permit. Test holes were put down in the bottom of the trench by driving 3-inch pipe casing to the bed-rock. The casing was sunk with churn drills operated inside the casing, the material being removed with a water jet.

The formation was found generally to consist of a stratum of top soil from two to three feet in thickness, underlying which was a mass of heavy gravel and boulders. At a depth of from 12 to 16 feet the boulders diminished in size, and gave way to coarse, partly cemented gravel, hard enough to offer considerable resistance in removal with picks, below which, and at a depth of about 20 feet, alternating layers of loose sand and gravel carrying water extended to the bed-rock.

With these foundation conditions determined, and in order to provide not only a square foundation for the initial structure 55 feet in height, but for an ultimate structure which would raise the water level 70 feet above the floor of the valley, and double the capacity of the impounding basin, it was decided to install a curtain of steel sheet piling extending to the bed-rock.

After thoroughly prospecting both slopes of the valley, a sufficient amount of suitable material for building the embankment was found on the north side, directly opporite the dam, and distant about 400 feet from the north end of the dam axis. The material consisted of the hard-pan common to the district, gravel and sand mixed with clay, favorably proportioned for sluicing from place into the fill. The borrow pits were 150 to 250 feet in elevation above the valley floor, and afforded a working face or bank 8 to 18 feet high.

Clearing the timber from the dam site and the adjacent areas was begun as soon as men and equipent could be placed on the work. Powder and donkey engines were used extensively in removing stumps and piling the timber and debris for burning. A single acre in the dam site was found to contain 240 stumps of a size to require blasting for removal. The flowage area was not cleared beyond the immediate vicinity of the dam where clearing was required for construction purposes.

After the clearing was finished, and the stumps removed, the forest floor, consisting of partly decomposed vegetation, rotten wood and smaller roots, was removed to a depth of one to two feet from the area to be occupied by the base of the dam. Thirty acres of ground were cleared in all, 10.1 acres of which were stumped, and 4.1 acres stripped.

A cut-off trench, 6 feet wide at the bottom, 10 to 31 feet deep, with side slopes about ¾ to 1, was excavated parallel to the axis of the dam, the centre line of the trench being directly under the downstream edge of the crest of the embankment. The material excavated from the trench consisted of heavy boulders, gravel and sand. Steam and hand-derricks with skips were used in the dryer parts of the trench, while the section under water near the stream bed was removed with an hydraulic elevator. The total volume of material removed was 8,675 cubic yards

Interlocking steel sheet piling—Carnegie 12-inch 40-lb. section—was driven in the bottom of the cut-off trench to the slate bed-rock. Two pile drivers with 2,000-pound drop hammers were used, the driving gangs working night and day. The piles were furnished in lengths of 50 feet and less, the first shipment arriving at the site August 6th, 1911. Hard driving was encountered on the north side of the creek, but no pile was left until it reached bed-rock as indicated by the test holes. The piles were driven along the centre line of the cut-off trench, and from 4 to 6 feet were left projecting above the bottom. The trench was thoroughly cleaned before sluicing was started.

Total number of steel sheet piles driven	616
Total length of steel cut-off	580.5 feet
Net length cut-off per pile	about 11½ in.
Maximum penetration of pile below bottom of cut-off trench	68.5 feet
Average penetration of pile below bottom of cut-off trench	about 46.3 feet
Maximum penetration of pile below original ground surface	87.0 feet
Total piling driven	28,509.0 feet
Total weight of piling	570 tons

A permanent flood water spillway having a net opening 50 feet wide by 10 feet deep below the high-water level of the reservoir, was excavated in solid slate bed-rock around the north end of the dam. The spillway cut was about 350 feet in length by 35 feet maximum depth, with side slopes ¼ to 1. The larger part of the work was done under contract before sluicing was started, the rock being placed in the downstream toe of the dam.

Six concrete piers were erected in the throat of the spillway, against which timber stop-logs can be set horizontally to hold the pond at any desired level. A platform or runway extends from pier to pier, and an overhead cable with traveling tackle is provided for handling the stop-logs. The floor of the spillway is paved between piers and downstream for a distance of 10 feet. A concrete cut-off wall extending into impervious solid rock, is provided at the upstream end of the spillway piers. A second concrete cut-off wall, founded on bed-rock, extends from the south abutment to the puddle core of the dam.

The total quantity of material removed from the spillway was 11,267 cubic yards, of which 10,431 cubic yards was rock, and 836 cubic yards earth.

The masonry used in the piers, cut-off walls, paving, etc., amounts to 110 yards.

The material was placed in the dam by sluicing, except the rock from the spillway cut, and the material excavated from the cut-off trench, the material not sluiced amounting to 13,985 cubic yards in all.

A gravity supply of water for sluicing was obtained from a small creek on the north slope of the valley near the dam site. A storage reservoir was built on the ridge near the headwaters of the stream in which about 1,500,000 cubic feet of water were stored, sufficient to operate the sluices for a period of 5 to 7 days, depending upon weather condition. The water was taken from the creek at a point about two miles below the storage reservoir in a 10-inch spiral wound woodstave pipe, 1,300 feet in length, discharged into a head box from which a rivetted steel slip joint hydraulic pipe No. 12 gauge, 8-inch diameter, was laid to the borrow pits, the water being delivered at the nozzles with a static head of from 150 to 200 feet.

Owing to the necessity of completing the dam in time to store water for use at the power station during the summer of 1912, and in order to preclude, as far as possible, interruptions in sluicing from failure of the gravity supply, a pumping plant was installed below the dam near the creek, and pipes laid from the pumps to the borrow pits, all arranged to permit changing from gravity to pumped supply with small loss of time. The plant consisted of two 3-stage centrifugal pumps, 6-inch discharge, capacity 1,000 gallons per minute each, driven with steam engines. Four 50-h.p. boilers were installed, and wood from the site was used for fuel. The pumping plant was put into service whenever the gravity supply ran low.

Sluicing flumes for carrying the material were erected from the borrow pits, and extended the full length of the dam. The grade of slope of the boxes was 6 per cent. on the main flumes, the size of box being 16 inches wide by 18 inches deep, built of 2-inch plank, and lined in the bottom with wood paving blocks 4 inches deep. The lateral or distributing flumes were given a grade of from 7 per cent. to 9 per cent., were not lined, and were built with lap or telescopic joints to facilitate moving.

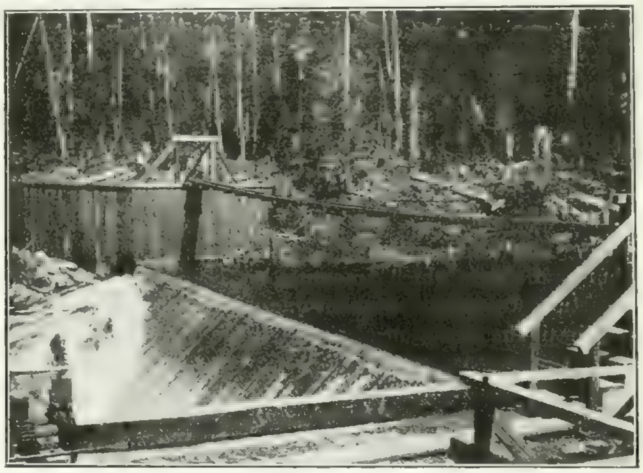
Three decks or levels of flume were used as the work progressed, the maximum height of supporting trestle being 70 feet. The trestle posts were round poles, cut on the site. The total length of flume erected for the work was:

First of lowest deck	1,050 feet
Second deck	1,150 "
Third deck	1,400 "
Lateral or distributing flumes..	3,000 "
Total	6,600 feet

About 360,000 board feet of lumber were used in the course of the entire work, the larger portion of which was in the sluicing flumes.

Sluicing was started September 1st, 1911, and carried forward night and day during the winter and spring until April 15th, 1912, when the fill was completed. More or less serious delays, due to freezing weather, snow-fall, maintaining temporary spillway through the dam for discharging flood water, and minor interruptions, were experienced; but in spite of these the average progress was better than anticipated, the estimated date of completion being May 15th.

The water in the reservoir was raised gradually as work of building the dam proceeded, no run-off being wasted after March 1st, 1912. At the date of completion the water level in the pond stood at the elevation of the spillway floor. Extremely dry weather conditions prevailed during the spring, and the basin failed to fill, the highest level reached being about 7 feet below the high-water level. The storage obtained, however—250,000,000 cubic feet—is sufficient for normal plant operation with one machine during the summer. The second unit which is being installed by the company will not be ready for service before the coming of the wet season.



Diversion Dam on the Jordan River Development.

The quantities and classification of material in the dam are:—

Excavation measurement:	
Rock from spillway and gravel cut-off trench..	13,985 cu. yds.
Material sluiced from borrow pits	129,364 cu. yds.
Total	143,349 cu. yds.
Embankment measurement, completed structure	148,390 cu. yds.
Excess of embankment over excavation measurement	5,041 cu. yds.
Excess of embankment over excavation measurement	3.6 per cent.

No attempt was made to break the hard-pan formation in the pits with the water from the monitors. Powder was used throughout the work for breaking down, holes being gophered in the base of the bank to a depth of 10 to 16 feet. A gang of men was kept constantly at work with picks, breaking up the larger masses to assist the action of the monitor stream. In fact, it was endeavored at all times to keep the solid material coming at a rate to utilize the full carrying power of the water flowing to the sluices. The quantity of water used in sluicing varied from 3 to 6 cubic feet per second, which was discharged through 3-inch and 4-inch nozzles in the pit. The following table gives a summary of the sluicing records:

Sluicing Record, Bear Creek Dam.

DATE	% time sluicing	Hours sluicing	Water used avge. in second feet	Cubic yards Placed	Proportion solids to water	Cubic yds. per 24 hrs. sluicing time
1911.						
Sept., 30 days	70 %	504	3.53	17,085	7.2%	813
Oct., 31 days	43.5%	322.8	3.2	10,300	7.3%	765
Nov., 30 days	51.9%	373	6.25	14,950	4.8%	964
Dec., 31 days	66.4%	493.5	6.25	18,150	4.4%	888
Jan., 31 days	85.6%	637	4.7	19,600	4.9%	740
Feb., 29 days	99.9%	694.5	4.3	29,650	7.5%	1110
Mar., 30 days	69.2%	518.8	3.4	17,300	4.4%	802
Apr., 15 days	48.5%	174.4	4.3	7,370	7.3%	1060
	66.9%			134,405	6.3%	893

Remarks:

October—Delay, waiting for free or gravity water.
November—Delay, waiting for free or gravity water.
Delay due to freezing weather.
December—Delay due to flood through temporary spillway.
January—Delay removing temporary spillway.
Delay due to freezing weather.
March—Delay draining fill.
April—Delay, slow work finishing crest.

A temporary spillway was maintained through the dam during the winter season, the maximum observed flood discharge through which amounted to 1,300 second feet. The structure was removed about January 1st, 1912, after which, and until the elevation of the permanent spillway was reached, an emergency overflow spillway was maintained over the dam, with plank apron attached to timbers embedded in the fill extending down the slope. The necessity of using this emergency overflow never arose. By manipulating the permanent outlet gates, the water was varied to provide storage in the main pond for floods in the stream, and the peaks were all safely passed without the water level reaching the top of the dam.

Outlet Structure.—Two 30-inch riveted steel pipes, ¼ inch thick, each 300 ft. long, are installed in the base of the dam, immediately south of the original stream bed. The trench in which the pipes are laid is excavated in the bed-rock, and backfilled with concrete which forms a casing around the pipes one foot thick on all sides. At the upper end of the pipes a reinforced concrete intake structure with screens is provided. This contains two 24-inch hydraulic gate valves with stems extended to a platform at the top of a structural steel tower 50 feet in height, from which the valves are operated. Venturi tapers were inserted in the pipes on both sides of the valves to minimize flowage losses through the 24-inch valves, made smaller than the pipe merely for sake of economy.

The excavation for the outlet works amounted to 3,730 cubic yards and 343 cubic yards of concrete was used in pipe casing and head works.

The behavior of the dam since completion has been most satisfactory. Measuring weirs set at points below the dam to intercept the water flowing by the dam, show that the aggregate discernable loss on April 4th, 1912, was .191 second feet, which was decreased on April 27th to .100 second feet. Subsequent reports indicate that the loss is steadily diminishing as the body of the fill gradually drains out.

The desirability of raising the height of this dam to obtain additional storage will no doubt appear shortly. The undertaking will be comparatively simple with the apparatus now on the site, a safe foundation installed, and all the perplexing and expensive features of design, methods, and transportation solved. By raising the embankment 20 feet the capacity of the storage basin may be increased to 608,000,000 cubic feet.

Diversion.—Two diverting dams, one in the main Jordan River, and one in "Y" Creek, a tributary stream, were installed.

Immediately below the junction of "Y" Creek with Jordan River the canyon narrows, and a ridge of outcropping bed-rock crosses the stream and extends well up the steep slopes on both sides of the canyon, forming a site well adapted for the placing of a concrete or masonry dam. It was originally planned to place the diverting dam at this point, but owing to limited time, the lack of a supply of concrete material nearer than the beach, and further, in view of the possibility of utilizing the site for the construction of a high masonry dam, which would, in addition to diverting the stream into the flume, form a large impounding reservoir in the valleys above, this site was reserved for the erection of the more permanent and higher structure at some later time, and a site for the main initial diversion was selected some 2,000 feet further up the stream.

The diverting dam on "Y" Creek was built a short distance above its junction with Jordan River, and a branch flume installed, which carries the water down the west side of the stream, crosses the main river on a timber truss 60 feet long, and discharges directly into the main flume.

The main Jordan River diverting dam is a log crib filled with rock resting throughout on solid rock. Rock from the excavation for the intake basin was used to fill the cribs. Timber cut adjacent to the site was used in the construction, the logs being notched and drift-bolted together, and thoroughly pinned to the underlying bed-rock. The top, upstream and downstream faces of the dam are sheathed with a double thickness of 2-inch plank laid with broken joints. The general dimensions of the dam are:

Length of crest	127 feet
Top width	8 feet
Upstream slope	1 to 1
Downstream slope	1 to 1
Maximum height	18 feet

Three timber head gates, with rack and pinion operating gear, are provided to regulate flow of water into the intake basin, which is also formed of log cribs, backfilled with rock, and lined with plank for water-tightness. At the lower end, and immediately above the flume entrance, sand gates are provided, depressed two feet below the flume floor, through which silt and sand collecting in the bottom of the intake basin may be discharged.

The dam has withstood the floods of two seasons, nearly 8 feet depth of water having passed over the crest at the highest stage, and at low-water the observed leakage is practically nothing. The "Y" Creek diverting dam is similar in type to the main dam already described, the crest, however, being only 90 feet in length.

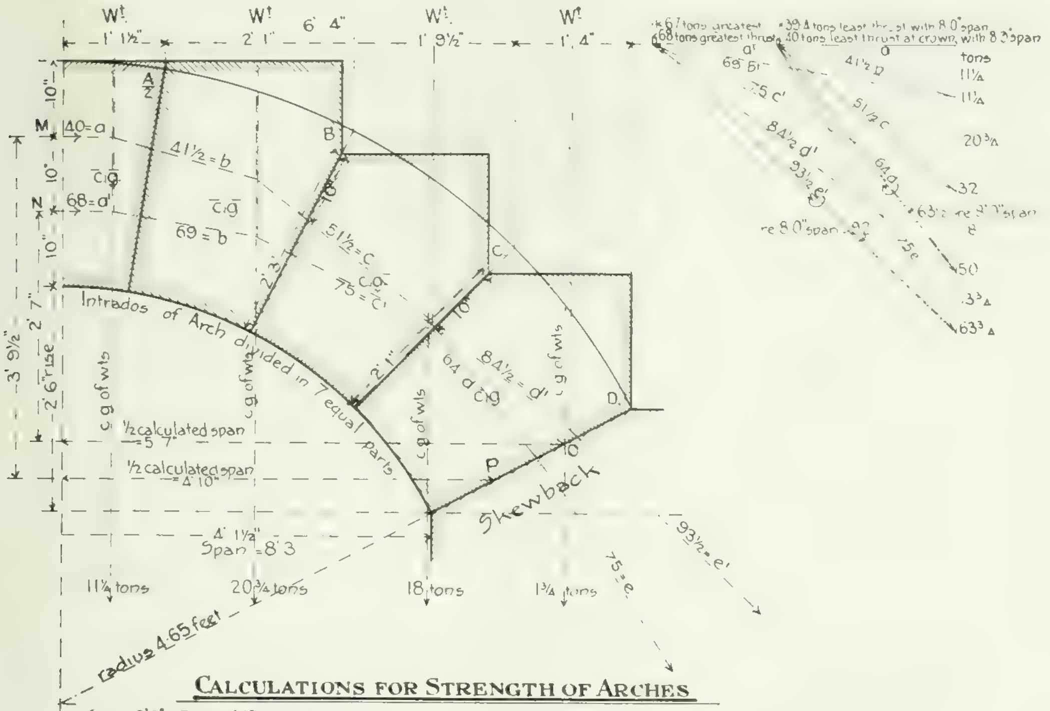
Main Flume.—The main flume follows the south side of the Jordan River canyon for a distance of about 5½ miles. The side of the canyon is precipitous at points, the slope being frequently broken with deep indentations. The formation, as a rule, is stable, and favorable for the flume foundation, consisting generally of hardpan or solid rock, topped with a comparatively thin layer of soil.

(To be continued next week).

CALCULATIONS FOR THE STRENGTH OF ARCHES.

By Leonard Goodday, C.E and M.E., late of the British Admiralty.

This paper is written with the intention of putting forward clearly a simple and practical method of obtaining the thrust on each voussoir, and finally on the skewback, with accurate results. In most cases it is taken for granted that the reader will understand the reason of each step, and, consequently, no explanation is given. The result is that too often a formula is used without the true principle or knowledge of its construction being known. The example given below was calculated for an engine-house which was built some years ago in the East.



CALCULATIONS FOR STRENGTH OF ARCHES

Span 8' 3". Rise 2' 6".
Sectional area of voussoirs 4' 6" x 2' 6" = 11 25 sq feet
Stone taken at 125 lbs per cu ft
Distributed weight, 9 3 tons per foot run
Total weight, 127 tons
Least thrust at centre $S = \frac{W \times L}{8 \times D} = \frac{127 \times 9\ 66}{8 \times 3\ 79}$ = say 40 tons
Greatest thrust at centre. $\frac{127 \times 11\ 16}{8 \times 2\ 58}$ = say 68 tons
Average thrust at centre $\frac{40 + 68}{2} \div 11\ 25 = 4{\cdot}8$ tons per sq ft
Least thrust on pier = 64 tons = 5 7 tons per sq ft
Greatest thrust on pier = $2\overline{)157\tfrac{1}{2}}$ $93\tfrac{1}{2}$ $78\ 75$ = $2\overline{)14\ 0}$ $8\ 3$ $7{\cdot}0$
Average thrust on pier = $\frac{78{\cdot}75}{11\ 25}$ = 7·00 tons

Span 8' 0"
Least thrust at centre $\frac{127 \times 9{\cdot}41}{8 \times 3\ 79}$ = 39 4 tons
Greatest " " " $\frac{127 \times 10{\cdot}91}{8 \times 2\ 58}$ = 67 tons
Average thrust at centre becomes 4 7 tons per sq ft
Average thrust on pier becomes 7 1 tons per sq ft
Allowing for deterioration and imperfections of stone
take ⅔ of the sectional area and we get
$\frac{78\ 75 \times 3}{11\ 25 \times 2} = \frac{78\ 75}{7\ 5}$ = 10 5 tons thrust per sq ft on pier
In the same way 7 2 tons thrust per sq ft at centre
For 8' 0" span, thrust at centre becomes 7 1 tons per sq ft
thrust on pier becomes 10 3 tons per sq ft

Calculations and Stress Diagram for Design of Arch.

The method given for finding the least line of resistance and thrusts on the skewback is by graphic strains, which, when drawn carefully to a large scale, is very quick and accurate, and can, of course, be checked mathematically if required. The arch had a clear span of 8' 3" with a rise of 2' 6" and 4.65' radius, and was made up of seven voussoirs of equal section for calculation, viz., 4' 6" x 2' 6". As it is necessary to have the least line of resistance within the middle third M.N.O.P. on the section, divide the arch at its centre and at the skewback into three equal parts, and obtain the spans and vertical distances as on the diagram for the calculation of the least and greatest thrusts at the centre preparatory to constructing the stress diagram. The vertical dotted lines indicate the centres of the distributed weights on each voussoir, and the centre of gravity of each stone is indicated by c. g., whilst the vertical full lines represent the centre of gravity of the total weights, including voussoirs. To obtain the least thrust at centre, the shortest span and greatest depth of the middle third should be taken, and for the greatest thrust the longest span and least depth should be taken.

It will be noticed that each thrust is lettered the same as the voussoir upon which it acts, the only difference being for the greatest thrusts which have a dash over them.

The construction of the stress diagram is as follows:—

Draw to scale the horizontal thrust a, equal to 40 tons as calculated.

From the right-hand end draw the vertical line, composed of the weights in rotation, commencing from the centre of arch.

From the left-hand end draw the lines b, c, d, e to the ends of each line representing the weights. Next, draw to scale the greatest horizontal thrust a', equal to 68 tons as calculated, and proceed as before and as shown. This completes the resolution of forces, which are built up step by step.

Beginning with the least thrust at the crown on the half section of arch, draw the horizontal thrust a from the point M until it intersects the centre line of weight through voussoir a, and from this point draw the line b parallel to the line b on the stress diagram until it intersects the centre line of weight through voussoir B, and so on to thrust d on skewback, viz., 64 tons, which equals the least thrust. For the greatest thrust at centre, viz., 68 tons, draw the horizontal thrust a' from the point N until it intersects the centre of weight through voussoir a, and continue as before to thrust e' on skewback, viz., 93½ tons, which equals the greatest thrust. From these thrusts the average thrust per square foot is obtained on the skewback and centre of arch, as shown in the calculations given below the sketch and stress diagram; and lastly, the thrust per square foot for a sectional area of two-thirds the sectional area of the voussoir, for reasons already explained.

The final results and the course of the line of resistance now obtained show that the stability of the arch is certain, and the profile of the voussoirs may be drawn out.

To do this mark off from the least line of resistance one-third of the depth, viz., 10 inches at the first and second points from the skewbacks, and construct the voussoirs, which, as will be seen, are in proper and uniform proportion to one another. The stability of an arch of this type is easier to obtain than a semi-circular one, as it is most difficult to keep the line of resistance within the middle third, an arch of this form cannot be crippled if properly constructed.

THE NEW PLANT OF THE DOMINION TAR AND CHEMICAL COMPANY, LIMITED.

The Dominion Tar and Chemical Company, Limited, has just erected a creosoting plant for the treatment of railway ties. The plant is located about six miles east of Winnipeg and is now operating. The plant has a contract to treat from 500,000 to 1,000,000 ties for the Canadian Pacific annually for ten years, which marks the first use of treated timber for ties on a large scale by that road. The plant also has a contract to treat some ties for the Canadian Northern, which will be used for experimental purposes, and large paving block contracts are being executed successfully for various cities in Western Canada.

A View of the Storage Yard for Ties.

The plant was built on a comparatively small scale, but was designed with a view to future enlargement, and some additions are now being made, while others are definitely planned. The two cylinders now being operated have a capacity of over a million ties annually upon the basis of present operations. The ties treated are principally jack pine, Norway pine, tamarack and white spruce, while some experiments are being made with British Columbia spruce and fir, and black spruce and poplar from Ontario. Although some of these species are not as well adapted to treatment as some other woods, they are used because they are easily obtainable along the company's lines. The climatic conditions in Canada are such that decay in ties is not so rapid as on roads located further south, the period of the year in which the frost is out of the ground, which is the only time that decay can seriously affect the wood being much shorter. The plant is equipped to treat timber by any method. The C.P.R. and C.N.R. contracts specify the Bethell process, injecting a minimum of two United States gallons per tie. The ties are receiving from 2 to 3½ gallons, depending upon the size of the ties. The process consists of preliminary steaming, when the timber is not air-seasoned, followed by a vacuum, after which the cylinder is filled with creosote and the desired amount of oil injected into the timber. After the oil is ejected from the cylinder, the timber is allowed to stand a short time to recover the drippings. Most of the oil used is secured from the distilling plants which the Dominion Tar and Chemical Company operates at Sault Ste. Marie, Ont., and Sydney, N.S.

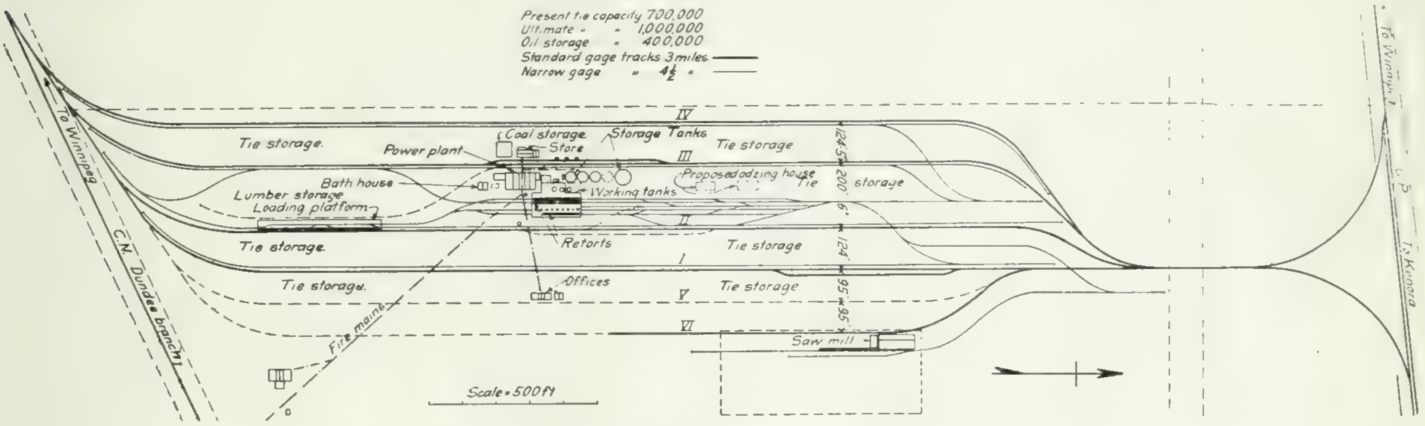
General View, Showing Treating Plant.

The treating plant occupies a tract of 40 acres, with the buildings located near one end of the yard. It is planned to add 30 acres to this next year, which can readily be done, as the company owns 110 acres. There are four long yard tracks serving the storage piles, which are designed to accommodate 700,000 ties, and the additional yard space planned for next year will provide for the stacking of over a million ties.

Practically all of the ties that reach the plant are shipped with the bark on the sides, which must be removed as the ties are unloaded. At present this work is being done by hand, but, when an adzing and boring plant is installed, as is planned for next year, it is hoped that some arrangement can be made to bark the ties by machine when they are adzed, although no detailed plan for effecting this has yet been prepared. All ties are seasoned before treatment, the length of time varying with the species of the wood and the requirements for treated material. Each yard track is paralleled by a narrow-gauge track for the operation of the cylinder cars. The narrow-gauge cars are operated by two narrow-gauge locomotives, one of which is of English make. A five-ton locomotive crane is used for handling some of the treated ties and paving block baskets and for switching standard gauge cars when necessary. It has also been found very useful in the building of tanks and other facilities about the plant. The yard is connected at one end with the main line of the Canadian Pacific and at the other with a branch line of the Canadian Northern. An elevated loading platform of frame trestle construction is provided for loading treated ties in standard gauge cars for shipment. This platform is served by two narrow-gauge tracks.

The treating plant is housed in steel frame buildings covered with corrugated iron. There are two treating cylinders 6 ft. 6 in. in diameter and 135 ft. long now in use, a third one 6 ft. 6 in. in diameter and 84 ft. long is practically completed, and a fourth one 6 ft. 6 in. in diameter and 135 ft. long has been ordered. The present cylinders have a capacity of 16 trains to a charge. The cylinder doors are swung from a crane attached to the cylinder, and when closed are secured by 24 clamps. These clamps are of heavier construction than that commonly used in creosoting plants in the United States. The cylinders are supported on I-beams carried on concrete foundations, with a special channel and I-beam construction at the expansion joints.

Two working tanks, 20 ft. in diameter and 14 ft. high, with a capacity of 34,500 gallons, supply oil to the cylinders through 8-in. pipes. A third working tank of the same size is practically completed and ready to operate. Compressed air is used to force the oil back when the pressure is removed. Recording thermometers and gauges are provided in the engine-room, which make a permanent record of the temperature and pressure in each cylinder during treatment, and a similar gauge registers the vacuum. Indicator gauges are also provided to show the amount of oil in the working tanks. The engine-room is equipped with three oil-pressure pumps, two vacuum pumps and two air compressors. The piping from the oil pumps is so arranged that either pump can force oil into either cylinder, thus eliminating the necessity for delay when either pump is out of order. Steam for the plant is supplied by two 450 horse-power Babcock and Wilcox boilers. Boiler water is secured from wells, and is treated by a soda and lime softening process. The boiler feed water is heated by a Cochrane heater. A 350-amp. 100-volt generator direct connected to a 50 horse-power engine furnishes electricity for 16 arc lamps and 350 incandescent lamps throughout the yard and the buildings.



Plan of Layout of Creosoting Plant.

A machine shop alongside the boiler plant is able to take care of minor repairs, and the locomotive house adjacent to the machine shop is used to store the yard locomotives. A bath-house is provided in the yard for the use of the 135 or more workmen which the plant employs. This house is equipped with two showers and four tubs. A boarding-house is furnished by the company near the yard for the accommodation of the workmen. The supply of creosote for the plant is kept in three storage tanks at present, one 40 ft. in diameter and 25 ft. high, and two 30 ft. in diameter and 15 ft. high. Two additional 30-ft. tanks 15 ft. high have been ordered and will be erected this year.

Mr. E. Bernard Smith, the general manager of the Dominion Tar and Chemical Company has recently removed his office, which is the head office of the company, from Sault St. Marie to the new Birks Building, Montreal.

The plant is operated under the direction of F. W. Zoates, manager for the Dominion Tar and Chemical Company, and G. G. Roberts, assistant manager. J. H. Dixon is the representative of the Canadian Pacific at the plant.

THE TREATMENT OF SEWAGE SLUDGE.

One of the largest schemes for the treatment of sewage, entailing an expenditure of $6,000,000, is now being carried out by the corporation of Bradford, England. The original works at Frizinghall having proved to be inadequate, an estate at Esholt, covering an area of 1,856 acres, was purchased in 1906, situated to the northeast of the city, and about six miles distant from the centre of the town.

The plant for dealing with the sludge has been removed from the old works at Frizinghall and housed in new and commodious buildings at Esholt; and since it has been found necessary to retain for the time being the old precipitation tanks at Frizinghall for the collection of the sludge, a temporary 8-in. steel pipe-line has been laid down, some five miles long, to deliver sludge to the new works. The main which follows the towpath of the Bradford and Leeds and Liverpool Canals has been laid in such a manner that it has sometimes a falling gradient and sometimes a rising gradient, whilst a great length of it is level. The total fall from the inlet to the outlet end is 70 ft. In order to get sufficient velocity to discharge 500 tons of thick sludge, containing only 80 per cent. of water, compressed air is fed into the main with the sludge, and this is the Pohle air lift worked upside down. It is found that the pressure on the inlet end varies from 30 lb. to 40 lb. per sq. in. The sludge is fed into the main by compressed-air-operated sludge-rams.

The new buildings, which cover 1¼ acres, are faced with a coarse sandstone. The design is in keeping with the nature of the stone, being massive and rugged in appearance, and the moulds simple, but bold.

In addition to the boiler-house, engine-house, and water-tower there is a press-house measuring 237 ft. by 92 ft., which contains 128 sludge-presses—64 of which have been made by Messrs. Manlove, Alliott and Co., Limited, of Nottingham; 36 by Messrs. John Wilson and Sons (Johnstone), Limited, of Johnstone; and 28 are now being made by Messrs. Knowles and Co., of Bradford, to complete the installation of 128. The grease-house, measuring 237 ft. by 50 ft., contains 16 grease-vats, each capable of purifying 6 tons of grease, with a grease storage tank under, capable of holding 1,000 tons; also grease separators, sludge-boiling vats, and rams.

The sewage of Bradford presents unique features on account of its strength, character, and concentrated condition, for which the trade refuse discharged into the sewers is responsible, and on account of this peculiar character the sludge-disposal works present novel features, being designed for the recovery of grease from the sludge. The method adopted by Mr. Garfield, the engineer of the scheme, is as follows: The sludge, on its arrival at the receiving-tanks, is lifted to the boiling-up vats by means of compressed air, here it is heated by live steam, and passed into three steel vessels placed underneath, and from which it is forced by compressed air to the sludge-filter presses. Each press contains forty-seven chambers, 3 ft. square. The object of heating the sludge is to facilitate the filter pressing, and to render liquid the grease contained in the sludge. The grease and water coming away from the filter-presses are separated in tanks, from which the water is pumped back again into the sewage, and the grease into the purification-vats.

From these vats the grease is run into barrels, pumped into tank-wagons on the adjoining railroad, or discharged into the storage-vats, whichever may be necessary. It has been found that the 100 filter presses now in operation produce from 12 to 15 tons of grease per twenty-four hours, which is valued at from 8l. to 10l. per ton, and the resulting cake is more valuable than that usually produced, consequent upon the fact that it contains no lime and only 28 to 30 per cent. of moisture. It is sold at the price of 3s. per ton at the works, where it is loaded direct from the filter-presses into the railway-wagons below.

Two main sewers eventually will convey the sewage of Bradford to Esholt. The larger sewer will be 10 ft. in diameter with a gradient of 1 in 2,000, and be capable of discharging 180 million gallons of sewage daily. This sewer will be in tunnel for 4,807 yards, and the work is about to be commenced. The smaller sewer has been completed, the contractors being Messrs. H. Arnold and Sons, of Doncaster. This sewer intercepts the sewage of Eccleshill and Idle, and conveys it to the works by gravitation, the cross-section being egg-shaped in form, 3 ft. 6 in. by 2 ft. 4 in., 1 mile in length (one-third of which is in tunnel) with a gradient of 1 in 630, and capable of discharging 12 million gallons of sewage. Into this sewer will be pumped the low-lying area of Greengates, where a pumping station with two 6-in. centrifugal pumps of the "Stereophagus" type is now being erected. These pumps will be electrically driven and automatically controlled, and have been designed to pass unscreened sewage. They are capable of raising 2,000,000 gallons of sewage and trade effluent through a 12-in. rising main to a height of 100 ft. daily. Tanks have been provided at the works to treat temporarily the sewage of these districts and of the district of Yeadon by chemical precipitation, the effluent being finally purified by land filtration.

The engineer of the scheme is Mr. Joseph Garfield, Assoc.M.Inst.C.E. For the 10-ft. diameter sewer and Aire Valley Crossing the engineers are Messrs. James Watson, M.Inst.C.E., and Joseph Garfield, Assoc.M.Inst.C.E., acting jointly; whilst the resident engineer is Mr. Howard Wontner-Smith, Assoc.M.Inst.C.E.

◆

TRAIL LOCATION AND CONSTRUCTION.

In a paper published in the Forest Club Annual of the University of Nebraska, Mr. Ernest Wohlenberg gives an interesting discussion on trail location and construction. He states that the first and most important consideration in trail construction is always the location, and grade is the determining factor in location. Where it is steep, switchbacks should be resorted to. The methods used in location are: (1) Compass and Abney hand level (accurate); (2) hand level only (fairly accurate), and (3) ocular levelling (inaccurate).

A route should first be reconnoitered and definitely decided upon before it is staked out. The main points can be sketched in on a map by means of a compass and hand level. On short distances the hand level will be sufficient. Laying out by eye is a poor method and inaccurate at its best. The route should be staked every 50 to 100 ft. and blazed, but as a usual thing routes are laid out by blazing only. The blazes should be made close together along the trail so that there will never be any trouble in following them. Location should always be from the top of a hill to the bottom, otherwise the maximum grade is apt to be exceeded, because in locating from the bottom there is danger of making the grade steeper than necessary. Location work can be done with a crew of three men and costs from $2 to $10 per mile.

There are several choices for trail routes: (1), Valley or canon; (2), ridge route; (3), trails crossing mountains, and (4), foothill. The use of one of the first two routes depends somewhat on the nature of the country. Where the canons are extremely steep, narrow, and full of boxes or interrupted by cliffs, the ridges and sidehills can be followed without much trouble. For the latter, the south sidehills should be used, because they are passable three weeks earlier in spring and later in autumn than north hillsides. Where the country has been worn down the valleys have a gentle grade and are fairly wide, so that they make good trail routes. Routes crossing the mountains are usually expensive and contain steep grades. Foothill routes are undesirable because there is so much winding in and out of the heads of canons, to keep an even grade, that the trail becomes extremely long.

Factors which influence the building and cost of trails are: (1), Grade; (2), width of the cleared space and the tread; (3), nature of soil; (4), cost of labor; (5), distance for packing supplies; (6), distance men have to walk to the work; (7), cost of supplies; (8), supervision. Grade is the determining factor.

The cleared space varies from 6 to 14 ft., and the tread from 1 to 4. ft. Ordinarily a tread of 18 in. is wide enough, for a horse will almost invariably travel on the lower side of a trail and always in the same place; if the trail is wider, the inside will fill up with sliding material and the extra cost in excavation will be thrown away. On turns, trails are widened and on switchbacks the width is doubled. The trail bed should be flat. Excavation should be made into the bank instead of building up the outer side of the trail, because on steep slopes earth thrown out of the trail makes a poor footing. The supervision of the crew is a most important factor, for if the work is not arranged as it should be, the trail will be expensive under the most favorable conditions.

The size of the crews varies from 2 to 15 men. In crews of 8 to 15 men it is necessary to have a cook, a packer, and a foreman. The brushing out can be done by 2 to 4 men, while 5 to 8 can do the grading. Small crews vary from 2 to 5 men.

On side-hill locations where water will run down a trail, it is always best to put in water bars; that is, small ditches 2 to 4 in. deep, running diagonally across the trail and banked on the lower side with earth or a small log sunk a few inches in the ground. These will turn the water and prevent any great amount of washing, which might ruin a trail. The number of water bars will vary with the grade of the trail and the degree of slope of the side hill. It is much cheaper to put them in when building the trail than afterward. Under ordinary conditions they can be located from 150 to 225 ft. apart. In building a trail, the country should first be reconnoitered and the route fully decided upon. It should then be located by stakes or blazes, and cleared and brushed, after which it will be graded and the tread formed to the specified width.

A NEW TYPE OF WATER TURBINE CHAMBER.

At low-head developments it is a common occurrence that during periods of floods the tail race water level raises to a considerable height and the endeavor of the designers of water turbine plants has been to place the electrical machinery and the power house floor above the highest tail water level experienced. In order to accomplish this use has been made of the arrangement with vertical shaft, whereby it is possible to place the generator at any height above the water level by only lengthening the shaft. However, this arrangement with vertical shaft has various well-known drawbacks as the accessibility of the turbine suffers greatly, and the dismantling of same is very complicated and requires a long time. The desirability of being able to install at low heads, as above described, horizontally arranged water turbines led the firm of Escher Wyss & Company to the design of a turbine chamber with artificially raised head water level.

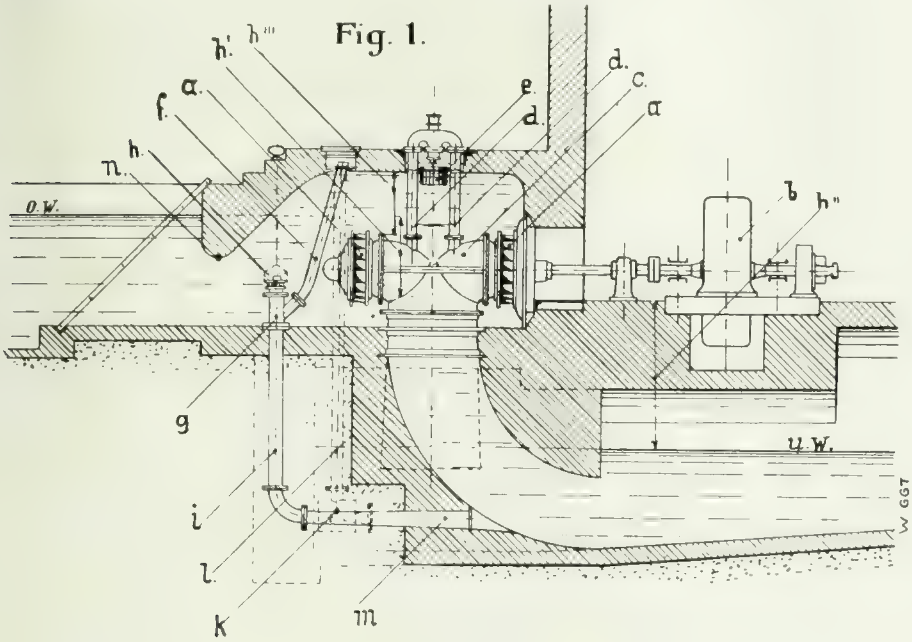


Fig. 1.

In order to ensure proper working of water turbines installed in open water chamber, it is necessary that the turbine be submerged to a certain extent so as to prevent any air from entering the machine, whereby the efficiency and the power would be decreased considerably.

The above mentioned arrangement, with artificially raised water level enables the designer to place the upper edge of the turbine (no matter if the shaft is arranged horizontally or vertically) slightly below the head water level. The advantages of thus placing the machine as much elevated above the tail water (of course within the possibility of proper suction) is: Firstly, that the direct coupled generator may be located considerably higher above tail water level than previously was possible, and secondly, that the excavation required for the tail race canal, and consequently the expense is reduced to a great extent. It goes without saying that the same advantage is gained if the turbine is of the vertical or horizontal type.

This method of artificially raising the head water level is of late very often adopted, and in special cases with the greatest advantage. The patent for this arrangement has been taken out by Escher Wyss & Company in most countries, and the demand for this kind of installations has increased very rapidly, so that quite a number of plants of this type are in operation at the present time. The raising of the head water level may be effected in different ways. Reference is directed to the illustrations, Figs. 1 and 2. There will be observed that the wheel pit is covered by a concrete roof, which is made air-tight. By sucking the air which remains between the head water level and the concrete roof the water level is raised gradually until the whole wheel pit is completely filled with water.

There are two different methods of obtaining this. The first method works automatically in the following way: As soon as the turbines open the water discharges through same and sucks through the pipes "D" attached to the draft chest, the air, thereby gradually the water (of course within the possibility of whole chamber is filled. As soon as the chamber is full an automatic float valve closes the pipes "D" so that no more water is discharged through the draft chest and consequently very little water is actually wasted. The other method consists of a separate connection between the water chamber and the draft tube, which is opened by hand, and discharges the water through same continuously during the operation of the turbine. In consequence, this quantity of water is wasted.

With the first method the turbine has to be put in operation before the wheel chamber is being filled and the level raised. With the second method the wheel chamber might be filled and the head water level raised before the turbines are opened and put in operation. Fig. 2 depicts a similar arrangement adapted to a vertical turbine installation.

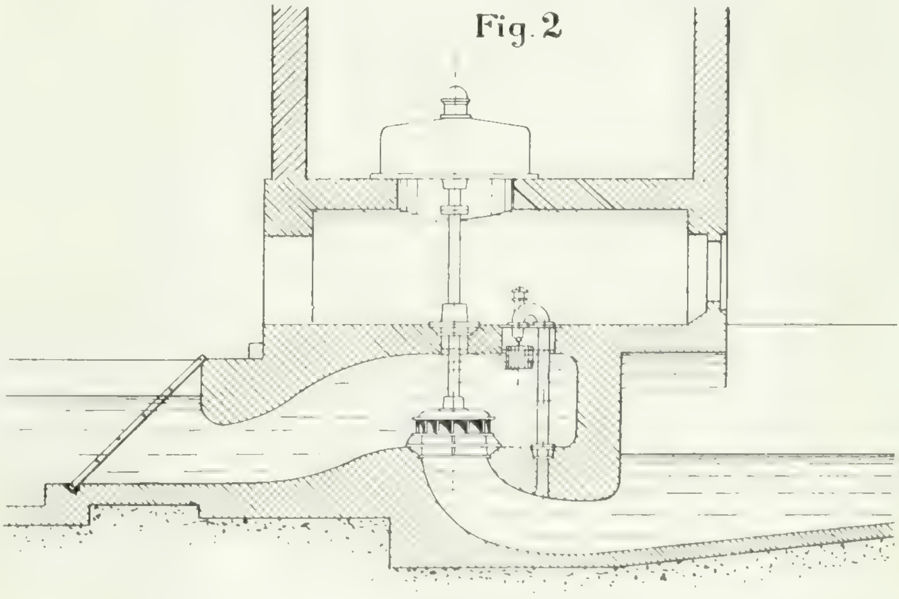


Fig. 2

Fig. 3 shows a cross section of such a water chamber with the turbine units erected. The automatic air sucking off devices with float valves are shown in the upper vaults on each side of the inspection shaft, in the centre of the chamber. The three first turbines working with this patent are in operation in Unterbruck, Bavaria, for the Amperwerke Electric Works, Munich, and were started up in 1908 and have been working with entire satisfaction since. The Unterbruck installation contains three turbines each with four runners having an output of 650 h.p. at a head of 15½ feet.

Since that time Messrs. Escher Wyss & Company have constructed a great many turbines working with artificially raised water level, of which the following are the most important:

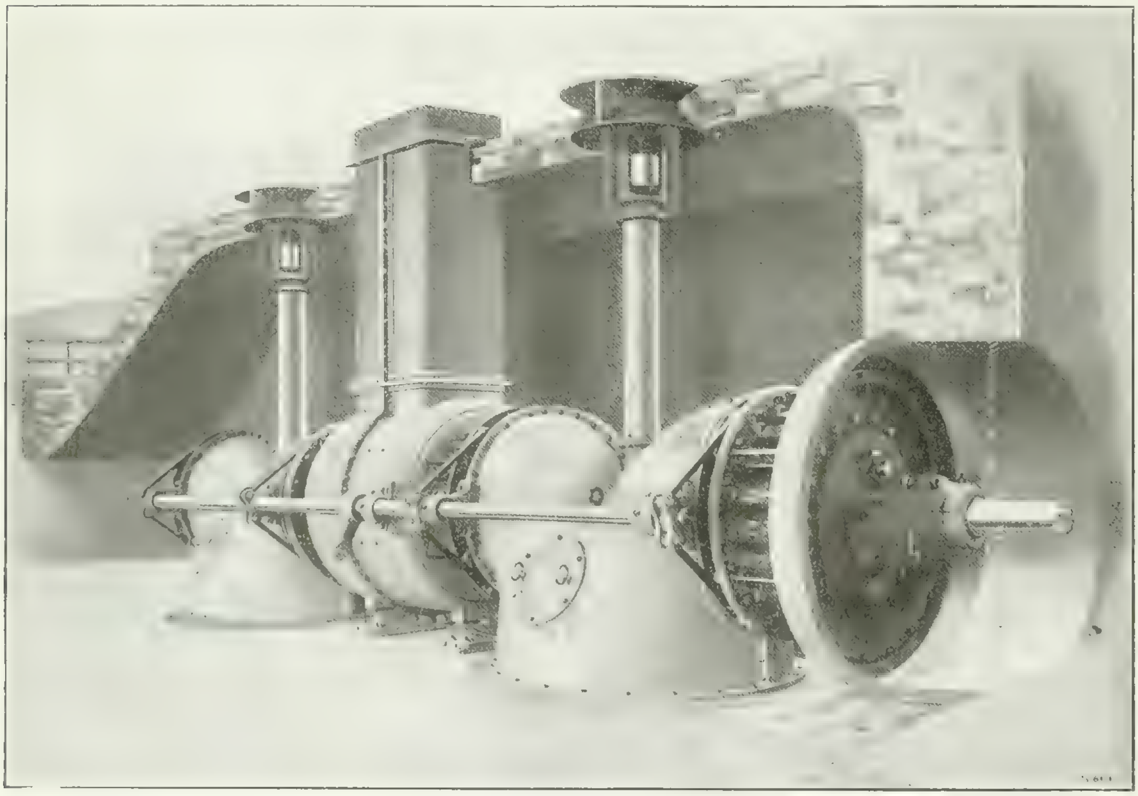


Fig. 3.

Messrs. Jenny & Schindler, Kennelbach-Tirol, in 1910, one turbine of 250 h.p. working under a head of 10½ feet. This turbine has four runner wheels on one shaft.

Societe Union Electrique de St. Claude (France), in 1909, two turbines, each of 945 h.p. and working under a head of 23 feet, for the Saut Mortier installation. In 1912 a repeat order was given for a third unit for the above installation and the capacity being increased to 2,200 h.p. under a head of 36 feet.

Messrs. Calvet, of Barcelona (Spain), in 1911, one 240 h.p. turbine with horizontal shaft working under a head of 11 feet.

The air may also be extracted by means of a jet-pump, which has induced Messrs. Escher Wyss & Company to take up the construction of turbines which can be erected above the head race water level. In order to start the machine an artificial water level must be created by operating the jet-pump, as shown in Fig. 1.

A turbine of this type fitted with six runner wheels on one shaft is at present in course of construction, destined for Messrs. Guenther & Richter, of Wernsdorf, Germany. This turbine has an output of 1,730 h.p. when working under a head of 16¼ feet.

NEW CARS FOR LONDON COMPANY.

The London & Lake Erie Railway & Transportation Company, of London, Ont., recently received from the Niles Car and Manufacturing Company two motor passenger car bodies and two trailer car bodies. These cars are of light weight, the body weighing about 21,000 lbs., and will seat 54 persons. They are built for double end operation. The arch roof and single side walls decrease the weight and cost, and increase the width of aisle and length of seats. The cars are designed to handle summer excursion traffic.

The general dimensions of the cars are as follows: Length over buffers, 49 ft. 4 ins.; length of car body, 38 ft.; length of passenger compartment, 27 ft 2 ins.; length of smoking compartment, 10 ft. 10 ins.; width over all, 8 ft. 8½ ins.; height under sills to top of roof, 9 ft.; height from track to top of roof, 11 ft. 10 ins.; distance between bolster trucks, 26 ft.; wheel base of trucks, 6 ft. 4 ins.; length of seats, 36 ins.; width of aisle, 26½ ins.

The underframe is of semi-steel with two centre sills of 6-in. steel I-beams reinforced on both sides under the platforms with ½-in. by 5-in. steel plates; two side sills of ⅝-in. by 7¾-in. steel plates between yellow pine sills; two 9-in. plate truss bolsters; two 6-in. I-needle beams; two 4-in. by 3-in. end sill angles; two ⅝-in. buffer plates; ¾-in. tie rod at each cross joist; and two 1¼-in. under-truss rods, and wooden framing. The floor is of double thickness yellow pine with waterproof tar felt between. The alternate panel and single side posts of the body are of oak with ½-in. vertical rods; single wall below windows of 1-in. tongue and groove oak gained ¼ in. over each post, finished inside for waist panel and sheathed outside with ¾-in. by 2-in. vertical poplar. The vestibules are flush with the car floor, and supported on steel centre sills. The car has 36-in. folding doors and has double steps and trap door over the opening at each side. In the trailers the body end bulkheads are omitted and iron pipe railings are placed between the step openings and the corner seats. The roof is of single arch style with concealed steel rafters. The interior finish is of oak. The ceiling is fitted with roof boards and rafters. The car trimmings are of bronze. A toilet is located in the main compartment against the smoking partition and has a dry hopper, sanitary finished and a cement floor. A water cooler is located in the alcove on the outside. The cars are fitted with 14 square-corner twin windows on each side, having stationary upper sashes, with five sections of clear glass in zinc channels so standing passengers can see out. There are three windows across the ends of the car, affording passengers an unobstructed view in either direction.

The motor cars are equipped with four Westinghouse, No. 93A, 60-h.p., 600-volt, d.c. motors, straight air brakes and Baldwin trucks. They weigh complete about 28 tons.

◆

ASTRONOMICAL OBSERVATIONS FOR AZIMUTH ON DOMINION LAND SURVEYS.

By J. A. Macdonald.*

With the high class of instruments now supplied our Dominion land surveyors, Azimuth observations, by using Polaris, are possible at almost any time on a light, clear, day, provided the telescope is properly focused. During the summer difficulties are sometimes experienced in detecting the star, when the object glass is not sufficiently protected from the reflection of the sun's rays. The instrument makers, however, provide a ray shade to obviate this.

On every clear day the watch error is easily determined by the surveyor by the sun's transit at noon. This observation entails no delay, and is by far the safest, because an observation on a star for the same purpose might keep the surveyor late on the line, but often prove impossible later on in the day.

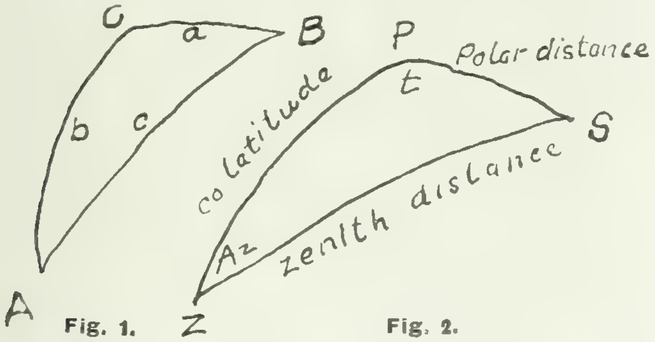


Fig. 1. **Fig. 2.**

The formula recommended by the Surveyor-General's Department for the reduction of Azimuth observations in Polaris is derived as follows:

In the spherical triangle to be solved, two sides and the included angle are given. The sides are arcs equal to the co-latitude of the place of observation, and to the Polar distance of the star (Polaris).

They include the hour angle of this star at the moment of observation.

The required angle and Azimuth of Polaris is formed by the two great circles which intersect at the zenith, and of which one is the Meridian of the place.

In Fig. 1.—To prove $\tan A = \dfrac{\tan a \operatorname{cosec} b \sin c}{1 - \tan a \cot b \cos C}$

$$\text{Now, } \frac{\sin A}{\sin a} = \frac{\sin C}{\sin c} \text{ or } \sin A \sin c = \sin C \sin a \quad (1)$$

and $\cos a = \cos b \cos c + \sin b \sin c \cos A$,

$$\text{or, } \sin c \cos A = \frac{\cos a - \cos b \cos c}{\sin b} \quad (2)$$

Dividing (1) by (2) we get

$$\tan A = \frac{\sin a \sin b \sin C}{\cos a - \cos b \cos c}$$

Dividing numerator and denominator by $\cos a \sin^2 b$ we get

$$\tan A = \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos b \cos c}{\cos a \sin^2 b}}$$

Now, $\cos c = \cos a \cos b + \sin a \sin b \cos C$

Hence,

$$\tan A = \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos b}{\cos a \sin^2 b}\left(\cos a \cos b + \sin a \sin b\right.}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos a \cos^2 b}{\cos a \sin^2 b}} - \frac{\sin a \sin b \cos b \cos C}{\cos a \sin^2 b} =$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos a \cos^2 b}{\cos a \sin^2 b} - \dfrac{\sin a \sin b \cos b \cos C}{\cos a \sin^2 b}}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1 - \cos^2 b}{\sin^2 b} \quad \tan a \cot b \cos C}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{1 - \tan a \cot b \cos C}, \text{ since } 1 - \cos^2 b = \sin^2 b$$

Now in the spherical triangle P Z S (Fig. 2).

P = Pole

Z = Zenith

S = Star (Polaris)

$$\tan PZS = \frac{\tan PS \operatorname{cosec} PZ \sin ZPS}{1 - \tan PS \cot PZ \cos ZPS}$$

$$\text{or } \tan \text{Azimuth} = \frac{\tan P \sec L \sin t}{1 - \tan P \tan L \cos t}$$

where P, L and t are Polar distance, latitude and hour angle respectively.

This is the formula recommended by the manual of surveys of Dominion lands for the reduction of Azimuth observations by using Polaris, though its derivation is not shown in the manual, but it is here given in graphic form.

Surveyors are, however, at liberty to use any formula or process for reducing their observations, but as forms and tables could not be prepared for every method this formula,

$$\tan Z = \frac{\tan P. \sec L. \sin t}{1 - \tan P. \tan L. \cos t}$$

where Z. P. L. t. are Azimuth, Polar distance, latitude and hour angle respectively.

The logarithms of secant and tangent L are given in tables for the north side of every section

By means of these astronomical field tables now supplied surveyors, the observation has become very easy and simple.

The instruments necessary are a watch, keeping sidereal time, that is to say, gaining 3 minutes 56 seconds a day, and a four-inch transit theodolite, now listed by several manufacturers, so-called "Canadian Pattern." A common watch of a reputable manufacturer is good enough. The best grades keep the time for weeks and months with sufficient accuracy, the error being ascertained from time to time by a Meridian observation of the sun or star.

---

* Of the Topographical Surveys Branch, Department of the Interior, Ottawa.

In the western provinces and territories the air is exceedingly transparent, and a light, star-like Sirius may be seen at any time during the day. The pole star is best seen about an hour to a half hour before dark. While there is still ample light for reading the graduation, it may also be observed in the morning.

Observation of the Pole Star for Azimuth.

The instrument must be carefully levelled. The observation is made on a section line or traverse station, which is called the reference line, the bearing of which is known with sufficient approximation for setting the instrument in the Meridian.

Set the vernier of the horizontal circle to read the bearing of the reference line, loosen the lower clamp and turn the instrument until the telescope is directed on the reference line; fasten the lower clamp and release the upper clamp. The instrument is now set to read the astronomical bearings. By setting the vernier at 360 deg., the telescope is in the Meridian.

In the example below, the vernier is set to read 180° 05′, the lower clamp released and the telescope directed on the east boundary of section 18. The telescope is set for the latitude of the pole star, shown in tables furnished the surveyor. For example, in the example the table or diagram shows a latitude of 51° 20′ corresponding to township 27. The vernier is now set to read the bearing of the star taken from the time shown by the watch. In the example it is set at 358° 19′. So set, the star is in the field, and will be seen, provided the telescope is accurately focused. The time by the watch is noted as well as the horizontal circle reading. For all Azimuth work it is essential that the observation be made in two positions of the instrument, circle right and circle left. The position of the instrument is reversed by transmitting the telescope and turning the vernier plate 180°. The first part of the observation is now repeated. The H. C. R. on the reference line is recorded, the telescope is set at the altitude of the star, the vernier at the bearing, and the field is scanned for the star. When found, the time by the watch and horizontal circle reading are again recorded.

The following example shows clearly how the observation is worked out:

Astronomical Observation.

Date—January 19, 19—, 8.45 a.m., mountain time.
Place—N.E. corner Sec. 18, Tp. 27, R. 20, W. 3rd. Mer.
Reference Line—East boundary of Sec. 18.

	Face.	H.C.R. on reference line.	H.C.R. on Polaris.		Watch time.
1	Right	180° 05′	1° 21′.9		16 h. 22 m. 57 s.
2	Left	180° 03′	1° 23′.0		16 h. 25 m. 07 s.
	Mean	180° 04′	1° 22′.45		16 h. 24 m. 02 s.
3	Watch correction			——	42 s.
	Sidereal time				16 h. 23 m. 20 s.
4	Tabular bearing for 16 h. 20 m. and Tp. 20				1° 15′.5
5	Difference for 3 m. 20 s.			+	1′.1
6	Difference for 7 townships			+	1′.0
7	Convergence for 2 sections			+	2′.2
8	Bearing of Polaris				1 19′.8
9	H.C.R. on Polaris				1 22′.45
10	Correction to H. C. R.			----	2′.65
11	H. C. R. on reference line				180° 04′
12	Bearing of reference line				180° 01′.35

The bearing is generally found to differ from the bearing by account which was 180° 05′ in this example. The difference represents the accumulated errors of the survey. It is distributed among the previous courses of the survey, according to the judgment of the surveyor.

In the observation, the watch correction was assumed to be known within one minute. This correction has to be ascertained from time to time, more or less frequently according as the watch is of a better or of an inferior grade.

The watch having been set approximately to sidereal time, its correction is ascertained by observing the meridian transit of a star or of the sun.

When it is desired to observe at a place where no line of known bearing exists, the surveyor sets his instrument in the Meridian by means of the compass for turning the instrument in the direction of the star. The magnitive declination can now be easily determined from tables, when the star can be brought into the field of the telescope.

◆

COAL IN THE WEST INDIES.

The only locality in the West Indies where coal has been found is the island of Trinidad. There is little information as to its mode of occurrence and extent, for attention has been mainly directed to the investigation of the deposits of petroleum and its residual deposits of bitumen, including asphalt and "manjak."

A seam of lignite (brown coal) from 4 to 6 ft. thick is said to occur in the cliffs of the south coast between Oropuchy and Moruga, in strata of Tertiary age dipping to the east at an angle of 30°. It sometimes contains interlaminar deposits of calcium sulphate, and is frequently discolored by the presence of iron oxide. In other cases it is more compact, and resembles cannel coal or pitch, being evidently allied to "manjak." An analysis of a mixed sample in the Scientific and Technical Department of the Imperial Institute gave the following results:

	Per cent.
Volatile matter (including sulphur but not water)	32.9
Fixed carbon	34.0
Water	13.7
Ash	19.4
Sulphur	5.06
Calorific value,[1] small calories	4,378
Evaporative power[2]	8.17

[1] The calorific value represents the number of grams of water raised from 0° to 1° C. by the combustion of 1 gram of the coal.

[2] The evaporative power represents the number of grams of water at 100° C. converted into steam at the same temperature by the combustion of 1 gram of the coal.

The coal burned readily with a highly luminous flame. When it was heated to drive off the volatile constituents, the residue did not cake and form coke, but left a friable mass which fell almost at once to powder. The coal is therefore of inferior quality, the percentage of fixed carbon being too low, and that of ash and sulphur too high. The amount of sulphur is no doubt largely due to the presence of calcium sulphate, which might be removed by washing. The fact that the samples were taken from the surface may be responsible for their poor quality.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, Managing Director
T. H. HOGG, B.A.Sc., Managing Editor
A. E. JENNINGS, Advertising Manager
P. G. CHERRY, B.A.Sc., Circulation Manager

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, NOVEMBER 28, 1912. No. 22

CONTENTS OF THIS ISSUE.

Editorial: PAGE

The Jordan River Development of the Vancouver Island Power Company 801
The International Joint Commission and Sewage Pollution of Boundary Waters 801

Leading Articles:

The Vancouver Island Power Company, Limited, Jordan River Development 787
Calculations for the Strength of Arches 793
The New Plant of the Dominion Tar and Chemical Company, Limited 794
Trail Location and Construction 796
A New Type of Water Turbine Chamber 797
New Cars for London Company 798
Astronomical Observations for Azimuth on Dominion Land Surveys 799
Letters To The Editor 802
Preservation of Ties 803
The New Home of the Canadian Society of Civil Engineers 804
Grade Elimination and Railroad Bridges 805
American Road Builders' Association 807
Annual Report of The Canadian Northern 808
The New Offices of The Bank of Toronto 809

Engineers' Library 810
Coast to Coast 815
Personals 817
Coming Meetings 818
Engineering Societies 818
Market Conditions 24-26
Construction News 65
Railway Orders .... [illegible]

THE JORDAN RIVER DEVELOPMENT OF THE VANCOUVER ISLAND POWER COMPANY.

The Jordan River Development of the Vancouver Island Power Company, Limited, is an exceedingly interesting one from many points of view. The plant itself is not a very large one, but the difficulties that were met with and overcome in securing the necessary data, and afterwards, in installing the plant, were exceptional.

The preliminary investigations were carried on in what was practically virgin forest, and the engineers had practically no data to hand to enable them to decide where the development should be located. The powerhouse itself is located in almost inaccessible country, and the difficulties of getting a construction plant on the ground, together with the actual construction of the plant, will, therefore, be appreciated. The first section of a description of the Jordan River Development appears in this issue of *The Canadian Engineer.* The way the necessary data was compiled, and the constructive details were worked out, reads most interestingly. The engineers in charge of this work are to be congratulated for the ingenuity and perseverance shown throughout the investigation and the actual construction.

◆

THE INTERNATIONAL JOINT COMMISSION AND SEWAGE POLLUTION OF BOUNDARY WATERS.

As has been noted in these columns from time to time, the International Joint Commission is taking up, under instructions from the several governments, an enquiry into the pollution of international boundary waters. At the Washington session on November 18th, Secretary of State Knox directed that, "The enquiry should be confined to cases of pollution on one side of the boundary which extend to and affect the other side." This statement very much limits what was thought to be the original scope of the enquiry. It would appear from this statement that investigation of pollution would be restricted to the narrow waters of the St. Mary's River, Mackinac Strait, the St. Clair, Detroit, Niagara and St. Lawrence Rivers. Thus, the cities of the United States, which are located on the Great Lakes, and which are at present polluting lake waters, do not come within the sphere of investigation of the Commission.

It would appear that the above limited meaning of what is meant by sewage pollution will greatly impair the usefulness of the investigation. This construction is placed on the enquiry by the United States Branch of the International Joint Commission. It is not believed, however, that the Canadian Branch will assent to the above meaning. While it is true that it is highly desirable to investigate the relationship of cities, such as Buffalo and Detroit, to the question of sewage pollution, it is just as desirable that cities like Rochester and Cleveland should also come within the meaning of the enquiry.

If this investigation is to serve the best interests of Canada and the United States, it is highly desirable that the scope should be understood to include all cities and municipalities using international waters as a means of sewage disposal. With the limited construction placed upon the question, it would be impossible for the Commission to consider pollution of international boundary waters from boat traffic, and this would be a serious limitation.

EDITORIAL COMMENT.

The council of a thriving Western municipality announce that they will erect a jail and storehouse in one building at a cost of $20,000, but omit to state what preparation has been made to preserve the "long termers" during the storage period.

* * * *

The executive of the Ontario Good Roads Association announce that the annual meeting will be held on February 26th, 27th and 28th, in the Machinery Hall of the Toronto Exhibition grounds. A Good Roads exhibit, showing different classes of road-making machinery and samples of various roadbeds, will be held at the same time. This exhibit should be an added stimulus to this already very successful Association. No doubt, the different manufacturers will be interested in making the exhibit a success.

* * * *

In this issue, under "Letters to the Editor," will be found certain correspondence in connection with an editorial which appeared in our issue of November 7th on "Protection of Canal Lock Gates." Our impression was, at the time this editorial was written, that the Gowan Safety Device had been in use on gates other than Lock 24 of the Welland Canal. We are glad to note Mr. Gowan's correction. The letter from Mr. W. H. Sullivan, Superintending Engineer of the Welland Canal, corroborates Mr. Gowan's statement that the gates at Lock 24 have had some severe tests.

* * * *

In our last issue, November 21st, the City Commissioners of Edmonton advertised for sealed tenders for "Paving for 1913" for approximately 400,000 square yards of asphalt and bitulithic pavement. The Commissioners of Edmonton cannot be too highly congratulated for their progressiveness in this matter. The only sure way of getting a paving contract started early in the spring is to call for tenders in the preceding fall. Far too often paving work is just being started in September or October, with the result that the pavements are always at least a year behind. If more city engineers would follow the move of the City Commissioners of Edmonton there would be less trouble in the letting of contracts for the summer's pavements, the work would be better done, and it would be finished on time.

◆

LETTERS TO THE EDITOR.

PROTECTION OF CANAL LOCK GATES.

Sir,—Your article in last week's issue of The Engineer re "Protection of Canal Lock Gates," is timely and appropriate, as far as the necessity for the adoption of some efficient device for the protection of lock gates against the impact of vessels is concerned.

In this article you describe the "Gowan safety device" and the "chain fender system," the former as applied on the Welland Canal, the latter to be on the Panama. While you admit the Gowan safety device has been very successful on the Welland in cases of small speed, you conclude that, from the number of accidents recently occurring, some more suitable device is necessary, and suggest the "chain fender," as to be applied on the Panama.

Admitting that the intention of your article is to be fair to both devices and in the interests of navigation, the writer must take exception to your conclusion, as it is based on a wrong idea, viz., that the gates on the Welland Canal are equipped with the Gowan safety device. This is not so.

In the description of the Gowan safety device, supplied you by Mr. J. L. Weller, now engineer-in-charge of the new Welland Ship Canal, and appearing in your issue of July 4th, 1912, the words, "as applied to the existing gates of the Welland Canal," are incorrect, and may have misled you. This device has, so far, been installed on one lock only on the Welland, viz., Lock 24, one of the most dangerous points on the canal, and has proved by three actual tests to be a decided success, not only against a light impact, as you describe, but against a vessel under full steam, as in the case of the "Harry Packer," which snapped three cables and cut an oak wale on the gate, 6 x 10, completely in two with her stem. Had the Welland Canal lock gates been equipped fully with the "Gowan safety device," the accidents you record would have in no case happened, and your article in reference would have been uncalled for.

The Engineer can get full corroboration of the above statements as to the merits of this device under actual tests from the Department of Railways and Canals, Ottawa, or by applying to W. H. Sullivan, Engineer-in-Charge, Welland Canal, St. Catharines, Ont.

It is hoped you will give this letter as full publicity as your article, to which it is a reply, said article having been copied by other papers.

Yours respectfully,
N. W. Gowan,
Inventor and patentee.

St. Catharines, Nov. 16th. 1912.

Sir,—Replying to your communication of the 19th inst., I would state that the Gowan safety device for the protection of lock gates was installed by Mr. Weller, now Engineer-in-Charge of Welland Ship Canal, on the upper gates of Lock No. 24 of the Welland Canal about two years ago.

This lock was chosen on account of its being the one where the consequences of a break would prove most serious. Until the present season no vessel collided with these gates with sufficient force to give the device a severe test.

On May 20th, 1912, the steamer "Beaverton," bound up, while locking, surged ahead with sufficient force to break a wire hawser, striking the upper gates and opening them sufficiently to admit the boat's stem into the mitre. I feel satisfied that but for the device the gates would have been carried out.

On August 16th, 1912, the steamer "Harry E. Packer" entered the lock with speed, and through some misunderstanding of signals the engineer, instead of backing up, drove the vessel full speed ahead against the gates.

Three large snubbing lines were broken, and the boat struck the right head gate, cutting a 6 in. x 12 in. oak wale through and opening it quite a distance.

The upper finger of the device supporting the left gate broke, which was, so far as can be judged, due to a flaw in the casting. The full load was thus thrown on the lower finger, which held, and prevented a very serious accident.

The injured gate, though badly twisted, was sufficiently repaired in three hours to resume navigation, and later on was replaced by a spare gate.

The device will be placed on at least five more locks this winter.

Trusting the above information covers your requirements, I remain,

Yours very truly,
W. H. Sullivan,
Superintending Engineer,
Welland Canal.

St Catharines, Nov. 21st, 1912.

CANADIAN ENGINEERS AND DRAUGHTSMEN.

Sir,—The article on the above subject in your issue for the 14th inst., while offering some good suggestions, makes some rather amazing statements. The writer attributes the scarcity of capable draughtsmen in Canada chiefly to the large proportion of people whose parents were "nothing but farmers." In other words, boys who hail from the country are thereby partly incapacitated from thoroughly learning engineering, and, presumably, any profession. I quite disagree with this. History and biographies show again and again that the real genius comes from the country and seldom from the city, and in no sphere of life is this more true than in engineering. Telford, Watt, Stephenson, and a great many other engineers in our own day came straight from the land. Practically all the great authors and poets owe their genius to mother earth. Most of the great statesmen, Gladstone excepted, were country bred. Everyone knows the story of Abraham Lincoln.

To my mind, the reason why the Canadian-born draughtsman, as a rule, has not had the experience, and does not possess the initiative of his competitors, is that competition in a new country like Canada is not keen enough. In Britain, no one without shop experience could get a job as draughtsman. To a large extent, drawing offices in Canada seem to be recruited from a few college students and many tracers, instead of from young men who have just completed a shop apprenticeship. On the latter point I quite agree with the author of your article. One reason, I consider, why young Canadians do not stay long enough at the drawing-board to acquire thorough experience is the fact that in many offices a draughtsman's lot is a dog's life of push and drive. The man quietly makes up his mind to get out at the first opportunity and into some opening where there is a little more mutual trust and confidence.

As to the suggested increase in technical schools, I maintain that this has been overdone in England to such an extent that the market value of a knowledge of mechanical engineering design has been reduced to 35 shillings a week ($8.40). My experience has been that the quickest draughtsmen are often those who have not a superabundance of technical knowledge, as they do not stop at every turn to worry themselves about theoretical considerations. This statement will probably meet with opposition.

Without trespassing further on your valuable space, I shall conclude with a short reference to the much-maligned premium apprentice system. Don't pay a premium if you can help it, of course. Personally, I owe my practical training to this system, as without it I could not have got a start in an engineering works, having no friends or relatives who were ever connected with the business. In Europe, at all events, the premium apprentice is the only form in which new blood comes into a concern. Almost all the mechanical engineers of the British railways are from the ranks of premium apprentices.

C. Oldrieve Thomas.

Montreal, Nov. 20th, 1912.

◆

25-CYCLE CURRENT FOR LIGHT.

Sir,—It has occurred to me to wonder if any one has considered the probable effect on eyesight of the disagreeable flicker noticed with lights deriving power from Hydro-Electric System. This would appear to be due to the fact that they are using 25-cycle alternating current. I have not seen any explanation as to why the 25-cycle current was chosen, as it must surely have occurred to the devisers of the system that this was approaching very closely to the limits of persistence of vision so that a sensitive eye readily notes the flicker due to the comparatively slow alternation of polarity. It is a point that deserves consideration by expert oculists.

Yours truly,

J. EDW. MAYBEE,
Ridout & Maybee, 59 Yongs St.,
Toronto.

Nov. 22nd, 1912.

◆

PRESERVATION OF TIES.

Sir,—Your issue of November 14th contains an article written by Mr. E. A. Sterling on "The Development and Status of Wood Preserving Industry in America," in which he gives a summary of the various processes of treating methods now in use in this country. He divides the different kinds of treatment into three classes, namely, (1) high artificial pressure process, (2) atmospheric pressure process, and (3) low artificial pressure process. Each of these is again sub-divided into two classes, namely, (1) "full-cell" and (2) "empty-cell." This is quite a foxey classification, but it is inconsistent and is not entirely in accord with the facts. In the first place he omits to mention in his summary the "boiling in oil process," which is used to a considerable extent in the West, and we would be curious to know in what class he would include that process. Again, he does not describe how "full-cell" and "empty-cell" treatment is secured or performed with "low artificial pressure process," as he does for all the others mentioned in his schedule, and leaves one to guess as to how it is accomplished. Nor does he make clear what he means by "high artificial pressure" and "low artificial pressure." Is it not true that the pressure in the impregnating cylinder may be anywhere from one pound to 250 pounds, or even more? Therefore, wherein is the distinction between the two processes? If there is any, when and by whom was the line of demarcation established?

In regard to the so-called "full-cell" and "empty-cell" process, I desire to repeat here what I have often expressed orally and in writing, that there can be no such distinction between different treating processes, and that these words were coined by exploiters of patented creosote processes to humbug and bamboozle the uninitiated. These so-called "empty-cell" processes are nothing more than "partial dose" processes, injecting only a limited quantity of creosote oil into the timber, and in many instances the proper seasoning and preparation of the ties before treating, which is so essential for good work, are ignored.

I would summarize the methods in use in this country at the present, as follows:

Artificial Pressure Processes.

Full Dose.—Impregnation done in closed cylinders. Preservatives injected in the wood to total refusal, after the wood is put into a receptive condition by air seasoning, or boiling in steam or oil. Preservatives mostly used are creosote oil, zinc chloride, crude oil and other chemicals and solutions. Penetration and diffusion as thorough as the condition of the wood and process of treatment will admit.

Partial Dose.—Impregnation done in closed cylinders. Duration and amount of pressure regulated so as to inject a limited quantity of preservative into the wood. Creosote being the only preservative used in this process. Penetration usually scant except in sapwood and the variation in absorption in individual ties is very large.

Atmospheric Pressure Processes.

Light Dose.—Impregnation done in open tanks. Preservatives usually creosote oil, crude oil, or carbolineum. Quantity absorbed depending upon the temperature and nature of solution, character and condition of the wood. Treatment only superficial.

The Lowry and the Rueping processes come within the category of "partial dose, artificial pressure process."

Mr. Sterling states that the present tendencies are towards lighter impregnation with creosote and that no less than sixteen plants use a light impregnation creosote process. While not specifically so stated, the impression left on my mind after reading this article, and I think on that of most readers, is that it is economical to treat ties with a light dose of creosote. We do not believe these light treatments are economical, and possibly some of the railroad companies treating their ties with light doses of creosote are making a great mistake.

Treating railroad ties with light doses of creosote oil has shown emphatically by experience, a very unwise thing to do. For motives of economy some of the French railways undertook to reduce the quantity of oil injected into their ties, from full dose to partial dose, and met with unfavorable results. Why should we not profit by past experience and treat ties to refusal, instead of repeating these mistakes

In France where the creosoting of ties is an old industry, heavy treatment has been the rule, forcing into the timber all of the creosote that it would take. In England, also, the creosoting of railroad ties is an old industry, but, on the average, a somewhat smaller quantity of creosote per unit volume of timber has been used than was common practice in France. In comparisons of the practical results obtained in the two countries it has always been reported that the life obtained from creosoted ties in France was longer than in England, purely and simply because of the larger amount of material used per unit of the treated timber. If the long-standing results of experience in these countries have been correctly represented, and if any significance attaches to them, we fail to see the logic in much of the supposedly experimental work that has been done in this country. If the life of the timber depends upon the amount of preservative injected, as long-time experience seems to teach, then skimping the material might be expected to result as skimping usually does in other engineering work, no matter under what name or disguise the art is practised. The old adage, "Anything worth doing at all is worth doing well," is eminently fitting in the treatment of ties and timber.

W. F. GOLTRA, President,
The W. F. Goltra Tie Company.

Cleveland, Ohio, Nov. 22nd, 1912.

◆

ELECTRICITY AND REINFORCED CONCRETE.

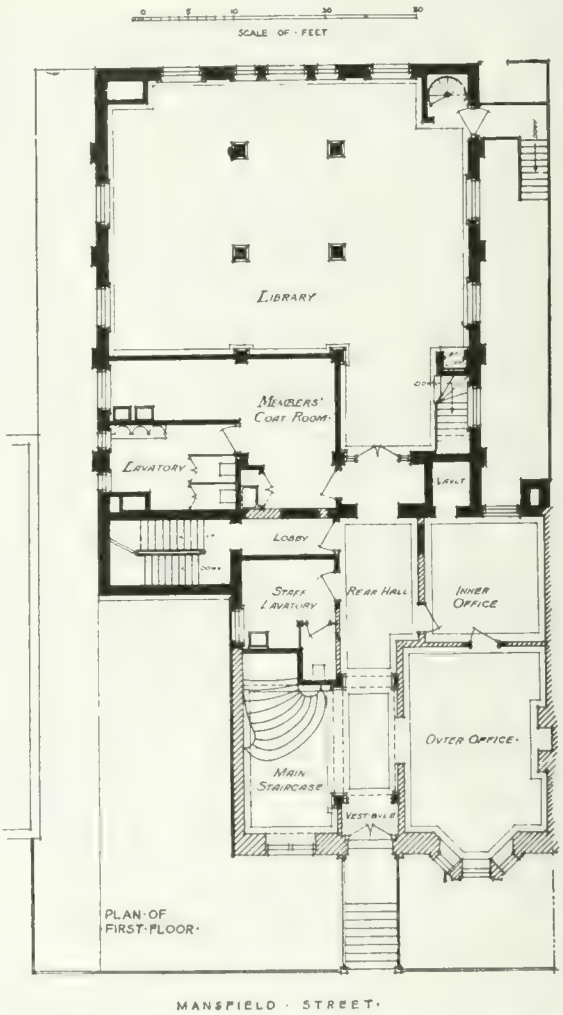
A description and data of tests on the action of electricity (stray direct currents) on reinforced concrete made at the Technical School at Darmstadt, Germany, are given in a recent issue of Le Génie Civil, and abstracted in the Journal of the American Society of Mechanical Engineers. With concrete blocks placed in air on a layer of moist sand, or in sweet water, and subjected to the passage of a current of 0.1 ampere at 140 volts, fissures appeared after a period of from 50 to 110 days, the location of the fissures depending entirely on the position of the anode; in blocks placed in salt water they appeared at the end of from 20 to 70 days, and the concrete was colored in the neighborhood of the fissures first greenish gray (ferrous oxide), and after some exposure in the air, brown (ferric oxide). Fissures appeared in blocks immersed in chalk water in about the same time. A series of experiments led to the belief that these fissures were produced not by an evolution of gases, but by a thickening of the iron anode enclosed in the concrete, owing to superficial oxidation. By further tests it was found that the resistance of the reinforcing members to being torn out is increased by the action of the current, which may be explained by the formation of a layer of oxide adhering to the concrete more strongly than the original clean line.

THE NEW HOME OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

As is well known, the Canadian Society of Civil Engineers sold their property at 413 Dorchester Street, Montreal, recently, where their rooms have been located for some time, and have acquired a new location at 176 Mansfield Street, Montreal.

On this location they are building new rooms which, it is expected, will be ready for occupancy for the annual meeting.

The building is very commodious, and is designed to secure the maximum advantage of the available space. The old house which stood on the lot at the time of its purchase has been remodelled to suit office requirements, and a new two-story building is now in process of construction in the rear. The new structure will provide an auditorium, giving seating accommodation for 225 persons. A library, reading rooms, and dressing rooms are also provided. In the basement is located the heating and boiler equipment, and a very large bookstack room, affording adequate storage accommodation for unbound engineering literature not suitable for the library shelves and for the surplus stock of publications of the society. The plan of the first floor, as seen in the cut, shows the offices, cloak rooms, and the library located there. On the second floor is located the reading room, the board room and the lecture room. The attic floor



First Floor Plan of New Premises of the Canadian Society of Civil Engineers.

is laid out to provide two bedrooms, a living room, kitchen, store-room and bath-room.

The cost of the lot and the old building amounted to $47,100, and the contracts for alterations to the old building and construction of the new building to $36,449, making a total expenditure of $83,549. This amount will have to be supplemented to a small extent by the purchase of additional furniture and minor contingencies.

Building operations are now well under way, and it is expected that the premises will be ready for occupation on January 1st next.

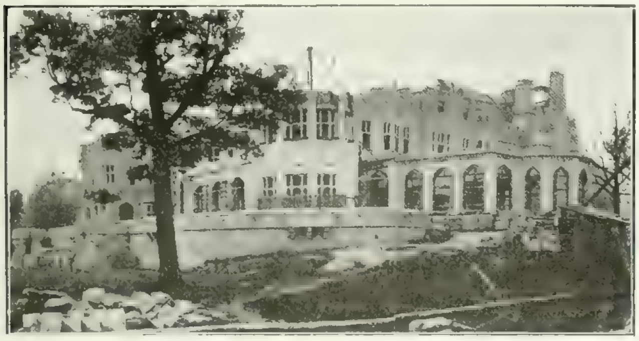
◆

A STEEL, STONE AND CONCRETE RESIDENCE.

The illustration depicts the exterior of a residence that is possibly without a rival on this side of the Atlantic. It is situated on Wells Hill, overlooking the city of Toronto, and is being constructed for Sir Henry Pellatt.

The exterior undoubtedly is a good representation of an ancient baronial stronghold and is very similar to structures now standing in various parts of Europe, but the interior at once shows several marked departures in construction methods from those generally employed in residence building.

The main entrance faces toward the south, but as this is inaccessible to carriages and automobiles an entrance for these has been constructed in the rear of the building to which a long winding driveway leads; this entrance opens into the main reception hall, which is a very large room, and will contain the base of the grand staircase and a pipe organ with a balcony for an orchestra. A library to the east and a dining room to the west occupy the entire front of the building and from a hallway passing by the library entrance is gained to the palm house and swimming pool; practically all the eastern section of the house is taken up by the latter.



New Residence for Sir Henry Pellatt, Toronto.

An underground tunnel has been constructed whereby the stables may be reached without going outdoors; the entrance to the tunnel from the residence is reached from below the base of the main staircase.

The method of interior construction is entirely along the lines adopted in the erection of modern office buildings. Many steel beams are used and the floors are all of interlocking tiles covered with concrete and the various pipes used for steam heating and electrical insulation.

When the structure is completed and the floral decorations are properly arranged it will be a handsome addition to the buildings and architectural interests of Toronto.

The architect for this work is Mr. E. J. Lennox, Toronto.

GRADE ELIMINATION AND RAILROAD BRIDGES.*

By C. H. Tinker.

I have been asked to make a few remarks upon some of the details of construction in connection with the design of grade elimination and railroad bridges. This subject has been studied by railroad employees for a number of years. From experience with the early bridges, there have been two or three points developed which it seems necessary to consider in the design of such structures. Some of the early bridges which carry trains over the street are quite noisy and are objectionable on that account. If any one will visit Lakewood and stand under Clifton Boulevard bridge, he will understand what I mean. The rails rest directly upon the floor plate, held down by clips, and every time a train goes across, it produces a roaring sound which can be heard for a long distance; in fact, it is hardly possible to hear anything else while the train is on the bridge. It seems desirable to avoid this objectionable roaring, and considerable study has been put upon that point.

To determine how the noise could be best reduced, bridges of various types in several cities have been observed with that point in mind. In the city of Pittsburg, near the Pennsylvania station, there are two bridges which carry the Pennsylvania tracks across Penn Avenue and Tenth Street, and it is remarkable how little noise can be heard from a train crossing these bridges. When the reason is sought, it is, at first, difficult to see. However, on both bridges there is a deep bed of ballast which carries the track, so that the effect is an ordinary roadbed crossing the street by a bridge.

In the city of Chicago, there are a number of bridges which are apparently of similar construction, and yet the noise is quite pronounced. It is probable that there is not very much ballast upon the deck of these bridges, and that fact has apparently considerable effect upon the amount of noise produced. There is also a great deal of noise produced by the passage of street cars underneath the bridges, and in the case of some bridges the street cars make a great deal more noise than the railroad trains do. Where the beams forming the floor of the bridge are exposed below, forming air pockets between them, the passage of the car sets up a reverberation. There is a similar reverberation noticeable in a through girder bridge. The sound seems to rebound from one girder to the other, back and forth, until it produces a continuous roar.

It is also noticed that where the floor of the bridge is heavy and there is considerable concrete, the noise is much less. At the Detroit Avenue bridge over the Nickel Plate tracks in Cleveland, the bridge carries the roadway with the street car tracks across the railroad. The beams are exposed below, but they are covered with concrete to a thickness of some two inches on all sides. There is a sand and brick pavement on top of the concrete slab, and the street car tracks are carried upon steel ties which rest directly upon the beams. There is a slight reverberation noticeable from the passage of street cars over that bridge, but the noise is not objectionable.

Following out this line of investigation, the observations seem to indicate that if a bridge be constructed with considerable depth of ballast that the vibration of the rails and the parts of the bridge would be reduced. And, further, that if a smooth under-surface of the floor is obtained that there will be very little opportunity for a reverberation underneath the bridge. This is very well illustrated by the present Euclid Avenue bridge on the Nickel Plate Railroad.

---

* Paper read before the Cleveland Engineering Society

The noise from the passage of trains there is very slight. A person may stand under the bridge and hear ordinary conversation with ease while a train is passing. The space between the beams is filled with concrete, producing a smooth under-surface, and there is about two feet of ballast on top of the slab which carries an ordinary roadbed. So, we think that the reduction of noise is accomplished by attention to these details of construction.

Another point which has caused a great deal of thought is the nuisance from the dripping of water through the bridge floor upon the street below. This is objectionable even when the amount of water passing is quite small, because the water passing through ballast, trickling down through the interstices of the floor slab collects various substances such as lime, grease and iron rust, which, dripping upon passers-by, may ruin their clothes. Therefore, it has become necessary, and is required by ordinance in some cases, that bridge floors should be waterproof.

A great deal of study has been put upon the subject of waterproofing masonry, and especially the waterproofing of bridge floors, which seems to be one of the principle things requiring waterproofing. The American Railway Engineering Association through its Masonry Committee, has had this subject under investigation. The committee has made three progress reports, but has not, as yet, published any definite conclusions. The committee has found this to be a large subject, and one upon which almost any proposition may be proved if the contradictory instances are ignored.

There are several companies who are exploiting various waterproofing compositions. They have had a large growth in the last few years, partly because of the necessity for waterproofing structures of this kind. There are many substances which are more or less impervious to water. In fact, nearly every substance is impervious to a degree; some very slightly, some very much so. A wooden plank offers a certain resistance to the passage of water; so does a slab of stone. Under some conditions considerable water will pass through either. Various substances of a hydrocarbon composition—asphalt, coal tar and petroleum products—seem to be quite impervious to water under certain conditions. Many substances are on the market for incorporation with the sand and cement to make impervious concrete. The theory is that these substances make the concrete so dense that water cannot percolate. Extravagant claims are made for some of these materials. Some engineers believe that for the waterproofing of masonry—and masonry now-a-days means concrete—about the best thing is concrete. The accepted method of waterproofing a concrete slab in a bridge floor is to place upon it a layer of ½-inch to 2-inch thickness of some of the asphalt, coal tar or petroleum product gums, with which may or may not be included several layers of burlap or felt paper. Now, a small surface covered with these substances will hold water indefinitely, but when you spread them over a large expanse of bridge floor, there are other difficulties to be met, and the greatest of these is the expansion and contraction from temperature. Asphalt itself, if its condition remains unchanged, is quite impervious to water, but if it contracts through cold, and cracks, the water will pass through the crack. It takes a very small crack to produce a leak which is objectionable in a bridge floor, and therefore it is necessary to have a substance which will expand and contract with the slab and not crack. This leads to the other extreme, that is, a substance so soft that when it becomes warm it will run. There are bridge floors in Chicago which leak asphalt. It is therefore clear that it is not a simple subject, and for any man to guarantee off-hand that any particular waterproofing composition will make a watertight bridge floor is rather hazardous. It is true, instances may be found of bridge floors which are apparently watertight, but there are more instances where this is not true. I think I may say that a well built slab of concrete is fully as impervious as a poorly built slab with any style of waterproofing.

In connection with the above method of waterproofing bridge floors, the asphalt, coal tar or petroleum products used require protection against abrasion and damage from external causes. This requires a still greater thickness. Many bridge floors have been built with a protection of brick on top of the asphalt. They have been fairly successful from a waterproofing standpoint, but the finished waterproofing adds in the neighborhood of 6 inches additional thickness to the bridge floor, and it is the opinion of a good many that that 6 inches could be better utilized by placing 6 inches of concrete on the floor.

In the bridges recently built in Cleveland by the Nickel Plate no foreign waterproofing substance has been used. An attempt has been made to construct a concrete slab which would be in itself as nearly waterproof as it is practicable or desirable to make. This has proved satisfactory. When the Cedar Avenue bridge floor was built, the ends of the bridge were dammed up, the trough so formed was filled with water and allowed to stand for several days. No water whatever came through at any point of the slab. A little water ran through the dam and down over the back wall, and seeped through the joint between the bridge seat and the floor slab. At the centre bent there is a drainage system provided to carry what water might percolate through at that point down to the gutters. Through some slight defect in the formation of this drainage some water seeped through there and dampened the concrete, but at no point of the bridge did any water drip.

One of the most essential things in the successful waterproofing of a floor slab is to get rid, in the most direct manner, of all the water that accumulates. That means that a drainage system must be provided which will be ample to take care of all of the water which can be collected upon the bridge floor. This sounds simple, but it is quite difficult. These drainage systems have to be carried some distance; they have to pass around a great many angles and eventually reach the level of the street gutters or of the sewer. At the Euclid Avenue bridge such a drainage system is in place. When the bridge was first completed it was discovered that at some point between the bridge floor and the sewer the drain pipe was clogged, with the result that the water did not run away, but stood in the drainage gutter and eventually soaked through the concrete. This illustrates the care and painstaking attention to detail necessary to secure the desired results. This pipe has since been cleaned out so that water runs away readily.

The essential points in constructing a watertight floor slab are: Dense concrete—the denser the more impervious; intelligent study and design in the location of expansion joints the provision of an ample drainage system; careful workmanship and constant supervision during construction.

Another point which has developed from experience with bridges over the tracks where the under-clearance is low, is that the blast from the engine has a very detrimental effect on the structure overhead. In the city of Chicago it has been determined that where the clearance is about 18 feet the steel will be worn away by the engine blast at the rate of about ¼ inch in ten years. That means that the flange of an I-beam would be so much deteriorated in ten years that the beam would have to be replaced. This has occurred in some instances in Chicago.

At the Detroit Avenue crossing of the Nickel Plate the clearance is 16 feet 3 inches, which is the general rule in

Cleveland. The I-beams in this case are covered with concrete to a thickness of 1½ to 2 inches; it was found in the course of a few years that the engine blast eroded the concrete, so that in about five years there is a bare streak of steel over the centre of the track. At the Adelbert Road and Cornell Road bridges it was decided to place cast iron plates immediately over the centre of the track. These smoke plates are about ½ inch thick. The engine blast will not be as destructive as upon steel, the cast iron being harder and when the plates are destroyed they can be replaced with little trouble and expense. In some cities a wood plank has been used for this same purpose. In the city of Philadelphia, the Philadelphia & Reading Railroad placed a wooden ceiling under their steel bridges. These gave fair satisfaction for several years.

Our experience is that a concrete covering will be satisfactory for a few years, but where the head room is low, as is apt to be the case in cities, that it will not protect the steel permanently. It must then be replaced, and it is well known that to repair an old, worn surface of concrete is likely to prove a difficult and costly operation.

One point in connection with the subject of co-operation. In some cities, there has been a tendency to design the work of grade elimination at the least possible expense. That means the lowest height for retaining walls, the least difference between the grade of the railroad and the grade of the street and the least thickness for bridge floors. This is unfortunate. While it is true that a bridge floor may be built quite thin, it is not satisfactory; it leads to the objectionable designs which I mentioned. Wherever the bridge floor consists of simply I-beams and steel plate, which is about as thin as a bridge floor can be made, there will be noise and leakage. In order to reduce the noise to a minimum, to reduce leakage to a minimum, it is necessary to have a reasonably thick bridge floor. In recent designs in the city of Cleveland about 4 to 4½ feet has been adopted. With this thickness a very satisfactory floor can be made, and it is believed that the additional expense due to the increased height and length of approaches is offset by the greater length of the life of the structure, and by the greater satisfaction which accrues from its use.

◆

AMERICAN ROAD BUILDERS' ASSOCIATION.

Plans for the Third American Good Roads Congress under the auspices of the American Road Builders' Association, which will open at Music Hall, Cincinnati, Ohio, Tuesday, December 3, are practically complete. Reports from the officers of the association and the several committees charged with the work of preparing the programme, arranging for the allotment of exhibition space and the entertainment of visitors, etc., indicate that this congress will surpass in interest and actual value to the paving and road building industry any previous meeting ever held.

The exhibit of the United States Office of Public Roads will consist of models of modern roads of different types and historic models showing the evolution of road building from ancient times to the present. The exhibits of the states and cities will comprise maps, charts and photographs showing various methods of building roads and streets, models of the different kinds of work, testing machinery, samples of materials, etc. The exhibits of the engineering schools will consist of maps, drawings, diagrams, photographs, charts and outlines of the engineering courses, as carried on in the several institutions.

The tentative programme which will be carried out practically as prepared, with a few minor changes and additions follows:

Tuesday, December 3.

8.30 to 11 a.m.—Registration of delegates at convention headquarters, Music Hall.

11 a.m.—Congress called to order by the president. Address of welcome on behalf of the State of Ohio. Address of welcome on behalf of the city of Cincinnati. Address of welcome of behalf of Hamilton County. Address of welcome on behalf of the Cincinnati Chamber of Commerce. Response on behalf of the American Road Builders' Association. Response on behalf of visiting state officials. Re-Response on behalf of visiting city officials. Response on behalf of visitors from other countries. Appointment of committees.

2.30 p.m.—Opening address by the president of the American Road Builders' Association, Nelson P. Lewis. "The Organization of a Highway Department": (a) For a State, by Major W. W. Crosby, consulting engineer, Baltimore, Md.; (b) For a large city, by Wm. H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, Pa.; (c) For county and township, by A. N. Johnson, state highway engineer of Illinois. Discussion to be opened by James Macdonald, state highway commissioner of Connecticut. "The Development of a Plan for a State Road System," by James R. Marker, state highway commissioner, of Ohio. Discussion to be opened by Col. E. A. Stevens state highway commissioner of New Jersey.

Wednesday, December 4.

10 a.m.—"Bituminous Pavements for City Use," by George W. Tilson, consulting engineer to the Borough of Brooklyn, New York City. Discussion. "Wood Block Pavements Laid by Day's Labor," by Ellis R. Dutton, assistant city engineer of Minneapolis, Minn. Discussion to be opened by H. W. Klausmann, city engineer of Indianapolis, Ind. "Cuts in Newly Paved Streets," by H. M. Waite, city engineer of Cincinnati, Ohio. Discussion.

2 p.m.—"The Contractor's Point of View," by Hugh Murphy, contractor for public works, Omaha, Neb. Discussion to be opened by S. D. Foster, chief engineer, State Highway Department, Pennsylvania. "Plant Equipment," by F. E. Ellis, manager, Essex Trap Rock and Construction Company, Peabody, Mass. Discussion.

8.30 p.m.—The visiting delegates will be the guests of the citizens of Cincinnati.

Thursday, December 5.

10 a.m.—"Some Features of Macadam Construction," by T. R. Agg, road engineer, Illinois State Highway Commission. Discussion to be opened by R. A. Meeker, state highway engineer of New Jersey. "Earth and Gravel Roads," by Robert C. Terrell, commissioner of public roads of Kentucky. Discussion to be opened by Robert J. Potts, College Station, Texas. "Highway Bridges and Culverts," by W. A. McLean, engineer of highways province of Ontario, Canada. Discussion to be opened by A. W. Dean, chief engineer, Massachusetts Highway Commission.

2 p.m.—"The Economics of Highway Construction," by Clifford Richardson, consulting engineer, New York City. Discussion. "Traffic Census as a Preliminary to Road Improvement," by Col. Wm. D. Sohier, chairman, Massachusetts Highway Commission. Discussion to be opened by Prof. A. H. Blanchard, Columbia University, New York City. "The Laying of 104 Miles of Smooth Road Surface in One Borough in Five Months," by G. Howland Leavitt, superintendent of highways, Borough of Queens, New York City.

Friday, December 6.

10 a.m.—This session of the convention will be devoted to topical discussions. The particular subjects to be discussed will be determined by vote of the delegates. Ballots con-

taining a list of questions will be distributed at the first session and delegates will be requested to indicate their choice. The speakers selected to open the discussions will be allowed ten minutes and other speakers five minutes. This promises to be one of the most interesting and profitable sessions of the convention.

2 p.m.—Unfinished business. Report of the Committee on Resolutions. Meetings of members of the American Road Builders' Association; selection of Nominating Committee.

List of Questions from Which Subjects for Topical Discussion are to be Selected.

1. Small blocks, natural or artificial, for country roads.
2. Convict labor on road work.
3. Correction of alignment and grade in existing highways.
4. Care of the roadside, including tree planting and removal of unsightly objects.
5. Division of expense of road improvement.
6. Unit price vs. lump sum contracts.

◆

ANNUAL REPORT OF THE CANADIAN NORTHERN.

The gross earnings of the Canadian Northern Railway for the year ended June 30th, 1912, as shown in the company's annual report, amounted to $20,860,093. Working expenses were $14,979,048. The net earnings are given as $5,881,045, and the net surplus was $575,396. An increase of $4,499,381, or 27.50 per cent., is thus shown in the gross earnings, while net earnings are $890,698, or 17.85 per cent. greater than the preceding year. The working expenses were 73.82 per cent. of the gross earnings proper, and 71.81 per cent., including taxes, of the gross earnings from all sources, compared with 72.59 per cent. and 69.50 per cent. respectively last year. During the year over 586 miles of newly constructed tracks were added to the system, the average mileage operated being 3,888 miles.

The detailed report follows:—

Gross earnings—	
From passenger traffic	$ 3,434,140.81
From freight traffic	15,567,998.17
From express, mail, telegraph, dining and sleeping cars, interest and profits from elevators and other subsidiary companies and investments	1,857,954.65
	$20,860,093.63
Working expenses (including taxes, &c.)	$14,979,048.52
Net earnings	$ 5,881,045.11
Deduct—	
Fixed charges (per statement, page 17)	4,630,844.12
Surplus	$ 1,250,200.99
From this deduct interest at 5% per annum paid on income charge convertible debenture stock outstanding	674,804.11
Net surplus for the year	$ 575,396.88

An increase of 120 per cent. in the total bulk of commercial coal carried is also remarkable, the figures being 804,803 tons moved this year, compared with 370,161 tons for the previous twelve months. This increase is indicative of the growth of the coal mining industry in Western Canada, which, upon the completion of the extensions now being constructed in the larger coal areas, will receive an even greater stimulus. There is also a further indication of the prosperous extension of the cities, towns and settlements along the lines, as shown by the increase of 48 per cent. over last year in the amount of building materials carried by the railway during the year.

Land sales during the year were 55,111 acres for $836,084.37, an average of $15.17 per acre, compared with 279,151 acres for $3,345,498.73, an average of $12.00 per acre, the preceding year. The reduction in sales is substantial, but the directors, recognizing that the value of productive acreages in Western Canada is assured, and being desirous of, as far as possible, selling to settlers only, have not pressed the sale of lands. On the other hand, they have adopted an agressive policy of colonizing the free lands offered by the Dominion Government in territories adjacent to the railway. Two million four hundred and seventy-nine thousand acres of these lands were entered upon by settlers during the year, of whom a largely increased number were a most desirable class of British emigrants.

The operation of the Royal Line of steamships continue to vindicate the wisdom of engaging in the Atlantic trade. The increasing popularity of the route emphasizes the necessity for extending the service so that the company may take the full benefit of the business controlled by its organization.

Great progress has been made in the construction of the transcontinental line of the Canadian Northern system, which it is hoped will be completed by the end of 1913; the line through British Columbia to connect the western lines with tidewater at the Pacific Coast is advancing rapidly. In addition to a very fortunate advantage of easy gradients the location of the line enters without competition into a large territory, the physical characteristics of which will attract a very desirable class of settlers. The line will also give access to an hitherto unknown section of the Canadian Alps, of which the scenic attractions are such as will divert a large volume of the transcontinental tourist traffic to the route.

The work of linking up the lines in Western Canada with the railways of the Canadian Northern system in the eastern provinces is making satisfactory progress, having regard to weather and other conditions. The resources of the country opened up by this line will be productive of great traffic advantages. Capital is only awaiting the completion of these transportation facilities before entering upon the development of iron and other mineral deposits, extensive pulpwood and timber areas. In addition to the tonnage assured from this industrial development, there are the traffic advantages which will accrue from the agricultural development of the great clay belt of Northern Ontario, through which the railway will pass for a distance of three hundred and fifty miles. Experienced officers who have carried out explorations of the entire area estimate that the industrial and agricultural resources of this territory will attract and support a population of over two million of people.

During the year another section of the Canadian Northern Ontario Railway was opened for traffic, but the directors regret that owing to adverse weather and other conditions the completion of the line between Ottawa and Toronto has been delayed. The work is, however, progressing, and it is hoped in a short time to establish a through service connecting Toronto with Ottawa, Montreal and Quebec. The pulp and paper industries in Northern Quebec are expanding quite satisfactorily, the traffic advantages of which chiefly accrue to railways operated under Canadian Northern control in Quebec.

In conclusion, Sir William Mackenzie refers to the numerous prominent men who have recently visited Canada, stating that personal and unbiased examination of the actual and potential resources of the Dominion will result in still greater confidence in the future of Canada and the close cooperation in her development.

THE NEW OFFICES OF THE BANK OF TORONTO.

By Lyman B. Jackes.

Visitors to the larger and older Canadian cities must be at once impressed with the idea that the architecture of the newer structures is changing. Not only with the mode of construction and the use of steel and concrete, but in the design itself, and the expenditure of vast sums of money for no other purpose than the cultivation of the aesthetic. The new wing of the provincial parliament buildings may be taken for an example. Here the new adjoins the old with a short corridor between. The old is of the most inflammable construction; wooden floors and plaster walls with oak decoration and finish. The new is of fireproof construction; tile floors, marble walls and wainscoting, and metal covered doors that shut off various sections of the new portion. Over the new entrance to the building an elaborate stone cutting has been made representing the arms of the province and in every way the beauty of the new section outclasses anything that the old may show.

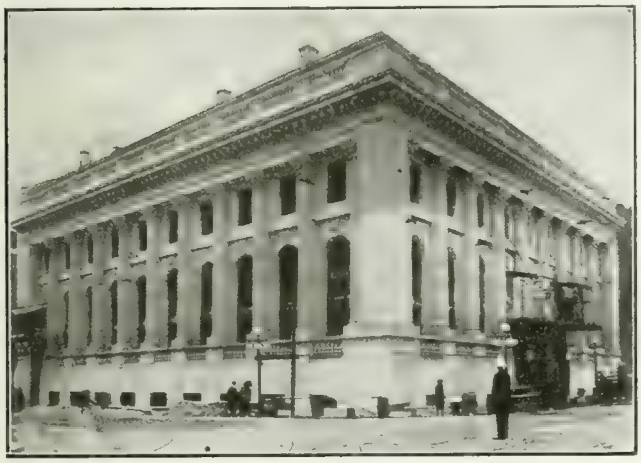


Fig. 1.—New Bank of Toronto Building.

Another example may be seen in the immediate vicinity of King and Bay Streets. A few months ago this was a corner almost a disgrace to the business section of the city with old tumble-down buildings (some mere shacks that had survived from the old days) devoted to small businesses such as the manufacture of keys (retail) and lunch rooms. To-day that corner will hold its own in architectural beauties with any similar block on the North American continent; but, it is to the latest addition to the section, the new offices of the Bank of Toronto, to which we direct tht attention of our readers.

This bank has for a number of years owned the property at the southwest corner of King and Bay Streets, with the object of erecting a new head office, but declined for many years to take a forward step until the character of the neighboring buildings could be more definitely learned. When this became suddenly the commercial centre of the city the bank announced that they would erect a million-dollar office building on their site.

It was at first expected that this would involve the erection of a sky-scraper, but a further announcement was made that the building would be but one and a half stories in height, and that the sum of one million dollars would cover the building expenses only and did not include the value of the land.

Million-dollar buildings were not a novelty to Torontonians, but the associations always accompanying such a thought were of magnitude and did not include anything of the artistic. As the new bank is rapidly nearing completion and the exterior false work is being cleared away there comes into view a building that rivals any temple ever erected by the ancients, and will be looked upon with pride by the passers-by as well as the bank directors.

The King and Bay Street facades, as may be seen from an examination of Fig. 1, is composed almost entirely of circular pilasters surmounted with a cap in the Greek Corinthian Order; there are eleven columns on the Bay Street side and ten on the King Street front.

All the exterior stone work is of Tennessee marble and practically all the carving was done after the stone had been placed in position. The carving was done with the aid of chisels driven by compressed air, the plant for supplying the air is illustrated in Fig. 2.

The interior decorations and finish will consist of polished marble stone ornaments and bronze work. The double row of windows shown in Fig. 1 would give a passer the idea that two floors were represented, but such is not the case, the public banking room extends right up to the ornaments capping the columns. The banking room ceiling, as examined from below, will show a plate of heavy, semi-transparent glassware, which shows through an elaborate pattern cast in the bronze. This bronze work is to slope upward from a wall of polished marble and will support various decorations and figures and then form a screen to allow the light filtring through the glass to reach the desks below. The weight of this metal will be enormous.

A beautiful stairway on the northern side of the public office leads to the private office which cannot be seen from the street or from below; these are placed back of the upper railing shown in Fig. 1., surmounting the abutment. The windows and doors of the private offices open onto a hallway, the outer wall of which forms the walls of a roof garden that utilizes the semi-transparent glass as a floor.

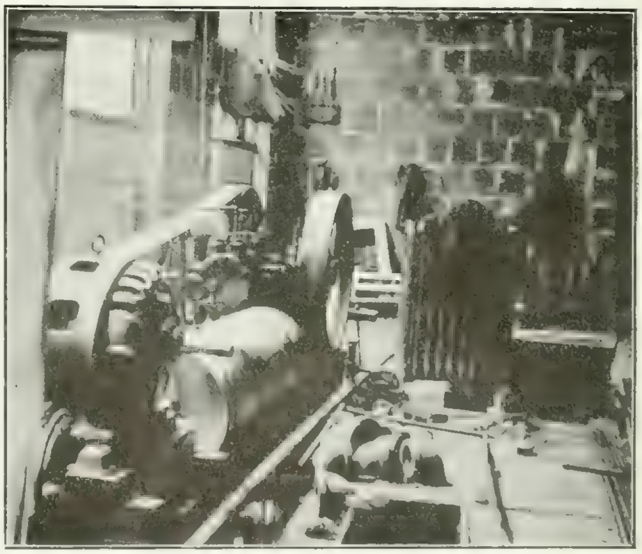


Fig 2.—Air Compressor Plant.

Taking the building as an entirety it is a novelty from the archtectural standpoint and a handsome addition to the buildings of Toronto.

Messrs. Henry Hope and Sons, Limited, 45 King Street West, Toronto, have furnished the steel frame and casement work for the windows. The lower windows will have a height of 21 feet and will be divided into two sections by a bronze panel.

Messrs. Carrère and Hastings and Eustace G. Bird, Traders Bank Building, Toronto, are the architects.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

METALLOGRAPHY OF IRON AND STEEL.

Sir,—In his kind and able review of my book which appeared in your issue for November, 1912, the reviewer expresses some astonishment that I should deal with the equilibrium diagram of iron and steel and with the phase rule at the end of the book instead of at the beginning. I am well aware that many teachers of metallography—probably the great majority of them—begin with a description of the diagram and of the phase rule as, in their opinion, the most logical and satisfactory course to follow. After some fifteen years of teaching I have come to the very opposite conclusion, namely, that it is better to postpone the study of the diagram and of the phase rule until the end of the course, and I hoped that my book would have demonstrated to the readers that I was right—that it was more logical and profitable to start with the simplest matters and to finish with the more complex considerations. To begin with the diagram and the phase rule is discouraging to the student unless he be a highly trained man, well drilled in scientific methods. In following the other course, on the contrary, it is an easy task to interest the student at the very start, to keep him interested and to lead him by gentle steps to the consideration of those subjects which at the start would have proved very unattractive to him.

In regard to the determination of carbon by microscopical examination, I still think, notwithstanding your reviewer's remarks, that, when applied intelligently and confined to annealed hypœutectoid steels it is as accurate as the colorimetric method. Of course, it presupposes that the steel is homogeneous but so does the chemical analysis. It is not my experience that the results "only hold for the surface examined because the steel one-eighth of an inch below its surface may be and often is of different carbon content."

The separate paging of the lessons was adopted with a view of facilitating the preparation of subsequent revised editions as it makes it possible to remove bodily from the book any lesson, to rewrite it and to replace it without disturbing the balance of the work. It seemed to me that such a very great advantage outweighs so much the slight disadvantages of this departure from the usual custom as to justify the course adopted. Yours very truly,

ALBERT SAUVEUR,
Harvard University, Cambridge, Mass.

November 5, 1912.

Sir,—In reply to Professor Sauveur's letter, I would point out that Professor Sauveur admits himself that the great majority of teachers of metallography have found it advisable to deal with the Equilibrium Diagram of iron and steel before attempting to explain the structure of individual samples of iron or steel. Quite true,—the student's interest may be stimulated at the start by taking up a few examples of iron and steel by themselves; but, to take up the whole subject, as Professor Sauveur has done in his book, before reaching the equilibrium diagram, means that the student [illegible] confused, whereas, if the underlying principles covering all irons and steels are taught him first by considering the equilibrium diagram, he is then able to follow very easily the differences in structure of the various irons and steels. It would be logical, as Professor Sauveur says, to begin with the simplest matters and to finish with more complex considerations. In this case, however, one cannot truly understand even the simplest cases without a knowledge of the equilibrium diagram. The equilibrium diagram is the foundation. When this has been considered one is at liberty to begin at the simplest cases and proceed. The point is, that without first understanding the principles of the equilibrium diagram, the student is apt to think of each iron or steel sample as a separate case, whereas all the irons and steels constitute a series.

Without regard to the determining of carbon by microscopic means, it cannot be denied that metallographic examination is purely a surface test, and one can never hope to replace chemical methods, which depend upon samples being taken by means of a drill from various portions of the specimen, by metallographic observation. Yours very truly,

THOS. R. LOUDON,
Metallurgical Engineer, Toronto.

◆

BOOK REVIEWS.

Reviewed by T. R. Loudon.*

Analysis of Metallurgical and Engineering Materials.—A Systematic Arrangement of Laboratory Methods. By Henry Wysor, B.S., assistant professor of analytical chemistry and metallurgy in Lafayette College. The Chemical Publishing Co., London: Williams & Norgate (14 Henrietta Street, Covent Garden, W.C.). Cloth: 8½ x 10½ in.; pp. 82. Price, $2, net.

The object of this manual is to present the work of the chemical analysis of metallurgical materials in an up-to-date logical order, both for the use of the college student and the practical chemist The departments outlined are given at the end of this review. It is sufficient to say that the book covers the metallurgical field very thoroughly.

The scheme of first stating the reagents required in a given piece of analysis and then outlining the determination is one that will make the work simple. Too often, the student has to read a great deal of matter not related directly to the subject before getting a definite statement of the reagents required.

The chapter devoted to the heat treatment of metals might be made a little more elaborate. It is a good step to include this department in the book, but, too little information is often worse than useless where heat treatment is concerned.

The book is an excellent up-to-date arrangement of the subject.

The following is a list of the chapters: Introduction; Sampling Ores by Hand; Specific Gravity of Solids; Analysis of Limestone; Analysis of Portland Cement; Analysis of Coal and Coke; Analysis of Iron Ore; Analysis of Chrome-Iron Ore; Analysis of Manganese Ore; Analysis of Copper Ore and Matte; Analysis of Lead Ore and Furnace Product;

---

* Metallurgical Engineer, Toronto.

Analysis of Zinc Ore; Analysis of Iron and Steel Works Cinders; Analysis of Iron; Analysis of Alloy Steel; Analysis of Ferro-Manganese and Iron Rich in Manganese; Analysis of Brass and Bronze; Analysis of Soft Bearing Metal; Analysis of Water; Analysis of Producer Gas; Calorimetry of Coal Coke and Oil; Calorimetry of Gases; Examination of Lubricating Oil; Examination of the Microstructure of Iron and Steel; Heat Treatment of Metals; Atomic Weights; Gravimetric Factors; Bibliography.

Reviewed by C. H. C. Wright.*

Elements of Drawing. By George F. Blessing, M.E., Ph.D., and Lewis A. Darling, E. in M.E. Published by John Wiley and Sons, New York. Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal. 193 pages; 6 x 9 in.; fully illustrated.

While this book contains much useful information and a great many suggestions valuable to the instructor, it is so carelessly written and edited that it is a very unsafe text to put into the hands of the novice, for whom it is evidently written.

In chapter I. on the selection, care and use of drawing instruments, Fig. 31 illustrates the type of scale recommended for architectural or mechanical engineering work, and is an open divided triangular scale. The use of this scale is illustrated in Fig. 32, but unfortunately the diagram shows a scale continuously subdivided. The text on page 31 says: "To mark off a number of consecutive measurements, such as 2 in., 5 in., 1 in. and ½ in., along any straight line, keep the scale stationary and, beginning at zero, mark off in succession the distances 2 in., 2 in. + 5 in. = 7 in., 2 in. + 5 in. + 1 in. = 8 in. and 2 in. + 5 in. + 1 in. + ½ in. = 8½ in."

It is evident to the experienced what the authors wish to avoid, but what will the beginner do when the sum exceeds 12 inches?

The introductory remarks to Chapter II. are good, e.g., "Good lettering and dimensioning on working drawings is of prime importance and cannot be too strongly urged. The outline and characteristics of each letter and numeral must be carefully studied." One is shocked, however, by the statement on the opposite page that "The bar in both the E and F is exactly midway between the top and bottom of the letter," as well as by the many illustrations throughout this chapter showing the same gross blunder in these and other letters, such as B and S. That the authors know better than this is evident from many of the drawings illustrated throughout the book, e.g., pages 43 to 70.

The authors' limitation of the term "mechanical drawings" to those orthographic projections of an object when the principal lines are parallel to the planes of projection is odd, but their extended definition is very confusing to the beginner.

Chapter V., page 157, "Isometric drawing is based on the principles of isometric projection, but it is beyond the scope of this text to take up the discussion of the principles underlying this art. For the purposes of this work it will be necessary to state only two new principles not included in orthographic projection."

A simple statement may be all that is desirable in an elementary text book, but there can be no excuse for misleading the beginner into thinking that an isometric is not an orthographic projection. Again, principle (1) defining the solid angle and its position relative to the plane of projection is, to say the least, incomplete as a projection consisting of any three straight lines radiating from a point such as to make angles of 120 deg. with each other would satisfy the conditions as stated.

This chapter is poorly arranged for in the introductory article (116) the beginner reads about the uses, advantages and disadvantages of isometric projection before he is given the principles of the projection (art. 117) or an elementary example of it (art. 118).

Strength of Materials. By Mansfield Merriman. Published by John Wiley & Sons, Ltd., New York; Canadian agents, Renouf Publishing Co., 25 McGill College Ave., Montreal. Sixth edition, revised and reset. Cloth; 5 x 7½ in.; 169 pages; price $1.00.

This volume, which is a text book for secondary technical schools on the strength of materials, beams, columns and shafts, was first published in 1897. The book has been so well received in the past that it has now reached its sixth edition. In the fifth edition a new chapter was added on reinforced concrete, especially columns and beams. In this edition a new chapter on combined stresses is added. Numerous changes have been made throughout the book and many new problems introduced.

The book is too well known to need much comment, with the exception of noting the changes in this edition.

Steel Sheet Piling Tables and Data on the Properties and Uses of Sections. Carnegie Steel Company, Pittsburg, Pa. 5 x 7½ ins.; pp. 88; illustrated; paper.

This little book, which may be had from the United States Steel Products Co., 220 King Street West, Toronto, contains a large amount of valuable information, not readily available elsewhere, on the subject of steel sheet piling. While the data concern particularly the three types of steel piling manufactured by the Carnegie Steel Company, what is said applies to a large extent to all forms of steel piling. Some of the subjects treated are the strength of the three forms of piling mentioned under lateral, vertical and longitudinal forces; methods and cost of driving; special driving appliances; pulling; watertightness; uses to which steel piling may be put; general engineering tables bearing on the subject of earth pressures and piling.

The publication should be in the hands of all engineers and others interested in sheet piling.

The Cooking of Coal at Low Temperature, with a Preliminary Study of the By-products. By S. W. Parr and H. L. Olin, has just been issued as Bulletin No. 60 of the Engineering Experimental Station of the University of Illinois.

This bulletin gives the details of experiments in the carbonization of coal at relatively low temperatures, not exceeding 750 deg. Fahr. The studies indicate that the bituminous matter in Illinois coals is in excess of the amount necessary to produce bonding material for the non-coking or cellulose residuum of the coal and that the best cokes are produced when mixtures of fresh coal and non-coking coal materials, such as coke breeze or powdered anthracite, are used. The tests show that the by-products consist of a gas of high illuminating power and heat value (1030 B.t.u.), and tarry material which consist in the main of oils of low viscosity having marked oxygen-absorbing properties.

In a very important aspect, this work constitutes a study in smoke prevention from a chemical rather than a mechanical standpoint, and the results show that bituminous coal in a form for combustion without smoke is at least a theoretical possibility. An interesting feature of the work is the information it affords as to the theory of the coking of coal. The summary touching this point concludes, that "for the formation of coke there must be present certain bodies which have a rather definite melting point" and further that "the temperature at which decomposition and carbonization take place must be above the melting point."

---

* Professor of Architecture, University of Toronto.

Copies of Bulletin No. 60 may be obtained upon application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Modern Gasoline Automobile, Its Construction, Operation, Maintenance and Repair. By Victor M. Pagé. Published by The Norman W. Henley Publishing Co., 632 Nassau Street, New York. pp. 693; 380 illustrations. Price, $2.50.

The faults in this book (a review is always supposed to find such) are noticeable by their scarcity.

The book is stated to be a "thoroughly practical, non-technical treatise," and is true to that description. Evidently the author is conversant with his subject, and while the work is very comprehensive in regard to the great amount of detail it contains, it is well written and the illustrations, being in many cases reduced from actual scale drawings, are clear and suitably chosen.

By a trained engineer much of the text could be dispensed with, but as this book is intended for owners of automobiles, chauffeurs and others, who may have no engineering knowledge, it is well suited to their needs, and should prove very useful to any reader of this class who may desire to understand his car, and particularly its engine, better.

The "Mechanical World" Pocket Diary and Year Book for 1913. Published by Emmatt & Co., Limited, "Mechanical World" offices, Manchester, England. Price, 6d. net.

This handy little book, now in its 26th year, contains a great deal of useful information on mechanical subjects. It is particularly suited to the needs of draughtsmen and is good value in spite of its low cost.

An electrical pocket book is also issued by the same firm, the style and price being identical with the one here referred to.

Differential and Integral Calculus. An introductory course for colleges and engineering schools. By Lorrain S. Hurlburt, Collegiate Professor of Mathematics in the Johns Hopkins University. New York and London: Longmans, Green & Co. Cloth; 5½ x 8½ in.; pp. 481; illustrated. Price, $2.25, net.

This book is intended as an elementary text book of the calculus. The author, for many years, has taught the subject without a text book, using lecture notes of his own placed in the hands of the students. These notes have been re-written from time to time and are now published in book form.

The book is most clearly written and a very logical presentation of the theory of the differential and integral calculus is given. The illustrations are exceedingly clear, and aid very much in an understanding of the text. The treatise is in every way to be commended to the student and engineer as a text book on the calculus.

Some Facts About Treating Railroad Ties. By W. F. Goltra, president of the W. F. Goltra Tie Company, Cleveland, Ohio. Paper; 6 x 9 in.; 105 pages; 8 folding plates. Price, $1.00.

This little volume is mainly a compilation of papers read before technical societies and articles published in the technical press, with the consequent discussion. The book also includes a discussion of the claims of the empty-cell process of treatment of creosote in which a proportion of the oil injected is withdrawn from the water. The following points are brought out in the author's discussion: The tie should be seasoned before treatment; that they should be treated to total refusal; that zinc chloride alone, and in combination with creosote, is more economical than creosote alone in treating ties to refusal; and that it is useless and impossible to group ties for treatment according to their species, degree of seasoning, proportions of heart, sapwood, etc. A letter along the same line will be found in this week's issue under "Letters to the Editor," written by Mr. Goltra.

The Properties and Design of Reinforced Concrete. Translated and abridged by Nathaniel Martin, C.E., and lecturer on "Reinforced Concrete," Royal Technical College, Glasgow. Published by Constable & Co., Limited, London. Cloth; 6½ x 9 in.; 116 pages; 28 tables; 29 figures. Price, $2.10.

The full title of this volume is "The Properties and Design of Reinforced Concrete, Instructions, Authorized Methods of Calculation, Experimental Results and Reports by the French Government Commissions on Reinforced Concrete."

As is well known, reinforced concrete had its origin in France. In December, 1900, a commission was appointed by the French Minister of Public Works, which embraced a group of engineers whose experience in this material was very wide. The work of this commission extending over the succeeding six years, included a series of experiments directed to the obtaining of results immediately applicable to practice. The report of the commission contains the results of the tests on experimental structures, and of the tests to destruction of several of the structures of the Paris Exhibition of 1900. The report has been much quoted and extracts have appeared from time to time in various English books and periodicals. In this volume the translator offers an abridged English edition which will afford professional men the opportunity to acquaint themselves with the scope of the work of the commission and to have the results at hand in readily accessible form.

The Official Good Roads Year Book of the United States. Edited by J. E. Pennybacker. Published by the American Highway Association, Colorado Building, Washington, D.C. Cloth; 6 x 9 in.; 406 pages. Price, $1.00.

This volume contains a concise digest of the road laws of all the States, a list of road contractors in the United States, a biblography of books, pamphlets, etc., pertaining to road building and maintenance, a list of colleges teaching highway engineering, and the course of instruction, a list of organizations working for road improvements, a directory of highway officials in the United States, a list of manufacturers of road machinery and materials, and a list of patents issued in 1911 in the United States relating to roads.

The book opens with a history of road-building, then, after a digest of the road laws in the different States, an analysis is given of the new suggested State Aid Bill. Chapters are then devoted to types of roads, road maintenance and repair, dust preventatives, highway bridges and culverts, bond issues, appropriation and mileage, and a section is devoted to the use of convict labor on roads.

Altogether, this book forms one of the most valuable additions to road-building literature which has come to our hand. The price, $1.00, in no way represents the value of the material contained in the volume.

Light: Its Use and Misuse, a primer on light and illumination which was published last month by the Illuminating Engineering Society, 29 West 39th Street, New York, has already gone into a second edition. Written in a clear and comprehensive manner for popular reading, this little pamphlet has met with immediate favor. It has occasioned considerable complimentary criticism from people who are generally supposed to have little or no interest in the subject of lighting. From the heads of engineering and physics departments of schools and colleges the society has received numerous letters of commendation, together with requests for quantities of the primer for distribution to students. Architects, engineers, oculists, merchants, and others have also expressed their appreciation of the publication. Several lighting companies are planning to issue it to their customers. One large manufacturing company in London has cabled for permission to print and distribute a large edition in Europe. It is not unlikely that the primer will go into many editions.

Engineering for Land Drainage. A manual for the reclamation of lands injured by water. By Charles Gleason Elliott, C.E., M. Am. Soc. C.E., author of "Practical Farm Drainage." Second edition, re-written. New York: John Wiley & Sons. Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal. Cloth; 5 x 7½ in.; pp. 339; 60 text illustrations; 15 tables. Price, $2, net.

The first edition of this book appeared in 1902, when the question of land drainage was in a very elementary state. Since that time the development and extension of land drainage work has been continuous and substantial. A great deal of actual experimental data is now to hand and the author has therefore entirely re-written the original volume, so that this book is practically a new one.

The author has undoubtedly, in his former position of chief of drainage investigation, U.S. Department of Agriculture, had the opportunity of a better training in land drainage work than is usual. This book, which is partly the result of that experience, is without question the best treatise on drainage engineering to be found to-day. The only criticism which appears justified, in a casual analysis of the book, is that the author has not abandoned the old formulae for flow in pipes and ditches, which have been, to a great extent, abandoned by engineers. The use of these formulae gives results for flow greatly in excess of actual gaugings.

Drainage assessments are discussed in Chapter XVI. very clearly and concisely. Brief chapters are included on Levee Drainage Systems, Reclamation of Tidal Land, Drainage of Irrigated Lands, Drainage of Peat and Muck Lands, and Control of Hill Waters.

This volume, while perhaps too small to be considered a thorough treatise on the question of land drainage, will be found to be a most valuable one to the engineer interested in this work.

Modern Sanitary Engineering.—Part I., House Drainage. By Gilbert Thomson. Published by Constable & Co., Limited, London. Cloth; size, 5¾ x 8¼ in.; 260 pages, 110 illustrations. Price, $1.60.

Of the numerous books on the above subject most have been written from the tradesman's point of view. At the same time many engineering problems are involved in the collection, conveyance and disposal of sewage. This volume deals specially with house drainage. Very few books are to be found which are based on general principles, and which lead from these to practical applications. This present treatise is based on a course of lectures on Sanitary Engineering delivered by the author in the Civil Engineering Department of the Royal Technical College, Glasgow. The book will be found to be a most invaluable one for the engineer interested in the sanitation of individual houses.

PUBLICATIONS RECEIVED.

Bridges Over Navigable Rivers.—Some practical considerations, by C. E. Smith. Being Vol. 14, No. 150, Bulletin of the American Railway Engineering Association. E. H. Fritch, secretary, 900 South Michigan Avenue, Chicago.

Institution of Civil Engineers of Ireland.—Being the transactions of the 76th section, November, 1911, to May, 1912. P. F. Purcell, honorary secretary, Dublin.

Map of City of Calgary.—Harrison & Ponton, engineers and surveyors, Calgary, Alta., forward copy of their latest revised map of the city of Calgary. Copies may be secured by addressing their office, Calgary.

Winnipeg Hydro-Electric Power Station.—Being a description of the Winnipeg hydro-electric power station, reprinted from "Engineering," July 26-Aug. 2, 1912. Vickers, Limited, of Sheffield, England, Canadian office, 20 Bleury Street, Montreal, will forward copies on request.

Text Books and Industrial Works.—The Canadian Engineer (Book Department), 62 Church Street, Toronto, have issued a new catalogue of text books and industrial works. Copies may be secured by addressing the Book Department, Canadian Engineer.

Rail Steel Concrete Reinforcement Bars.—Standard specifications for the above. Copies may be secured from the secretary of the American Steel Manufacturers' Association, address J. J. Shuman, c/o Jones & Laughlin Steel Company, Pittsburg, Pa.

Tide Tables for the Pacific Coast of Canada, for the year 1913. Issued by the Tidal and Current Survey, Department of the Naval Service, Dominion of Canada. Mailed free on request.

Tide Tables for the Eastern Coast of Canada, for the year 1913. Issued by the Tidal and Current Survey, Department of the Naval Service, Dominion of Canada. Mailed free on request.

Summary Report of the Mines Branch, Department of Mines, for the calendar year ending December 31st, 1912. Copies may be secured from Eugene Haanel, Director, Mines Branch, Department of Mines, Ottawa.

Weights and Measures, Gas and Electricity. Being Part 2 of reports, returns and statistics of the inland revenues of the Dominion of Canada for the year ending March 31st, 1912. Deputy Minister of Inland Revenue, Ottawa.

Sea Fisheries of Eastern Canada. Being the proceedings of a meeting of the Committee on Fisheries, Game and Fur-Bearing Animals of the Commission of Conservation, held at Ottawa, June 4th and 5th, 1912. Copies may be secured from the secretary, Commission of Conservation, Ottawa.

Report of the State Commission of Highways. Being the annual report of the State of New York for 1911. C. Gordon Reel, Superintendent of Highways, Albany, N.Y.

Supplement to the Annual Report of the State Engineer and Surveyor of the State of New York, for the fiscal year ending September 30, 1911. Being a report of the Bureau of Hydraulics, Department of the Barge Canal, comprising the 12th annual report on Steam Gauging. John P. Newton, assistant engineer, Albany.

Annual Report of the City Engineer of Toronto, for 1911. R. C. Harris, Commissioner of Works and City Engineer, Toronto, Ont.

Mine Fires. A preliminary study. By Geo. S. Rice. Being Technical Paper No. 24. Joseph A. Holmes, director, Bureau of Mines, Department of the Interior, Washington, D.C.

Mechanical Properties of Red Wood. By A. L. Heim. Being Circular 193, Forest Products Laboratory Series.

Henry S. Graves, Forester, Forest Service, U.S. Department of Agriculture, Washington, D.C.

A Study of Iowa Population. As related to industrial conditions. By John E. Brindley. Being Bulletin No. 27, Engineering Experiment Station, Iowa State College of Agriculture, Ames, Iowa.

Road Legislation and Administration in Iowa. By John E. Brindley. Being Bulletin No. 28, Engineering Experiment Station, Iowa State College of Agriculture, Ames, Iowa.

Some Fallacies and Facts Concerning Engineering Work in Great Britain. By W. A. Martin, late assistant general manager of the Toronto Electric Co. Being a reprint from The Canadian Engineer issues, August 8th and 15th, 1912. Copies may be secured from the Canadian British Engineering Co., Limited, Toronto.

◆

CATALOGUES RECEIVED.

Rubber Insulated Wire and Cable.—The Standard Under-Ground Cable Co., of Canada, Limited, Hamilton, Ont., forward copy of their pamphlet entitled "Sterling Rubber Insulated Wire and Cable." This is an artistic little publication, describing the manufacture of the Standard Under-Ground Rubber Insulated Wire and Cable.

Fire-Proof Houses.—The National Fire-Proofing Company, Fulton Building, Pittsburg, forward the sixth edition of their "Fire-Proof Houses of Natco Hollow Tile and How to Build Them." The book is distributed gratis to architects, but a charge of twenty cents is made to the general public.

Electrically Welded Wire.—The Clinton Wire Cloth Co., of Massachusetts, forward copy of catalogue describing their "Clinton" electrically welded wire fabric for reinforcing concrete construction. The catalogue is a most artistic one and gives many illustrations of the use of Clinton wire.

Beatty Hoists.—Messrs. M. Beatty & Sons, of Welland, Ont., forward their last catalogue describing their steam and electric hoists. The bulletin shows illustrations of their hoisting engines, centrifugal pumps, derricks, dredges, scows and clam shell buckets.

Briquetting Machinery.—The United States Engineering Company, 80 Wall Street, New York City, forward brochure on briquetting machinery, illustrating and describing briquetting machinery for coal, coke and ore products, as manufactured by William Johnston & Sons, Limited, of Leeds, England, for whom they are the representatives.

Water Filtration.—The Loomis-Manning Distributing Company, 828 Land Title Building, Philadelphia, forward their catalogue describing the Loomis system of filtration, pressure or gravity. They also enclose a reprint of the December issue of Dun's Review, in which in every building mentioned in an article on "The Rebuilding of New York," the Loomis filter plant had been specified by the architects and engineers.

Metal Windows.—Henry Hope & Sons, Limited, 45 King Street West, Toronto, Ont., forward copy of Hope's Catalogue of Metal Windows. This is a magnificently bound and illustrated volume, 10 x 15 inches in size and containing about 200 pages. Typographically, the book is above criticism, and is in every way a most artistic publication.

Taylor Stokers.—The American Engineering Company, of Philadelphia, forward a pamphlet entitled "Facts Concerning the Operation of Taylor Stokers Obtained from the Users." The results of a number of tests are given in which the Taylor stoker was tried out. There are a number of interesting charts, and the tests themselves are of considerable interest.

Hayward Buckets.—The Hayward Company, 50 Church Street, New York, forward copy of their pamphlet No. 596, entitled "Hayward Buckets and Digging Machinery."

Transits and Levels.—Iszard-Warren Company, 136 No. 12th Street, Philadelphia, Pa., forward catalogue describing their "Sterling" transits and levels.

Grout Mixers.—The Ransom Concrete Machinery Company, Dunellen, N.J., forward pamphlet entitled "The Use of Ransom-Canniff Grout Mixers."

Machinery and Supplies.—The Chicago Builders' Specialty Co., Room 450, Old Colony Building, Chicago, Ill., U.S., forward their catalogue No. 35, illustrating their machinery and general contractors' supplies.

Electrical Apparatus.—Ferranti, Limited, Hollinwood, Lancashire, England, through their Canadian representative, G. C. Royce, 1688 Dundas Strees, West Toronto, forward their latest revised catalogue illustrating their switchboard instruments, switch gear and accessories, transformers, etc.

◆

HOLLINGER FINANCIAL STATEMENT.

The provisional statement of the company's finances, as on October 26th, 1912, is as follows:—

Assets and Liabilities.

Current Assets—			
Cash on hand and in Imperial Bank			$ 33,496.44
Bullion on hand			27,570.00
Bullion shipped (not paid for)			89,498.65
Gold precipitates on hand			97,500.00
Gold in mill solutions			24,000.00
Gold in slags on hand			17,000.00
Materials and supplies on hand			30,659.54
Accounts receivable			7,407.30
Guarantee Deposits			500.00
Imperial Bank, Toronto, reserve for dividend No. 1			90,000.00
Insurance paid in advance			2,832.41
			$ 420,464.34
Capital Assets—			
Mining properties		$2,500,000.00	
Developments		302,556.24	
Plant		593,728.09	
			$3,396,284.33
			$3,816,748.67
Current Liabilities—			
Wages			$ 18,254.00
Salaries			2,750.00
Accounts payable			36,972.86
			$ 57,976.86
Capital Liabilities—			
Capital stock			$3,000,000.00
Surplus, made up as follows, viz.:			
Premium on shares sold invested in plant and development		$250,000.00	
Profits from operations			
Reinvested in plant	$ 82,432.92		
Reserve for Dividend No. 1	90,000.00		
Balance in reserve	336,338.89	508,771.81	
			758,771.81
			$3,816,748.67

The above figures are provisional, and are subject to correction after actual returns from smelters are received. It is estimated that the surplus on November 2nd will amount to approximately $800,000.00

COAST TO COAST.

Halifax, N.S.—The management of the Provincial Exhibition has not, so far, proved a financial success. The deficit for the past season amounts to $10,500—about $400 less than last year.

Port Arthur, Ont.—There are now on the streets of the city about two thousand lights and this number will be considerably augmented next year as the lighting system is extended to the outlying sections.

Calgary, Alta.—The weather has been most favorable for contracting work during the past few weeks and several builders are taking advantage of the same and rushing through their several contracts.

Regina, Sask.—The demand on the power house for the past six years and the estimated demand for 1913 are given as follows: 1907, 833,039 kw.; 1908, 986,237 kw.; 1909, 1,201,160 kw.; 1910, 1,567,631 kw.; 1911, 2,458,535 kw.; 1912, 4,179,948 kw.; 1913, 7,000,000 kw.

Quebec, Que.—The Canadian Northern Railway Atlantic liner "Royal George," which was stranded on the rocks in the south channel off Point St. Lawrence, Island of Orleans, was released and floated into deep water at 4 o'clock Saturday afternoon, an hour before extreme high water.

Sydney, C.B., N.S.—The town of Sydney has witnessed an expenditure of about $600,000 in new buildings in the last ten months, and has also increased in population to an extent which makes the erection of more houses a necessity. This is another evidence of general progress in the lower provinces.

Calgary, Alta.—Grading has been started on the C.P.R. cut-off from Bassano to Swift Current at the Bassano end. Work is in progress as far as Empress, the new C.P.R. townsite, 120 miles east of Bassano. At the present time 30 miles of the road is in operation from the Swift Current end, and grading is being rapidly pushed to cover the 100 miles between that point and Empress.

Bassano, Alta.—It is reported that the C.P.R. intend making application for the approval of a route map of the Swift Current cut-off from Bassano to the forks of the Saskatchewan, 118 miles east. The new line practically parallels the Red Deer River and it is probable that Bassano will be made the divisional point. The new line leaves the main line 2½ miles east of Bassano and goes in a slightly northeasterly direction as far as the forks of the Saskatchewan.

Montreal, Que.—The newspapers of this city are giving considerable publicity to a scheme calling for the erection of an immense cathedral. A sum of about $2,000,000 has been offered for two churches now standing in the business section, and there is talk of this money being accepted and applied to the erection of the larger building. St. George's Church and Christ Church Cathedral (Anglican) are the buildings mentioned in this connection.

Calgary, Alta.—The total work completed on the various civic utilities for the year makes a considerable amount. According to the statement prepared by the engineering department and submitted to the commissioners the following are the totals for the year: Sewers, 277,375 feet; waterworks, 208,737 feet; sewer manholes, 627; water connections, 2,552; sewer connections, 2,604; sidewalks, 1,238,660 square feet; curb and gutter, 148,049 lineal feet; conduits, 337.

Ottawa, Ont.—Through the Minister of Justice, Hon. C. J. Doherty, the Canadian Government has filed objections before the International Joint Commission, now in session at Washington, to the proposed construction of an international dam at Kettle Falls, the outlet of Rainy Lake, on the Minnesota-Manitoba boundary. The government protested that the dam would affect the levels of the Lake of the Woods, which are now a matter of arbitration between the two governments.

London, Ont.—Mackenzie & Mann, it is announced, have asked that two proposals concerning the London and Port Stanley Railway be presented to the City Council immediately. Mayor Graham has arranged for a conference between C.N.R. representatives and members of the London and Port Stanley board, to be held next week. The proposition is creating much interest, especially in view of the fact that Hon. Adam Beck has just brought forward his scheme for the electrification of the road for municipal operation at a cost of $890,000. This latter scheme is to be voted on by the ratepayers of the city.

Montreal, Que.—The new building by-law, which has been in process of preparation for some time past by a committee of experts, of whom Messrs. J. Venne and W. J. Francis are members, has been submitted to the chairman of the special committee. It will be submitted to the city council, whence it will be sent to the Quebec Legislature for sanction. It is stated that the most sweeping recommendations include provision for preventing the spread of fire in factories, the introduction of smoke-proof towers for factories and schools, and the installation of efficient fire escapes. The report as submitted covers 213 closely typewritten pages, comprising 1,000 clauses. We hope in the very near future to submit an abstract of the by-law in these columns.

Niagara Falls, Ont.—The Queen Victoria Park Commissioners discussed the decision of the Privy Council recently confirming their right to collect rentals for excess power on the peak load system of measuring the electric current. It is now likely that the commissioners will at once exercise the power vested in them by the decision of the Privy Council, before which body this case has been pending for the past three years. Although the commissioners are disposed to favor the application of the Ontario Power Company for permission to install unit No. 13, the matter was left over for a conference between members of the power company and the park commissioners, to take place at Toronto in the near future. The plans submitted by the Electrical Development Company for a proposed machine shop were not acted upon, but the plans for a stairway leading to the transformer house at the summit of the hill were approved.

Province of Ontario.—A sanitary investigation of international waters from the St. Lawrence to the head of Lake Superior is to be carried on during the next year by the joint action between the Canadian and United States health authorities. The decision to extend the examination of boundary waters for evidence of pollution is the result of the suggestion made by the International Joint Commission at Washington last week. The waters to be examined include the Rainy River, St. Mary's River, River and Lake St. Clair, Detroit River, Niagara River, the St. Lawrence, Lake Superior in the neighborhood of Fort William, Port Arthur and Duluth, Lake Huron in the neighborhood of Saginaw Bay, Sarnia and Port Huron, the west end of Lake Erie around Port Stanley and Cleveland, and Lake Ontario near Toronto, the mouth of the Niagara River and around Rochester and Kingston. The Provincial Board of Health will have charge of the investigation of Ontario waters, and will do all the analytical work necessary.

Vancouver, B.C.—The report of the Northern Pacific for the year ended June 30th, 1912, shows that during the past three years terminal property at Vancouver has been bought in the interest of the Northern Pacific and the Great Northern, and is now being developed. When the plans now under consideration are completed there will be a first class terminal for both freight and passenger business owned jointly by the two companies. New station buildings were put up during the year and increased facilities provided at a number of places in Minnesota, in North Dakota, in Montana, in the State of Washington, and in Oregon. During the year 175 bridges were replaced and three abandoned, 111 bridges, 19,234 ft. in length, were replaced by timber structures, and seven permanent and 57 timber structures were replaced in permanent form. Of these, 46 were replaced by embankments and 18 were replaced by truss, girder, I-beam and reinforced concrete trestle, a total of 20,717 lineal feet, 119 timber culverts were rebuilt, 15 in temporary and 104 in permanent form. There are now under construction on operated lines 1,145 lineal feet of steel girder and I-beam spans; 870 lineal feet of steel truss spans; 1,408 lineal feet of reinforced concrete trestle; one 425-ft. double-track steel draw span and one 191-ft. movable leaf bascule span; also one steel highway viaduct, 738 ft. long.

Edmonton, Alta.—City commissioners of Edmonton, Alta., have called for tenders on 400,000 square yards of a total of 511,533 square yards of street paving to be laid the coming year. The estimated cost is $1,734,786. Tenders will be opened on December 10, a day after the civic election. The plans call for 422,643 square yards of paving on the north side of the Saskatchewan River, and 88,893 square yards on the south side, formerly known as Strathcona. This does not include all the work to be done during 1913. It is simply the paving that has been petitioned for to date. The city is holding in reserve 111,533 square yards of paving for the municipal-owned plant to be built next year. The largest amount of work on one street is 47,531 square yards in Nelson Avenue, between First and Twentieth Streets. Others range from 4,189 to 28,531 square yards. Most of the forty-one streets affected will have more than 10,000 square yards of pavement. Four of the streets lead toward the country. Among these are the Fort Saskatchewan and St. Albert trails, Stoney Plain Road and Namayo Avenue. Namayo Avenue, formerly the southern portion of the trail to Athabasca Landing, will be paved as far north as the Grand Trunk Pacific tracks. Although provisions may later be made to pave First Street to Alberta Avenue, at the present time the plans show a pavement to Norwood Boulevard about a mile.

◆

ONTARIO GOOD ROADS ASSOCIATION.

The executive of the above held a meeting in Toronto on Wednesday, November 20th last to discuss several important matters, among which was the proposal of a convention. It was resolved that an exhibition and convention should be held in the Machinery Hall of the Canadian National Exhibition, Toronto, February 26th-28th next. At this exhibition various road building and improving machinery will be demonstrated and different varieties and qualities of road sections will be on view. The first day will be devoted to the engineer, another day will be given to country roads and the other to town and city roads. Special facilities will be arranged whereby delegates will be able to attend the convention and hear the various speakers with comfort, it being decided to partition off a section of the building for this purpose. Major T. L. Kennedy, president of the association, and Vice-president N. Vermilyea were appointed to represent the association at the American Road Builders' Association, to be held December 3rd in Cincinnati. Mr. George Henry, Oriole, Ontario, is on a committee appointed to secure a permanent secretary.

The constitution of the association has been altered in order that all associations interested in improved roads may be represented at the February convention.

EFFECT OF METERS ON WATER CONSUMPTION.

The statistics given in the accompanying table are a concrete example of the effect of meters on consumption, and should commend itself forcibly to all citizens, in that it proves conclusively the fact that to meters more than to any other factor credit is due for checking wilful or neglectful waste of water. The figures are taken from the annual report of the Water Department of Houston, Texas. A pumpage of 141 gals. per capita in 1907 has been reduced to 53 gals. per capita to-day without depriving any person of this essential element. Dire results were predicted by fearful people just four years ago when the meter system was proposed, but to-day those who were formerly antagonistic are firm believers in this plan of delivering water to consumers.

Effect of Meters on Water Consumption, Houston, Texas.

Year.	Number of meters.	Percentage of consumers metered.	Average per capita pumpage.	Population city census.
1907	108	1.5 %	141 gals.	73,017
1908	303	4.0	122 gals.	79,464
1909	1,903	21.0	106 gals.	82,542
1910	4,556	48.0	82 gals.	95,930
1911	8,131	82.0	53 gals.	109,594

A total of 2,125,981,520 gals. of water was pumped as reported by the Chief Engineer for the year 1911, as compared to 2,859,091,610 gals. for the year previous. This represents a saving of 733,110,090 gals., notwithstanding several large conflagrations which occurred during 1911.

This fact deserves more than casual notice, as it is an economy that means more to the city than is represented in mere figures. It is a supply of pure water held in reserve for future use, insuring at the same time a lease upon the practical capacity of the wells for a greater period of time.

◆

BRANCH MEETING.

At a joint conference held recently in the city of Victoria, B.C., between representatives of the Vancouver and Victoria branches of the Canadian Society of Civil Engineers, it was decided to hold a convention in Victoria in the early part of December at which subjects of interest to the profession will be discussed and plans prepared for a demand upon the government for legislation at the coming session of the legislature in order to protect the interests of the Canadian engineers. Chief among the demands to be made upon the government will be one asking that as far as possible positions in the government service shall be confined to British subjects.

◆

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Mr. Benjamin E. Briggs, city engineer of Erie, Pa., was elected president of the American Society of Municipal Improvements at the annual convention in Dallas, Texas, November 13th to 15th. Messrs. Edward H. Crist, of Grand Rapids, Mich.; William A. Howell, of Newark, N.J., and A. F. MacCallum, of Hamilton, Ont., were elected vice-presidents; Mr. A. Prescott Folwell, of New York city, was re-elected secretary, and Mr. E. L. Dalton, of Dallas, Texas, treasurer.

PERSONAL.

W. E. STAVERT, of Montreal, Quebec, has been elected president and general manager of the Alaska Northern, to succeed O. G. Laberee, resigned.

WM. HALL has been appointed assistant trainmaster of the Grand Trunk with office at Hamilton, Ont., succeeding L. Harold, assigned to other duties.

A. F. MACCALLUM, C.E., city engineer of Hamilton, Ont., has been elected a vice-president of the American Society of Municipal Improvements. The society had their annual meeting, November 13th to 15th, at Dallas, Texas.

MR. R. A. SARA, B.A.Sc., has resigned his position as assistant business manager of the Winnipeg power department and will return to his home in Toronto in order that he may become connected with the Hydro-Electric Commission in that city. He is a '09 graduate of Toronto University in electrical and Mechanical engineering.

DONALD M. McINTYRE, K.C., solicitor of the city of Kingston, who has recently been appointed chairman of the Ontario Railway and Municipal Board, is a native of Kingston and has lived there practically all his life. He is a graduate in Arts of Queen's University, and was called to the bar in 1885 with honors, obtaining the gold medal. He served as alderman in the city council from 1889 to 1905, except during 1892, when he was elected as mayor. In 1895 Mr. McIntyre was appointed city solicitor, in which office he has served to date. For many years he has been a trustee of Queen's University, a governor of the School of Mining, and is at present chairman of the Board of Governors of the School of Mining. He is a governor of the Kingston General Hospital, of which board he was chairman for the year 1904 to 1905. Mr. McIntyre is a member of the Frontenac Club and of the Kingston Golf and Country Club. He is a junior member of the law firm of McIntyre & McIntyre, practising in Kingston. As chairman of the Ontario Railway and Municipal Board he will be brought more intimately in touch with the engineering profession than in the past, and we therefore wish Mr. McIntyre every success in his new work.

Mr. Donald M. McIntyre, K.C.

MR. THV. HEYERDANL, chief engineer for the Canadian Office of Escher Wyss & Company, Zurich, Switzerland, is severing his connection with the company, and will leave Canada shortly. Mr. Th. Seidl, previously in charge of the engineering department of the London office of Escher Wyss & Company, has been appointed as Mr. Heyerdanl's successor.

R. F. PACK, general manager of the Minneapolis General Electric Company, formerly general manager of the Toronto Electric Light Company, has been appointed a member of the Smoke Prevention Committee of the Minneapolis Civic and Commerce Association.

DR. WILLIAM M. MACKAY, M.E., of the Reserve Mines, C.B., has been appointed Senator by the Canadian Government. Dr. MacKay has been interested in engineering contracting for many years.

NATHANIEL CURRY, of Amherst, N.S., has been appointed to the Senate by the government. Mr. Curry is president of the Canada Car and Foundry Company, Canadian Steel Foundries, Limited, and the Rhodes, Curry & Company, Limited. He is also a director in the Canadian Light and Power Company, Canada Cement Company and a number of other companies. He was born in Kings County, N.S., in 1851.

CHAS. L. DUNFORD, late of the city engineer's office, Toronto, was recently appointed assistant city engineer of London, Ont. After seven years' experience in England, Mr. Dunford came out to Canada and joined the firm of Ross & Holgate, consulting and supervising engineers, Montreal. After being with them for two years, he left to superintend the construction of a new and modern factory for the Standard Drain Pipe Company, of St. Johns, Que., and later some building work for the same firm in New Glasgow, Nova Scotia. He joined the main drainage works (Toronto), in November, 1908, and worked on the trunk sewer system, disposal works, Ashbridge's Bay improvement and grade separation schemes, and in 1910 visited England and reported to Mr. Chas. H. Rust (at that time city engineer) on several of the largest disposal works in England. Shortly after Mr. A. C. D. Blanchard's appointment as city engineer of Lethbridge, Mr. Dunford changed from the main drainage works to the sewer department, where he worked on the storm overflow sewer system, and was for some months resident engineer on the Carlaw Avenue storm overflow sewer. Later he worked with Mr. R. R. Knight on the combined sewer system for West Toronto, from which work he resigned to take up his new duties.

MR. J. S. MacLACHLAN, of Victoria, B.C., has been appointed resident engineer of federal public works on Vancouver Island. Mr. MacLachlan is a graduate of the Royal University, Dublin, and has been in Canada since the early part of 1911.

JOHN W. WATSON has been appointed as head of the accounting and purchasing department of the Works Department of Toronto by Commissioner R. C. Harris, and the appointment has been sanctioned by the city council.

◆

OBITUARY.

MR. CHARLES W. LEONARD, of London, Ont., died at his home in that city recently. He was a member of the firm of E. Leonard and Sons, London, Ont., manufacturers of engine boilers and other heavy sheet iron products.

◆

IMPERIAL DRY DOCK COMPANY.

The proposed steel plant and shipbuilding industry at East St. John is practically assured. Messrs. Norton Griffiths and Company have acquired the charter of the Imperial Dry Dock Company, and are negotiating with the city and the provincial and federal governments to guarantee the sinking funds on its bond issues, in establishing an immense plant beside the dry dock. They will also ask the federal government to agree to the enlargement of the dry dock to a length of 1,150 feet, which it is said would make it the largest in the world. It would be necessary to reclaim 200 acres near the dry dock to be the site of the steel plant and ship yards. The fullest confidence is expressed in St. John that this great industry will be established.

APPEAL FOR THE HOSPITAL FOR SICK CHILDREN.

Mr. J. Ross Robertson, chairman of the trustees of the Hospital for Sick Children, Toronto, has written to The Canadian Engineer, asking that the needs of this institution be brought to the attention of our readers.

In his letter he states: Last year we treated 1,294 in patients, and 341 of these came from 218 places in Ontario. I feel that no more worthy cause can be presented for generous public support.

Any reader wishing to contribute toward the upkeep of this worthy cause may send his contribution to Mr. Douglas Davidson, Secretary-Treasurer of the Hospital, Toronto.

COMING MEETINGS.

CANADIAN SOCIETY OF ENGINEERS.—Mechanical Section Meeting will be held in the rooms of the Society, 413 Dorchester Street West, Montreal, December 5th, 1912. Chairman, H. H. Vaughan.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

UNION OF MANITOBA MUNICIPALITIES.—Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg, Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annua Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayo Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.: Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose: Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.: Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION. President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. B. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
12-10—400,000 sq. yds. Asphalt and Bitulithic Pavement, Edmonton, Alta.	(P. & S.)	11-21

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page
Black Mountain, B.C., school house	Nov. 27.	Nov. 21.	65
Dunnville, Ont., turbine pump installation	Nov. 28.	Nov. 21.	74
Edmonton, Alta., paving	Dec. 10.	Nov. 21.	74
Fredericton, N.B., bridge, Reversible Falls	Dec. 2.	Nov. 7.	74
Fredericton, N.B., substructure of bridge	Dec. 2.	Nov. 14.	74
Kerrisdale, B.C., steel pipes	Dec. 2.	Nov. 7.	76
Kamloops, B.C., steam power station equipment	Dec. 5.	Nov. 21.	76
Montreal, P.Q., railway ties	Dec. 20.	Nov. 14.	65
Moose Jaw, Sask., steel bridge	Dec. 6.	Nov. 21	74
New Westminster, B.C., harbor improvement	Dec. 2.	Nov. 21.	76
Ottawa, Ont., metal naval stoves	Dec. 3.	Nov. 14.	65
Ottawa, Ont., conveyance of H.M. mails	Nov. 29.	Oct. 24.	74
Ottawa, Ont., conveyance of H.M. mails	Dec. 13.	Nov. 7.	76
Point Grey, B.C., steel pipes	Dec. 2.	Oct. 17.	74
Quebec, P.Q., grain elevator	Nov. 30.	Oct. 17.	76
Rock Island, Que., post-office fittings	Dec. 2.	Nov. 21.	65
Toronto, Ont., engines and boilers	Dec. 10.	Oct. 31.	74
Toronto, Ont. ,work on fire hall	Dec. 3.	Nov. 21.	65
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., turbine pumps and motors	Nov. 20.	Nov. 14	66

TENDERS.

Collingwood, Ont.—The contract for the erection of the rifle range at this point has been awarded to Mr. John Stockton at a contract price of $5,512.

London, Ont.—Sealed proposals addressed to the "Chairman and Members of No. 2 Committee," will be received at the office of the city clerk until 5 p.m. on Thursday, November 28, 1912, for the construction of tile sewers on (1) Queen's Place; (2) Burwell Street, between York and King Streets, London, Ont. Plans and specifications covering the above mentioned works may be seen at the office of the city engineer.

Long Branch, Ont.—The contract for the construction of the Rifle Ranges at this point have been let by the Department of Public Works, Ottawa, to Mr. A. T. McMaster for the price of $13,400.

Louiseville, P.Q.—R. C. Desrochers, secretary Department of Public Works, Ottawa, will receive sealed tenders up to 4 p.m. on Monday, December 9th, 1912, for the erection of public buildings in this municipality. Plans, specifications and form of contract can be seen and forms of tender obtained at the post office, Louiseville, P.Q., at the office of Mr. H. N. Lymburner, superintendent of Public Buildings, 103 St. Francois Xavier Street, Montreal, P.Q., and at the above Department.

Monteith, Ont.—Mr. John Critchley, Monteith, Ont., will receive sealed tenders up to 9 p.m. Saturday, December 14th next, for the erection of a frame school house in this municipality. Specifications may be seen at the post office, Monteith.

Ottawa, Ont.—J. D. McLean, assistant deputy and secretary, Department of Indian Affairs, Ottawa, will receive sealed tenders, marked "Tenders for Cape Croker Timber," until noon of Thursday, December 5th next; 400,000 feet of lumber, consisting of maple, beech, elm, basswood, ash and hemlock are required, which the Indians of Cape Croker are to take out during the ensuing winter and deliver on the shore of Lake Huron at convenient points for shipment.

The Crown dues payable to the Department on this timber are as follows: Maple and elm, $4 per M. ft., B.M.; beech and basswood, $3 per M. ft., B.M.; hemlock, $1, and ash $2 per M. ft., B.M.

Ottawa, Ont.—Messrs. William Kennedy and Sons, of Owen Sound, Ont., have received a contract from the Department of Public Works, for the supply of 16 heavy stop-log winches, at a cost of $297.90 each.

St. Joseph, N.B.—Sealed tenders addressed to Rev. B. LeClavalier, superintendent of St. Joseph's College, N.B., marked on the outside "Extension to College," will be received up to and including the 31st of December, 1912, for the construction of an ell to the existing college at St. Joseph, N.B.

The plans and specification may be seen at the office of R. A. Frechet, architect, 39 D'Aigiullon, Quebec P.O., or at the College, applying to the Rev. Superior.

Regina, Sask.—Tenders for the construction of power house, laundry and refrigerating plant, Regina General Hospital, will be received by the city commissioners up till noon of December 14, 1912. Full particulars may be obtained upon application to Wenger & Cockburn, Room 208, Aldon Block, 12th Avenue, Regina. (See advertisement in The Canadian Engineer).

Rocky Island Park, Alta.—Sealed tenders, addressed to the Deputy Minister, Department of the Interior, Ottawa, and marked on the envelopes "Tender for Dead Timber Permit," will be received at this department until noon on Thursday, the twelfth day of December, 1912, for permits to cut dead timber on the undermentioned parcels of land in the Rocky Mountains Park, Alberta. Each parcel must be tendered for separately.

Toronto, Ont.—Tenders will be received at the office of Frank Barber, civil engineer, 57 Adelaide Street East, Toronto, until noon of December 20th, 1912, for the erection of four steel bridges of 75 ft. clear span, in the county of Simcoe. Plans and specifications may be obtained at the office of the engineer. (See advertisement in Canadian Engineer).

Toronto, Ont.—Tenders for the several trades required in the erection of new school building on Lippincott Street, Toronto, will be received until noon of January 7th, 1913, by W. C. Wilkinson, secretary-treasurer of Advisory Industrial Committee. Full particulars may be obtained at the office of the architects, Messrs. Ross & MacFarlane, Room 506, 59 Yonge Street. (See advertisement in Canadian Engineer).

Toronto, Ont.—Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on Tuesday, December

3, 1912, for the purchase and removal of two-story and basement dwelling at the corner of Severn Street and Rosedale Ravine drive.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications may be seen and forms of tender obtained at the office of the Commissioner of Parks, City Hall, Toronto.

Vancouver, B.C.—Separate tenders will be received by the undersigned up to 3 p.m. Wednesday, December 11th, 1912, for the following quantities of steel pipe: First—26,400 ft. of 6in. steel pipe, 6,600 ft. of 8in. steel pipe, 5,280 ft. of 12in. steel pipe. Second—52,800 ft. of 6in. steel pipe, 13,200 ft. of 8in. steel pipe, 10,560 ft. of 12in. steel pipe. Third—79,200 ft. of 6in. steel pipe, 19,800 ft. of 8in. steel pipe, 15,840 ft. of 12in. steel pipe. Specifications and blank tender forms may be obtained at office of James Stuart, city purchasing agent.

Winnipeg, Man.—Tenders for the manufacture, delivery and erection in the power house at Point du Bois, Man., of two units of horizontal shaft turbines and governors, and three units of horizontal shaft turbines and governors, will be received until noon of December 16th, 1912, by the chairman, Board of Control, Winnipeg. Full particulars may be obtained at the office of the city light and power plant, 54 King Street, Winnipeg. M. Peterson, secretary, Board of Control office, Winnipeg.

Winnipeg, Man.—The Board of Control, Winnipeg, will receive tenders up to November 28th, 1912, for furnishing electric supplies and line materials required during the year 1913. Particulars may be obtained at the office of the City Light and Power Department, 54 King Street.

Winnipeg, Man.—Sealed tenders addressed to the chairman, Board of Control, will be received at the office of M. Peterson, secretary, Board of Control, up to 11 a.m. on Monday, December 2nd, 1912, for the manufacture and delivery f.o.b. city yards, Winnipeg, duty paid, of one well drilling machine for waterworks wells. Specification and form of tender, together with conditions governing tenders as prescribed by by-law may be obtained at the office of the city engineer, 223 James Avenue.

CONTRACTS AWARDED

Elmira, Ont.—The contract for the Carnegie public library has been awarded to Emmanuel Martin. The contract figure is $6,500. Mr. Mahoney, of Guelph, is the architect.

Fredericton, N.B.—Carvell Bros. and McDonald, of Woodstock, N.B., have taken a sub-contract on the St. John Valley Railway. They are to build three miles of the road between this city and Woodstock.

Ladysmith, B.C.—The Ladysmith school board has awarded the contract for their proposed new school to Messrs. Smith & Adams. The contract price is $7,047, including hot water heating, and the school will be built according to plans prepared by S. B. Birds, whose design was chosen in a recent competition.

Moose Jaw, Sask.—The A1 Electrical Company of this city have received the contract for the supply of the electrical generators and fittings to be used in the new building of the Progress Laundry. It is the intention of the shareholders of the laundry to generate their own electrical energy for light, heat and power purposes.

RAILWAYS—STEAM AND ELECTRIC.

Province of Alberta.—The line of the recently formed Western Dominion Railway, which has been approved by Hon. Frank Cochrane, will run from the international boundary line northward through Cardston and Pincher Creek to Calgary, a distance of about 200 miles. As well there will be a branch from the main line breaking off near Pincher and running up along the south fork of the Old Man River to coal fields in the Rockies. The branch will be about 30 miles long. It is reported that J. P. Morgan and George J. Gould, of New York, are financing this enterprise.

Niagara District, Ont.—Work will be commenced on the Niagara-on-the-Lake extension of the Niagara, St. Catharines and Toronto Railway during the next few days.

Saskatoon, Sask.—It is expected that the street railway will be in operation about the middle of December.

Toronto, Ont.—Civic Controller Maguire is working up interest in a proposed belt line for North Toronto. The idea is a belt line with civic street cars running on it. Since Yonge Street is tied up by the Metropolitan Railway he would construct a highway five hundred feet west from Yonge Street and paralleling that thoroughfare from St. Clair Avenue to Bedford Park, thence along the northerly limits of that village, and returning via the parallel road east of Yonge Street and through Mount Pleasant Cemetery.

Vancouver, B.C.—The management of the British Columbia Electric Company will add 100 new passenger cars to the street railway system of this city during the next twelve months. The cost of this addition will be $800,000. Mr. F. R. Glover is authority for this statement.

LIGHT, HEAT AND POWER

Beaverton, Ont.—The ratepayers endorsed a by-law calling for the installation of hydro-electric power into this municipality.

Esquimalt, B.C.—Messrs. Taylor & Gunson, mechanical engineers, have been formally notified of their appointment by the council of Esquimalt to report upon the best methods to be adopted in the installation of an electric lighting system.

Galt, Ont.—A movement is under way for the lighting of 2½ miles of roadway between the boundaries of Galt and Preston.

Regina, Sask.—The municipal commissioners have recommended that the water pumps be separated from the power house and two individual departments created with a separate plant each.

St. Catharines, Ont.—The directors of the Niagara, St. Catharines and Toronto Railway will erect a large power house in this city. Mr. Seixas is general manager.

GARBAGE, SEWAGE AND WATER.

Coquitlam, B.C.—Messrs. Wilson, Lake and Bentall have prepared plans for a temporary waterworks system to be installed at once.

Hamilton, Ont.—The municipal council are seriously considering several proposed improvements to the water supply and water handling facilities of this city. It is proposed to construct a seawall one mile in length. A. F. MacCallum, City Engineer.

London, Ont.—Probably the item of most importance to be voted on by the ratepayers in the coming election is that of a debenture issue of $625,000 to finance the construction of a storm sewer. It is probable that the entire issue will not be floated at once as the city has been divided into sections in order that one section may be completed and financed each year. It has been suggested that the services of an engineer be secured to revise and check the plans now prepared.

BUILDINGS AND INDUSTRIAL WORKS.

Calgary, Alta.—The provincial government of Alberta will erect a $400,000 Normal School in this city.

Duncan, B.C.—The Department of Public Works, Ottawa, will erect a building to be used as a post office and Indian Agent Office, at a cost of $50,000. Mr. F. H. Shepherd, M.P., for Nanaimo, is responsible for this information.

Edmonton, Alta.—The municipal council will erect a three-story market building at a cost of $100,000. A. J. Latornell, city engineer.

Lethbridge, Alta.—Mr. John Taylor, of the Taylor Milling Company has enquired of the municipal council as to what terms could be arranged should he erect a large milling plant in this city.

London, Ont.—If a suitable agreement between the officials of this municipality and the directors of the London and Port Stanley Railway may be reached, a new hotel will

Tarvia

Preserves Roads
Prevents Dust~

Section of Government Parkway, Ottawa, Canada, treated with Tarvia B.

The Property Owners' Investigation.

IN the City of St. Thomas, Ont., the property owners on Gladstone Avenue contemplate petitioning the City Council to improve the roadways. They commissioned one of their number to visit various American cities, inspect pavements and make a report. Their investigator, Mr. E. A. Horton, visited various cities in New York and New Jersey. In his report he made the following statements:

> "I saw a 'Tarvia X' road in Rochester which extends from the city to the lake front, a distance of about six miles. It had been in use for eighteen months, and when I saw it, it was in excellent condition, with heavy traffic over it every day. I........inspected a piece of road in Newark........the surface when finished was smooth, and to my mind was one of the finest pieces of road it was my privilege to see. We then inspected another piece of 'Tarvia X' which had been done by the Road Commission two years ago........Constant heavy traffic passes over this road every day, and trucks have loads of from 6 to 8 tons. Steel-tired drays were used with most of their heavy traffic. This piece of road, as I saw it, did not show any wear whatever, and was apparently in as good condition as when it was put down.
>
> "I did not confine my attention to Tarvia roads as I saw (here he mentioned five of the commonest types of road treatment) and every other kind of road that is known
>
> "I must say after making enquiries from people who were in no way interested, nor did they know I was seeking information, that everyone had a good word to say for the Tarvia road. I have no hesitation in recommending it for use on our street, and at the estimate cost that has been given us, after seeing the many pieces of road that I have seen, I think it is the cheapest road that can be built."

The foregoing is quoted from the St. Thomas, Ont., 'Journal of February 20th, 1912. Since that date Gladstone Avenue has been constructed with Tarvia X.

Anyone who will investigate the road problem with the same thoroughness will reach similar conclusions. Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B ' (applied cold) for dust prevention and road preservation.

Booklet describing the latest developments in methods for building tarviated roadways and pavements will be sent free on request. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER
THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

be erected in this city. Col. Davidson is representing the company in the negotiations.

Medicine Hat, Alta.—Messrs. Christie and Cousins will erect a five story theatrical building in this city at a cost of $100,000.

Medicine Hat, Alta.—The Medicine Hat Pump and Brass Manufacturing Company will erect a factory in this city. Mr. Charles Crary is an official of this company.

Moose Jaw, Sask.—The Canadian Pacific Railway will erect a large car shop and make an addition to their yards in the western portion of this city.

New Westminster, B.C.—The directors of the Dominion Trust Company have ordered the preparation of plans for a large office building in this city. The structure is to be erected on Columbia Street at a cost of $200,000.

Preston, Ont.—Announcement is made of an amalgamation of the Metal Shingle and Siding Company of this place with the A. B. Ormsby Company, of Toronto, and the Canadian interests of the United States Metal Products Company, of New York. The new concern will go in for the manufacture of an improved line of sheet metal products.

Regina, Sask.—The management of the Bank of British North America will build an office structure in this city.

Regina, Sask.—It is reported that the management of the Garden City Feed Company, of Iowa, U.S.A., have secured a suitable site in this city for the erection of a branch warehouse.

Regina, Sask.—The executive of the Regina College have decided to commence work on two towers at a cost of $70,000.

St. John, N.B.—The municipal council will consider the matter of erecting a civic abattoir. W. F. Murdock, city engineer.

St. John, N.B.—The Dominion Tar and Chemical Company, of Sydney, N. S., are considering the establishment of a tar distillery in this city and have requested the municipal council for a suitable site.

Toronto, Ont.—It is reported that Ernest McConkey has secured financial assistance and will proceed with the erection of a twelve-story hotel near the corner of Bay and King Streets. If this project is carried through the site will be that recently acquired by the Dominion Bond Company and reported in the columns of this paper.

Watrous, Sask.—A report in The Canadian Engineer a few weeks ago announced that negotiations were under way for the location of a bottling plant at this point. Word has now been received that the matter has been completed and the interested parties will commence on the erection work. All kinds of soft drinks and the waters of Little Manitou Lake will be bottled.

Winnipeg, Man.—The management of the Winnipeg Tribune, a leading daily paper of this city, have purchased a block of ground on which to erect a new building.

BRIDGES, ROADS AND PAVEMENTS.

Galt, Ont.—The ratepayers of this town voted in favor of a debenture issue of $75,000 to improve the highways in and around this municipality.

Lindsay, Ont.—A deputation of prominent citizens visited Peterboro' recently in order that an examination of the concrete paving might be made. It was announced in this connection that there is a probability of considerable paving being done in Lindsay next spring.

Ottawa, Ont.—It is reported that a Good Roads Bill will come before the legislature at this session and if the same becomes law the subsidies to be awarded the various provinces will be as follows:—Alberta, $52,189.90; British Columbia, $54,669.52; Manitoba, $63,460.10; New Brunswick, $49,019.86; Nova Scotia, $68,576.90; Ontario, $351,466.64; Prince Edward Island, $13,059.70; Quebec, $279,964.80; Saskatchewan, $66,592.58.

Port Arthur, Ont.—The municipal board of works have recommended that all the streets in the inter-city park be macadamized and the council will prepare the preliminary estimates for 1913 in such a manner that funds for this work will be provided.

Province of Saskatchewan.—The report of the Highways Commissioners will be presented to the legislature at Regina in a few days, and will contain a very comprehensive account of the work carried on this year in connection with the building and improving of main roads throughout the province. An extensive scheme covering the whole province has been mapped out, and is being worked out as rapidly as possible.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending November 11th, 1912:—

An analytical chemist in Yorkshire wishes to secure the co-operation of a capable firm in Canada for the introduction to the Dominion market of a new black waterproof enamel or varnish which is his specialty.

A London publisher, wholesale and export bookseller, is open to undertake the representation of a Canadian firm of wood pulp manufacturers.

From the branch for city trade inquiries, 73 Basinghall Street, E.C.

A London firm desire the addresses of Canadian producers and shippers of antimony gold ores.

CURRENT NEWS.

Calgary, Alta.—The council are taking steps to have an investigation commenced into the alleged exorbitant charges for natural gas. The corporation council will investigate the city's power to probe this matter, and upon his report the council will act.

Dunnville, Ont.—Mr. Charles Ross has located a four-million-foot gas well near this point. The Buffalo and Dunnville Oil and Gas Company holdings, controlled by Buffalo capital, adjoins the property on which this strike was made.

Fredericton, N.B.—Mr. J. H. Grisdale, director of the Experimental Farm system, has approved of the plans for the farm to be established near this city and the sum of $60,000 will be spent in order to have the place in working condition as soon as possible.

Kingston, Ont.—The municipal council has recommended the purchase of an auto fire engine and the electors will be requested to vote authorization for a debenture issue to cover cost of the same.

London, Ont.—There is a large list of money by-laws to be submitted for the opinion of the ratepayers, and it is probable that the list will be enlarged. At the present time the specific items are as follows:

Electrification of the London and Port Stanley Railway	$ 890,000
Federal Square	250,000
Storm sewer, total	625,000
Loans to industries	81,000
Sanatorium grant	15,000
Schools for 1913	80,000
Schools for next five years, additional	320,000
	$2,261,000

London, Ont.—The ratepayers will vote on a by-law calling for the appropriation of $250,000 to be used in the making of a federal square.

Montreal, P.Q.—A large block of vacant land between Longueuil and St. Lambert has been acquired by certain real estate interests and announcement is made of their intention to erect a model village thereon.

Province of New Brunswick.—It is the intention of the New Brunswick Government to establish two agricultural colleges in the province, one at Woodstock and the other at Sussex.

Ottawa, Ont.—The civic waterworks enquiry is officially closed and the presiding judge will present his report before the council at an early date.

Ottawa, Ont.—The Railway Commission will be asked to give a new hearing to the matter of agreements between the Bell Telephone and Independent Telephone Companies. This is a much vexed question, the Railway Board, under the chairmanship of the late Judge Mabee, having ruled on it

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

CONTINUOUS STAVE PIPE

RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

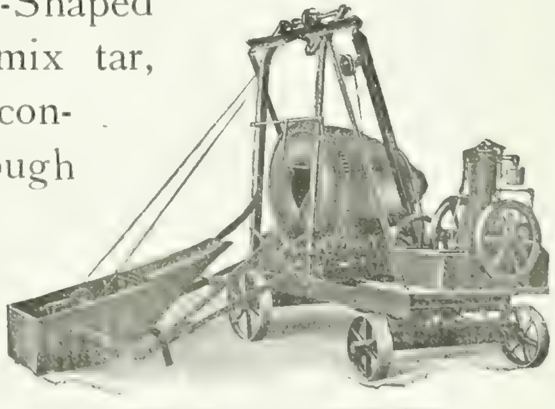
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER MIXERS

are carried in stock and can be delivered at once! They work right away—no tinkering necessary—and mix rapidly. For a rush contract, buy a Wettlaufer Heart-Shaped Mixer. They will not heat stone, mix tar, or do "stunts." But they will mix concrete in the fastest and most thorough fashion. Every part is designed for simplicity, speed and durability, and for just one specific purpose:

TO MIX PERFECT CONCRETE

Ask for Our Catalogue.



Wettlaufer No. 1 Heart-shaped Mixer

NAYSMITH & LOWE,
545 Bastion Street, Victoria, B.C.

HOOTON & MOORE,
613 Ashdown Block, Winnipeg, Man.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

WETTLAUFER BROS.

Head Office and Ware-rooms

178 SPADINA AVENUE
TORONTO

LAVALLE-ROSS, LIMITED,
Alexander Block, Edmonton, Alta.

A. R. WILLIAMS MACH'Y CO.,
15 Dock Street, St. John, N.B.

FACTORIES:
Mitchell, Ont. Buffalo, N.Y.
Detroit, Mich.

about a year ago. It was then thought the question was settled, but the companies have again disagreed, and consequently the matter will be re-opened before the commission.

Ottawa, Ont.—Public works main estimates this session will provide about $10,000,000 for harbor improvements next season at St. John, N.B., Quebec, Toronto, Port Arthur, Vancouver and Victoria. The new terminal scheme at Halifax will be looked after by the railway department, while the Montreal harbor improvements are financed under special arrangement with the harbor board.

Preston, Ont.—The ratepayers endorsed a by-law granting a loan and building site to the Anchor Bedding Company, of Toronto. This company will erect a branch factory at once. The management of this firm consists of Harvet S. Coombs, Thomas Coombs and A. W. Martin.

Windsor, Ont.—The committee dealing with the selection of an auto fire engine does not propose to purchase until a public demonstration of two engines is held in this city.

◆

THE J. C. WHITE COMPANY.

J. G. White & Co., Inc., of New York City, announce the formation of the J. G. White Engineering Corporation and the J. G. White Management Corporation, the former to take over the engineering and construction departments and the latter to take over the operating department. The parent company will continue to handle financial matters. Under this arrangement it is anticipated that greater efficiency will be obtained in the conduct of the increasing volume of engineering and construction work of the company and in the operation of its properties. The J. G. White Engineering Corporation has an authorized capitalization of $2,000,000, one-half of which is preferred stock and one-half common. All of the common stock will be issued to J. G. White & Co., Inc., and $500,000 of the preferred stock, the remainder being reserved for future requirements. The J. G. White Management Corporation has an authorized capitalization of $1,000,000, one-half being preferred stock and one-half common. All of the common stock will be issued to J. G. White & Co., Inc., and $350,000 of the preferred stock, $150,000 of the latter remaining unissued for future requirements. A meeting of the stockholders of the parent company will be held on December 10 to take final action on this plan, which is recommended by the directors.

◆

NEW INCORPORATIONS.

Prince Albert, Sask.—Cement Products Co., $6,000.

Medicine Hat, Alta.—Alberta Glass Bottle Co., $200,000.

New Westminster, B.C.—Westminster Woodworking Co., $100,000.

Calgary, Alta.—Compressed Gas Co., $10,000. Eureka Oil Co., $100,000.

Woodstock, Ont.—Standard Tube and Fence Co., $200,000. J. L. Hossack, C. Jones, H. A. Little.

Edmonton, Alta.—Edmonton Warehousing & Storage Co., $25,000. Motor Street Cleaning Co., $175,000. Edmonton Metal Works, $25,000. Ross' Brothers Plumbing and Heating Co., $50,000.

Toronto.—Cedar Valley Brick Co., $150,000. M. D. Jones, P. H. Ellis, C. W. Carruthers. Foreman Motor and Machine Co., $40,000. G. H. Foreman, J. Bowrey, T. H. Sharp. Exceisior Brick Co., $150,000. S. G. Hoffman, S. M. [illegible], F. A. [illegible].

Winnipeg.—Refrigeration and Engineering, $60,000. J. Bear, F. F. Montague, D. A. Stacpoole. Le Page Lumber Co., $100,000. J. T. LePage, F. A. Shaw, W. B. Tomlinson. Western Builders (builders' supplies), $160,000. H. Edwards, J. A. Flanders, A. S. Burgess. New Method Wet Wash Laundry Co., $20,000. P. C. Locke, G. S. Gould, R. H. [illegible].

We require a few copies of THE CANADIAN ENGINEER for October 24th, 1912, No. 17, Volume 23. Any subscriber sending in a copy of this issue will have his subscription extended one month free of charge.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

17992—November 11—Authorizing C.P.R. to divert (1) highway adjoining North Boundary, Sec. 11, Tp. 24, R. 20, W. 4 M., in North-Easterly direction, (2) highway adjoining North Boundary, Sec. 12, Tp. 24, R. 20, W. 4 M., in N.W. direction, (3) highway adjoining West Boundary, Sec. 12, in N.W. direction to connect with (1); and (4) to construct, by grade crossing, across First St. E. (1), and across road allowance proposed to be closed, all within Townsite of Hussar, Alta.

17993—November 12—Authorizing C.P.R. to construct Kerrobert-Northeasterly Branch across 15 highways, mileage 02.63 to 35.45.

17994—November 12—Authorizing city of Vernon, B.C., to extend Lyons Street across the C.P.R.

17995—November 12—Approving plan of rearrangement of siding necessary from G.T.R. and C.P.R. into Exhibition Grounds, West Toronto.

17996—November 12—Authorizing Kettle Valley Ry. to open for traffic the portion of its railway from Merritt easterly 29 miles.

17997—November 12—Directing C.L.O. & .W. (C.P.R.) to construct livestock pass for Norman Bellyou, Trenton, Ont., in Lot 6, Con. 1, Township of Murray.

17998—November 12—Directing M.C.R. to install a Hoeschen electric bell at crossing of highway 1 mile east of Shedden, Tp. of Southwold, Ontario.

17999—November 15—Authorizing C.P.R. to open for traffic new second track, St. Constant to St. Claude, mileages [illegible] to 26.6.

18000—November 13—Directing C.P.R. to demolish or remove baggage room at Farnham, Que., from its present site, before June 1st, 1913.

18001—November 13—Authorizing C.P.R. to construct sidings for Davenport Coal Co., S.W. ¼, Sec. 12, Tp. 7, R. [illegible], W. 5 M., at Burmis, Alberta.

18002—November 13—Authorizing C.N.R. to construct across C.P.R. in city of Moose Jaw, Saskatchewan.

18003—November 11—Approving C.N.R. Plan "B" showing structures to be erected at crossing of Park Road, Manitoba St., and 2nd and 3rd crossings of Moose Jaw Creek.

18004—November 13—Approving location C.N.O.R. station grounds at Fitzroy Harbor, Tp. Fitzroy, Co. Carleton, Ontario.

18005—November 13—Authorizing C.N.O.R. to construct across Con. Road between Cons. 9 and 10, Station 1784.40 and Side Road between Lots 20 and 21, Con. 10, Station [illegible], Tp. Fitzroy.

18006—November 12—Authorizing C.N.O.R. to construct across public road between Lots 343 and 350, Parish St. Leonard de Port-Maurice, Co. Hochelaga, Quebec.

18007—November 13—Approving location James Bay and Eastern Ry., station grounds at Dufferin, Tp. Dufferin, Que., mileage 30.7, from Roberval; and rescinding Order No. 16341, dated April 10th, 1912.

18008—November 14—Authorizing G.T.P. Branch Lines Company to construct Prince Albert Branch across highway in S.E. ¼ Sec. 4, Tp. 33, R. 27, W. 2 M., mileage 1.5, Rural Mun. No. 312, Sask.

18009—November 11—Authorizing G.T.P. Branch Lines Company to construct Moose Jaw-Northwest Branch across Twenty-two (22) highways, mileage [illegible] to mileage [illegible].

18010—November 13—Authorizing G.T.P. Branch Lines Company to construct Calgary-Boundary Branch across Eight (8) highways, in Dist. South Alta., Alta., mileage 82.5 to 90.3.

18011—November 9—Authorizing Niagara, St. Catharines and Toronto Railway to construct across Carlton and Niagara Sts., in Lot 14. between Cons. 4 & 5, Tp. Grantham, Co. Lincoln, Ont.

18012—November 14—Varying Order No. 16816, dated June 25th, 1912, to provide that Bartlett Ave., be maintained at grade, over C.P.R. & C.N.O.R. in North Toronto; that Ossington Ave. and Christie St. subways be constructed with 14 ft. clear headway; that Albany Ave. be not re-opened, and Huron St. not opened across said lines, but that Bridgeman Ave. be opened and graded through to Bathurst Street.

18013—November 12—Extending, until May 1st, 1913, the time within which C.P.R., equip all rolling stock in use by it of 37 ft. or over in length, or weighing 35,000 lbs. or more, with power brakes, to be approved by the Board.

18014—November 8—Directing C.P.R. to file, within 30 days from date of this Order, plans of gates directed to be erected at McTavish St., Fort William, Ont., and operated by a day and a night watchman.

18015—November [illegible]—Directing C.P.R. and G.T.R. to protect, from 6.30 a.m. to [illegible] p.m. daily by a watchman, crossing at George Street, Toronto, Ontario.

18016—November [illegible]—Refusing application of T. H. & B. Ry. to cross, at grade, the highway as Stanford Ave., Hamilton, Ontario, with two branch lines or spurs.

18017—November [illegible]—Directing T. H. & B. Ry. to protect by a day and a night watchman, crossings at O'Reilly St., and Ferguson Avenue, Hamilton, Ontario.

18018—November 14—Approving location C.P.R. proposed station at Severn Falls, on Lot 22, Con. 7, Tp. Matchedash, Co. Simcoe, Ont.

18019—November 13—Authorizing C.P.R. to construct spur for the [illegible] Furniture Co., Ltd., Calgary, Alberta.

18020—November 14 Authorizing C.P.R. to construct cross-over track opposite the V.V. & E. Railway & Navigation Company's freight sheds, to connect with G.N.R. New Westminster, B.C.

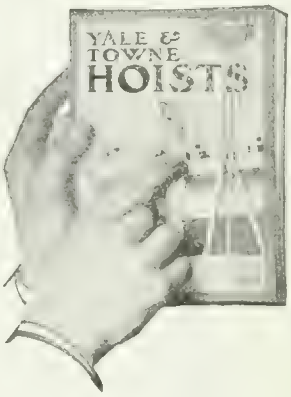
18021—November 14—Approving revised location G.T.P. Branch Lines Company Tofield-Calgary Branch in Sec. [illegible], Tp. [illegible], R. [illegible], W. 4 M.

18022—November 15—Authorizing G.T.R. to construct siding for the Canada Furniture Manufacturers, Ltd., Wiarton, Ont.

18023—November [illegible]—Authorizing Oshawa Railway Company to construct branch line from end of present track on Bruce Street, town of Oshawa, Ont., to property of "Brick Limited," and to cross C.N.R., and Toronto and Eastern Ry. Companies' tracks.

THE TRIPLEX BLOCK

REASONS FOR SENDING TODAY FOR THIS BOOK.



Triplex Block built into a 10-ton geared trolley and used for loading on floats lying alongside a pier in New York City.

A Book on the Handling of Loads, the Latest Practice Here and Abroad.

The change is coming fast. Modern plants today are equipping throughout to give each workman easy mastery over any load up to 20,000 lbs.

The new practice is to reduce all loads to one-man manageable loads, from the raw material coming in to the completed material going out. This frees the factory from an enormous waste. The primitive way of pitting time-paid muscle against stubborn weight, soon costs any manufacturer who stands for it a fortune in wages and restricts his output.

Months of research were spent by Yale and Towne engineers to make this book cover a wide range of conditions, so the man who sends for it will find it the most practical and helpful book that ever came to his desk.

Send for a free copy now, before
the thought is out of your mind.

Triplex Blocks { **16 Sizes:** One-fourth of a ton to forty tons.
9 Active Stocks all over Canada.

Every Block Tested to Fifty Per Cent. Overload.

The Canadian Fairbanks-Morse Co., Limited

MONTREAL, ST. JOHN, OTTAWA, TORONTO, WINNIPEG,
CALGARY, SASKATOON, VANCOUVER, VICTORIA.

18024—November 15—Recommending, to the Governor-in-Council for sanction, the agreement of amalgamation of the Western Dominion Ry. Co., and the Alberta Pacific Ry. Co.

18025—November 15—Approving Nipissing Central Ry. Co.'s Standard Passenger Tariff C.R.C. No. 8; company to publish same with a copy of this Order, in at least two consecutive weekly issues of "The Canada Gazette."

18026—November 15—Authorizing C.P.R. to take, for the construction of a business siding at Leslie Station, certain lands in Gore of Puslinch, Tp. Puslinch, Co. Wellington, Ont.

18027—November 15—Authorizing C.P.R. to open for traffic its Moose Jaw-Northwesterly Branch from Rosetown to Conquest, mileage 128.21 to mileage 162.57, distance of 34.3 miles.

18028—November 16—Authorizing C.P.R. to construct bridge No. 50.0, Cascade Subdivision, British Columbia Division.

18029—November 15—Authorizing C.P.R. to open for traffic Wilkie-Northwesterly branch from mileage 0 to mileage 27.8, in Province of Saskatchewan.

18030—November 15—Authorizing C.L.O. & W. (C.P.R.) to construct across five (5) highways in town of Bowmanville, Ont., from mileage 148.46 to mileage 149.20 (from Glen Tay).

18031—November 15—Authorizing C.L.O. & W. (C.P.R.) to construct across, by means of overhead bridge, road allowance between Lots 28 and 29, Con. B, Tp. Brighton, East Riding, Co. Northumberland, Ont., mileage 95.25 from Glen Tay.

18032—November 13—Directing G.T.R. to construct subway at highway leading to Cardinal, Ontario.

18033—November 14—Authorizing G.T.R. to construct siding for the Standard White Lime Co., Ltd., on Lot 18, Con. 2, Tp. of North Oxford, near Beachville, Ont.

18034—November 15—Authorizing C.N.R. to construct across thirty-eight(38) highways in the Province of Saskatchewan, on its Thunderhill Branch.

18035—November 15—Authorizing C.N.O.R. to construct across public road between Lots 32 and 33, Con. 15, Tp. Ferris, Dist. Nipissing, at Station 846.54, mileage 224.74.

18036—November 15—Authorizing C.N.R. to construct across public road between Secs. 10 and 15, Tp. 65, R. 22, W. 4 M., by overhead structure.

18037—November 15—Authorizing Kettle Valley Ry. Co. to construct across highway at Station 383.57, northwest of Penticton, B.C.

18038—November 15—Authorizing C.P.R. and G.T.P. to operate their trains, without first being brought to a stop, over crossing at mileage 6.1, Sec. 6, Tp. 39, R. 19, W. 3 M., Saskatchewan.

18039—November 14—Amending Order No. 17628, dated September 30th, 1912.

18040—November 11—Dismissing application of G.T.P. and G.T.P. Branch Lines Co., for an order relieving them from erecting gates in openings in right-of-way fences provided to give the public ingress to and egress from station reservations on their respective lines.

18041—November 12—Dismissing application of Rockwood, the town of Stonewall, and the Stonewall Dist. Board of Trade, for an order directing the C.P.R. to grant commutation passenger tickets to passengers travelling between Winnipeg and Stonewall.

18042—November 11—Dismissing complaint of the Board of Trade of city of St. Boniface, Man., and Messrs. Couture and Marion against C.P.R., alleging excessive charges on brick from St. Boniface, Man., to Yorkton, Sask.; also discrimination in favor of brick manufacturers of Portage la Prairie.

18043—November 11—Refusing application of Midland Ry. Co., of Manitoba, and Winnipeg Trackage, Ltd., for an Order granting leave to the Midland Ry. Co. to cross a main industrial spur of C.P.R. near Wall St., Winnipeg, with additional spur to the Winnipeg Trackage, Limited.

18044—November 11—Granting leave to C.N.R. to construct across C.P.R. in S.E. [illegible] Sec. [illegible], Tp. [illegible], R. [illegible], W. 4 M., Alberta.

18045—November 11—Amending Order No. 17216, dated August 15th, 1912, by providing that the overhead structure authorized by said Order be wide enough to permit of 2 tracks only to pass under the same; that this order is made without prejudice to the right of C.P.R. to apply at any future time for an Order for G.T.P. Branch Lines Co. to erect, at its own expense, a structure of sufficient width to permit of four tracks passing under same.

18046—November 11—Authorizing C.P.R. to construct one additional track and re-construct existing track on its Emerson Branch; and that it place, at its own expense, a watchman at Montcalm St., St. Boniface, Manitoba.

18047—November 11—Directing C.N.R. to file with the Board within thirty days from this date plans showing a four-car siding between Baldur and [illegible], Manitoba.

18048—November 11—Directing that the Municipality of North Norfolk, Man., be added as a party to the application of Robert Wallace et al, for a subway between Secs. 24 and 25, Tp. 11, R. 12, W. P. M., Manitoba, and that the road be diverted by the C.P.R.

General Order No. [illegible]—November 11—Providing specifications for maintenance of signals at highway crossings.

18049—November 12—Remitting penalties imposed under Order No. 16823, dated June 20th, 1912; and directing the city of Montreal to commence construction of subway under C.P.R. at Park Ave., not later than April 1st, 1913, and complete same by October 1st, 1913.

18050—November 15—Authorizing Kettle Valley Ry. Co. to carry freight traffic from Midway to Carmi, B.C., distance of 46 miles.

18051—November 18—Approving by-law No. [illegible] of Niagara, Welland and Lake Erie Ry. Company, authorizing C. J. Laughlin, Jr., Vice-President of the Company, or H. Rooke, Secretary, to prepare and file tariffs for freight and passenger traffic and of telegraph tolls.

18052—November 18—Authorizing the Government of the Province of Saskatchewan to construct road north of Secs. 13 and 14, Tp. 22, R. [illegible], W. 3 M., Saskatchewan.

18053—November 18—Approving revised location of site of the Burrard Inlet Tunnel and Bridge Co., bridge from the high-water mark south of Burrard Inlet, to high-water mark north of Burrard Inlet, also width (225 ft. each) of opening spans of bridge across the Second Narrows of Burrard Inlet; and rescinding Order No. 17565, dated September 24th, 1912.

18054—November 18—Authorizing M.C.R. to construct sidings across and upon certain highways in Tp. Crowland, and over and upon Lots 25 and 26, Con. 7, Tp. Crowland, Co. Welland, Ont.; and approving lateral and overhead clearances shown on plan.

18055—November 15—Relieving M.C.R. from providing further protection at crossing of Ferry Road, just west of Victoria Park Station, Niagara Falls, Ontario.

18056—November 18—Authorizing Nipissing Central Ry. Co. to open for traffic its line from Haileybury to New Liskeard.

18057—November 20—Establishing collection and delivery limits, by the Dominion Express Company, in town of Woodstock, N.B.

18058—November 18—Establishing collection and delivery limits for the Dominion Express Company, in the town of Wolfville, N.S.

18059—November 18—Authorizing C.N.Q.R. to construct across public road on Lot 27, Parish of St. Monique, Co. Two Mountains, Quebec.

18060—November 19—Authorizing C.N.O.R. to construct across public road between Cons. B and 2, Tp. Westmeath, Co. Renfrew, Ont.

18061—November 19—Approving proposed location C.N.O.R. station grounds at Desaulniers, Tp. Gibbons, Ont., mileage 265.5.

18062—November 15—Approving location C.N.R. through Tps. 7-11, and Rgs. 2-6, W. P. M., Manitoba, mileage 18.08 to mileage 53.76.

18063—November 19—Authorizing G.T.P. Branch Lines Co. to construct its Prince Albert Branch across highway in N.W. ¼ Sec. 3, Tp. 48, R. 26, W. 2 M., mileage 104.7, Saskatchewan.

18064—November 16—Authorizing G.T.P. Saskatchewan Ry. Co. to construct Weyburn-Branch across C.P.R.'s Weyburn-Lethbridge & Soo Branches, Sec. 20, Tp. 8, R. 14, W. 2 M., at Weyburn, Sask.

18065—November 16—Authorizing G.T.R. to construct two sidings for A. S. Nicholson, on part of Lot 11, village Burlington, Ont.

18066—November 18—Authorizing G.T.R. to construct siding for the John Carey Lumber Co., Ltd., on Lot 22, town Lindsay, Ont.

18067—November 19—Authorizing G.T.R. to construct siding for the Dain Manufacturing Co., Ltd., Tp. Humberstone, Co. Welland, Ont.

18068—November 19—Authorizing G.T.R. to construct siding for the National Concrete Mfg. Co., on Lot 18, Con. 4, Tp. Ops, Co. Victoria, Ontario.

18069—November 20—Authorizing C.P.R. to construct additional track across 4 highways, mileages 16.0 to 23.0, Swift Current Subdivision, Saskatchewan Division.

18070—November 18—Relieving C.P.R. from providing further protection at highway known as "Chemin de la Cote St. Elzear," 0.94 miles west of St. Martin Jct., Quebec.

18071—November 18—Approving revised location C.P.R., Sudbury-Sault Ste. Marie Branch, as now constructed from mileage 20.73 to mileage 21.40, Webbwood Subdivision.

18072—November 18—Relieving C.P.R. from providing further protection at Tilson Ave., town of Tillsonburg, Ontario.

18073—November 16—Authorizing C.P.R. to construct two spurs for the C. H. Wentz Lumber Co., Saskatoon, Sask.

18074—November 16—Authorizing C.P.R. to construct two industrial spurs for city of Calgary, Alta.

18075—November 19—Authorizing C.P.R. to construct bridge No. 2.65 on its Eastern Division, Prescott Subdivision, Ont.

18076—November 19—Authorizing C.P.R. to construct two spurs for the Superior Elevator Co., Ltd., Fort William, Ontario.

18077—November 16—Authorizing C.P.R. to construct spur for the Great West Saddlery Co., Calgary, Alberta.

18078—November 2[illegible]—Amending Order No. 17958, dated Nov. 8th, 1912, by striking out the words, "no one appearing for said land-owners in objection thereto," and substituting therefor the words, "and the property-owners affected."

18079—November 18—Extending, until May 31st, 1913, the time within which C.P.R. complete work to be done at highway crossing on Lot 18, Con. 7, Tp. Peel, at mileage 35.7.

18080—November 18—Authorizing C.P.R. to divert highway adjoining North Boundary, Sec. 24, Tp. 32, R. 19, W. 3 M., mileage 194.03, Moose Jaw Northwesterly Branch.

18081—November 19—Authorizing C.P.R. to construct additional track across 18 highways, mileages 105.6 to 124.04, Moose Jaw Subdivision, Saskatchewan Division.

18082—November 20—Authorizing C.L.O. & W. (C.P.R.) to construct across road allowance between Lots 22 and 23, Broken Front Con. of Tp. Clarke, Co. Durham, Ont., mileage 140.58 from Glen Tay.

18083—November 19—Authorizing C.L.O. & W. to construct bridge No. 87.8 across Ontario St., and C.N.R.'s spur, Trenton, Ont.

18084—November 18—Authorizing C.L.O. & W. to construct bridge at mileage 159.3, at Oshawa, Ontario.

18085—November 19—Authorizing C.L.O. & W. to construct across road allowance between Lots 33 and 34, Con. 1, Tp. Darlington, Ontario.

18086—November 19—Authorizing C.L.O. & W. to construct across road allowance between Lots 24 and 25, Broken Front Con., Tp. Darlington, Co. Durham, Ontario.

18087—November 11—Directing C.N.R. to install gates, to be operated by a day and a night watchman, at Gore St., Fort William, Ont.; said gates to be in operation by March 1st, 1913.

18088—November 21—Postponing, until and including December 31st, 1912, the effective date of cartage tariff of Wabash R.R.

18089—November 20—Authorizing G.T.R. to operate cars and engines, jointly with T. H. & B. Ry., upon and over siding of Standard Underground Cable Co., of Canada, at Hamilton, Ontario.

18090—November 21—Authorizing C.P.R. to construct spur for Hunter Structural Steel Co., Toronto, Ontario.

18091—November 21—Authorizing C.P.R. to construct spur for the Superior Match Co., Ltd., Owen Sound, Ontario.

18092—November 21—Authorizing C.P.R. to construct spur for G. A. Abbott, Lot 15, Con. 2, Tp. North Orillia, Co. Simcoe, Ont., mileage 71.5, Port McNicoll Subdivision.

Volume 23. Toronto, Dec. 5, 1912

Contents of this issue on page 831

The Canadian Engineer

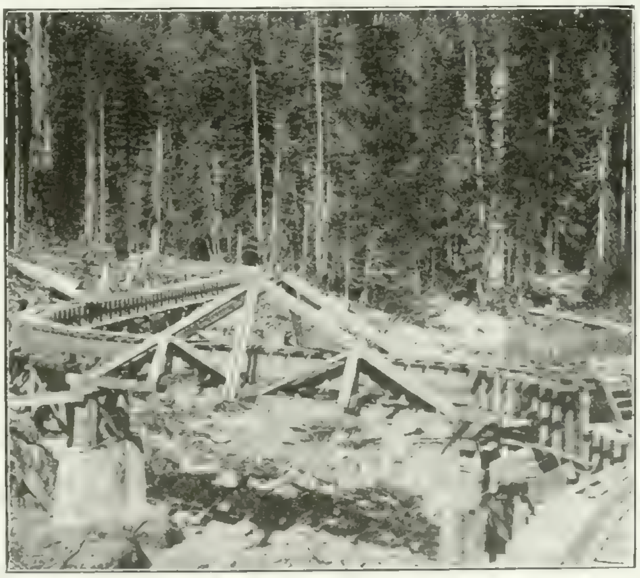
An Engineering Weekly

THE VANCOUVER ISLAND POWER COMPANY, LIMITED JORDAN RIVER DEVELOPMENT.

PART II.

The flume traverses a heavy belt of timber along the entire route, and the clearing necessary for adequate protection of the structure was very extensive. A wide clearing was made, all trees being taken down along the upper side which would reach the flume in falling, and all leaning and dead trees were cut along the lower side.

The fallen timber was hand-logged down the hill from the zone to be occupied by the flume proper and the flume railway, and the loppings and branches, as far as the season would permit without danger, were piled and burned as the work went forward. About 6,000,000 feet, board measure, of timber were cut in making the clearing.



Junction of "Y" Creek Flume With Main Flume.

The flume box, which is designed for an ultimate carrying capacity of 175 cubic feet per second, is 6 x 6 feet in size, and has a grade of one foot to 1,000 feet. It is supported by bents spaced 15 feet centre to centre, set upon ample footings, either of cedar blocks or concrete, according to the nature of the underlying material, the maximum bearing upon a square foot of the supporting ground surface being not greater than one ton. The sizes and dimensions of the different members of the flume are as follows:—

2 Bent posts	Cedar	8″ x 8″	battened
1 Cap	Fir	8″ x 8″	gained
2 Stringers	Fir	6″ x 14″	lapped
6 Sills	Fir	4″ x 8″	gained
12 Box posts	Fir	4″ x 6″	
6 Yokes	Fir	4″ x 6″	gained

The box is of fir and spruce planking, 2 inches thick, 12 inches and 18 inches wide, and surfaced on one side, with flat battens, ½″ x 3½″, nailed over the cracks.

Side planks to carry 75 cubic feet of water per second have been installed, and additional planks may be added as greater capacity is required, at which time intermediate bents, or at least supporting posts will be installed at the middle points of the stringers, reducing the span to 7½ feet. In the construction of the flume 3,500,000 board feet of lumber were used, to supply which, a saw mill was erected at the lower end of the flume and adjacent to the forebay reservoir. The capacity of the mill was about 30,000 board feet per day, and the equipment included machinery for surfacing, sizing, gaining and trimming the flume lumber for erection with a minimum of hand labor.

The total amount of lumber cut in the mill for the entire construction work was about 6,000,000 feet, board measure.

To facilitate the construction of the flume, a 36-inch gauge railway, with 30-lb. rail, was built parallel to the flume along its entire length, and at an elevation about 15 feet above it. Lumber and other material for the flume, as well as for the diverting dams and storage dam, were delivered over this track, which connects directly at its lower end with an inclined tramway of the same gauge. This inclined tramway begins at a landing wharf on the shore, is two miles in length and after overcoming a difference of elevation of 1,200 feet, connects with the flume railway near the saw mill.

The operation of the inclined tramway is accomplished by means of a powerful haulage engine placed at the upper end of the tramway, and a second and lighter haulage engine near the lower end, slight grades at sections preventing the cars from overhauling the cable by their own weight.

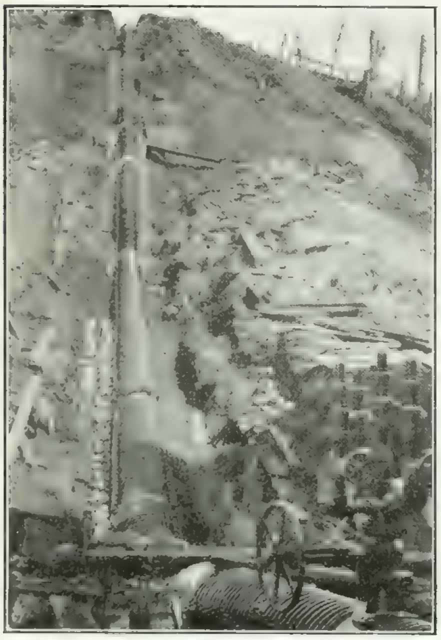
In building the flume, all members were sized and cut to true length, including bent posts, and all daps and gains were made at the saw mill by machine. The footings were accurately located and placed to elevation with transit and level, somewhat in advance of the erection; the length of the posts required for each bent was determined, and the information forwarded to the framing yard at the saw mill where the various parts were prepared. In this way, confusion and crowding was avoided on the work, and a greater rate of progress made possible.

The system worked out quite satisfactorily, very few errors occurring in the process.

Five combination sand and waste gates are provided along the length of the flume at approximately equal intervals, and a standard weir was built at the lower end where several measurements were taken to determine the carrying capacity with different depths of water. The results of these tests indicates a value of about 122 for the coefficient in Chezy's formula: $v = c \sqrt{rs}$.

The flume has been in continuous operation since November, 1910, and has proven tight, safe, and reliable in every respect, only one short interruption having occurred, due to the loss of one bent destroyed by a small landslide.

Forebay Reservoir.—The forebay reservoir site consists of two small, gently sloping, heavily wooded depressions leading in opposite directions from a low saddle or ridge, lying 1,150 feet above sea-level. Two earth dams were built across the valleys, the material for the embankments being all excavated from the higher ground between. Each embankment is about 35 feet in height, and 1,000 feet in length. The total volume of fill in the two dams is 35,000 cubic yards.



Pipe Line at Entrance Power House.

The material available for the embankments was semi-cemented gravel, or hardpan, which required drilling and blasting to loosen. A double-sheathed timber diaphragm of cedar planking, connecting with a concrete cut-off wall sunk well into the impervious hardpan, was installed in each dam to insure water tightness, the material from which the dams had to be built not being sufficiently impervious to make them adequately water-tight without diaphragms.

Dam No. 1 was built with wheelbarrows and heavy sleds, hauled with a donkey engine, and hoisted and dumped from an overhead cableway. Dam No. 2 was built under contract, with horses and carts.

No particular attempt was made on either embankment to puddle or compact the material during construction, except that a limit of three feet was placed upon the layers deposited, and a small amount of puddling with water was done immediately in front of the timber diaphragms.

A concrete intake structure, surmounted by a structural steel gate tower, from which were operated two roller bearing 54-inch hydraulic sluice gates, was erected inside the reservoir at the head of the pipe line. Two 44-inch steel riveted pipes are installed through the base of the south dam. From the intake structure to the core wall, the pipes are imbedded in a reinforced concrete casing, and from the core wall to the lower toe of the dam, two open culverts, with common centre wall, and roofed with reinforced concrete slabs, are installed around the pipes, insuring perfect drainage, and allowing access for inspection. Two 6-inch standpipes extending up to the floor of the gate tower are installed at the upper end of the pipes.

The reservoir, when full, covers an area of about 12 acres, and the capacity available—4,800,000 cubic feet—is sufficient to operate the single generating unit installed for a period of about 30 hours. To prevent damage to the slopes from wave action, a light timber boom is floated about four feet from the water's edge, and braced at intervals from the bank.

An emergency spillway with flash boards and apron is built in the solid ground at the east end of dam No. 2.

The function of this forebay reservoir is to increase the peak load capacity of the power plant by liberal storage immediately at the head of the pipe line; and also to furnish a reserve supply of water to run the plant for a considerable period in event of accident to the flume line.

Pipe Line.—The pipe line leading from the forebay reservoir to the power station is 9,800 feet in length, and follows a gentle slope for the greater part of its length, the lower 300 feet descending abruptly to the power house. The upper third of the length of this line is designed to deliver water for two generating units of 4,000 kilowatts each, and consists of one riveted steel pipe 44 inches diameter, ¼ inch to ⅜ inch plate. At the lower end of this section a cast-iron "Y" piece, fitted with two 36-inch cast steel gate valves is installed, providing for the extension of two lines to the power house. The lower section of the pipe is designed to deliver water for one generating unit only, and the single line installed consists of lap-welded steel, with riveted roundabout joints, in approximately equal lengths of 36-inch, 34-inch, 32-inch and 30-inch diameter, and varying in thickness from 5/16 inch at the "Y" end to 9/16 inch at the lower end.

The pipe line was designed with an ample factor of safety according to current practice in the extensive use of lap-welded pipe. However, owing to the apprehension aroused in the minds of the officials of the company by a reported failure of a similar lap-welded pipe elsewhere, the lower end of the pipe line for a distance of 2,200 feet was reinforced by one inch round steel bands, after the manner of a wood-stave pipe with spacing from 3¾ to 4 inches.

Several hours after first filling the line with water the 36-inch valve on the dead end at the "Y" burst without warning and the water in the 44-inch pipe above was suddenly discharged. No damage, however, resulted to the pipe line, ample air openings having been provided for its protection. The valve was split almost centrally through the body and bonnet, the lower half being blown a distance of 20 feet away. An investigation of the design of the body showed that an ample section of metal had been provided throughout for a large factor of safety and no flaws or other defects were disclosed. The valve had been ordered tested before shipment, but this had not been done. The accident emphasizes the unreliability of cast-iron, even for moderate pressures. The cast-iron valve bodies were then discarded, and cast-steel parts installed in their places, and, as an additional precaution, two expansion joints, one in the 44-inch pipe above the "Y" and one in the 36-inch pipe below, were introduced in the line to eliminate any strains due to expansion or contraction to which the cast iron parts might be subjected. Eight 4-inch air valves and 4 manholes were installed along the length of the pipe, and immediately back of the power house a cluster of four automatic pressure relief valves was mounted.

Concrete anchor bolts and supporting piers were erected at proper intervals along the pipe line.

The inclined tramway was installed parallel to the line along its entire length, from which the pipe and other materials were delivered.

The entire pipe line installation, including the furnishing of material and the erection, was done under contract by the Jens Orten Boving Company, Limited, of London, England.

Power Station.—The power station faces the ocean and is erected on low ground at the foot of the pipe line hill, which slopes very abruptly for the lower three hundred feet of its length. The ground surface is elevated only slightly above extreme high-tide elevation, but the waterwheel nozzles are placed 5.5 feet above the maximum high-tide level. A very heavy growth of cedar, spruce and hemlock timber was removed from the site in preparation for the construction work.

The power house building is 49 feet by 97 feet, sufficient space being provided for the installation of two complete generating units, with exciters, transformers, switchboards, low-tension and high-tension switches, etc. Concrete and steel were used exclusively in the construction of the building, account being taken in making the location for its extension to contain an ultimate installation of four generating units.

The pipe line previously described enters the power house at the back and is connected to the generating unit through a 24-inch gate valve, there being an effective head of 1,100 feet. The water is controlled by a needle regulating nozzle in conjunction with an auxiliary needle nozzle, the needle of which is mechanically connected to the main needle and is so arranged that it opens automatically as soon as the main needle closes rapidly or beyond a certain predetermined point. In this way the auxiliary nozzle maintains a sufficient vent to avoid a dangerous rise of pressure in the pipe line. The auxiliary nozzle is also fitted with an independent slow-moving adjustable time element mechanism which gradually closes the nozzle when the main needle stops moving, thus conserving the water supply.

A Lombard, Type Q, oil pressure governor is used for speed regulation and is directly attached to the main nozzle needle.

The main generating unit consists of a 4,000 kilowatt generator and a 6,000 horse-power impulse water-wheel. This unit is of the two-bearing type, having the revolving field of the generator mounted on the shaft between the bearings and the water-wheel overhung at one end. The speed is 400 revolutions per minute.

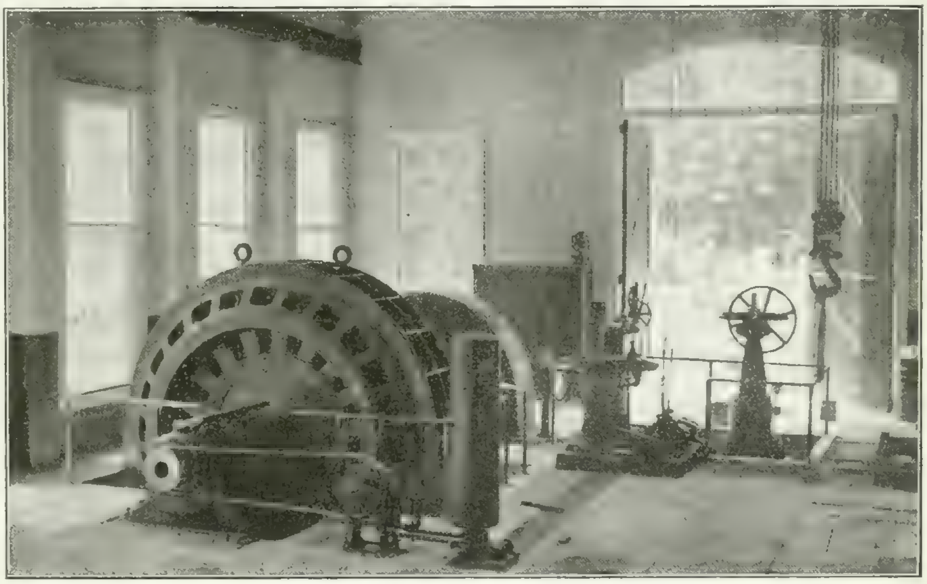
One exciter is installed which has sufficient capacity to supply maximum field current for two generating units. The extended shaft carries on one end an overhung impulse water-wheel, and is connected at the other end to an inductor motor, which operates at the generator voltage, and has sufficient capacity to drive the exciter generator continuously. The exciter water-wheel is equipped for hand control only, as the motor serves as a speed regulator and no governor is necessary.

A four-panel marble switchboard, provided with a complete equipment of instruments and controlling devices, including Tirrell regulator, is mounted on the switchboard floor, which is elevated about 6 feet above the generator floor.

The current delivered by the generator at 2,300 volts is stepped up to 40,000 volts by means of three 1,400 kilowatt-ampere oil-insulated water-cooled transformers, which are installed in fire-proof compartments back of the generator. These transformers are now operating with delta connection, delivering current to the transmission line at 40,000 volts. This voltage will be raised upon the installation of the second unit to 60,000 by changing the delta connection to star connection with grounded neutral.

The water-wheel equipment was furnished by the John McDougall Caledonian Iron Works, Limited, of Montreal, and manufactured under the Doble patents; the generator and exciter by the Allis-Chalmers-Bullock Company, Limited, and the transformers, switchboards, switches and lightning arresters by the Canadian General Electric Company, Limited.

A 75,000-volt three-pole oil switch with disconnecting switches, and arranged for hand operation from the generator floor, is installed in the high-tension room. A complete equipment of three-phase aluminum cell, 40,000-volt lightning arresters has been provided to protect each end of the transmission line.



View of Inside of Power House.

At Victoria the sub-station used in connection with the operation of the transmission line from the old Goldstream hydro-electric station has been utilized. Extensive alterations were made in the old building, including the erection of transformer stalls for two banks of transformers, and high-tension switch-room of reinforced concrete, space being provided for bringing two transmission circuits into the building.

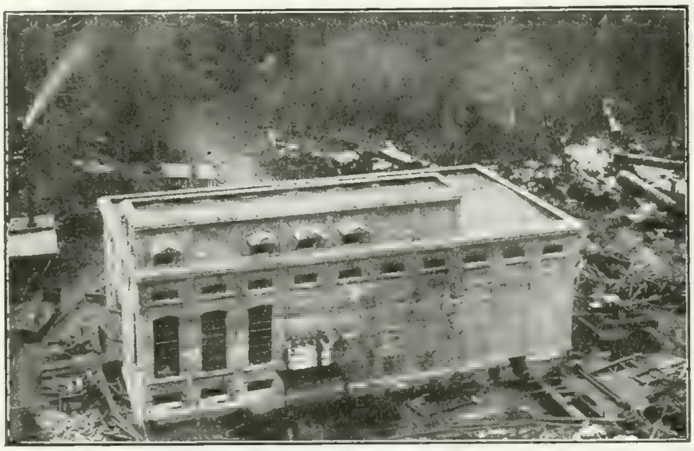
An unfortunate and very unusual set of conditions were encountered in the power station foundations, the remedying of which was fortunately taken in hand in time to prevent serious delay in putting the plant into operation.

In the construction of the building and the setting of foundation, unusual precautions were observed; the excavation for the foundation walls and the machine settings were carried to a depth of about 21 feet below the floor level. Some seams of peat, varying in thickness from 2 inches to 2 feet, were encountered. At the bottom of the trench a fairly stiff, blue, sandy clay was found, into which borings were made for a distance of 12 feet, showing the same class of material throughout this distance.

Tests of the bearing power of the ground were made, which showed that a load of five tons per square foot would not cause any settlement.

Having taken these precautions in predetermining the bearing power of the soil, it appeared that this material was entirely safe for foundation purposes with the load to be imposed.

After the building was completed observations taken indicated that a slight settlement was taking place. These observations were continued for several months in order to establish beyond a doubt that the building and machinery foundations were actually settling, and to determine as nearly as possible the rate of settlement.



View of Rear of Power House.

In June, 1911, a series of test holes were put down at points around the building, which showed that a soft muck bed from 5 to 15 feet in thickness lay some 50 feet below the floor level, and about 25 feet below the bottom of the foundations. The layer of clay on which the foundations were set had been stressed beyond its supporting power, and had gradually compressed the stratum of muck and peat beneath.

This most extraordinary condition could not have been found by any means of testing other than sinking deep drill holes, and, even if this had been done previous to the setting of the building, the strength of the clay seam could not have been determined by any test, except the application of a load approximating the entire weight of the structure and contents, which was, of course, impracticable. Only such a weight would have caused the bending of the clay stratum and the consequent yielding of the peat seam.

In the course of the original investigation, test piles 45 feet in length were driven adjacent to the power house, the bearing power of which, computed from the penetration under the hammer blow, was from 12 to 15 tons per pile. It is evident that if a pile foundation had been installed with piles driven to apparently ample depth based on penetration, the condition would not have been discovered in advance, nor the settlement obviated.

The underpinning of the machine foundations was begun July 15th, 1911, and carried on continuously night and day until September 10th, when the plant was put in operation.

Standard pipe or casing 12 inches in diameter was sunk with well rigs to the bed-rock beneath the peat seam around the machine foundation and pipe line immediately behind the power house.

The pipes were pumped out, cleaned, and after inserting steel reinforcing bars, were filled with concrete, forming a system of some 26 steel and concrete piles. Steel I-beams were placed on top of the piles supporting the concrete foundation, wedges being driven as tight as possible between the tops of the beams and concrete of the foundation, and the whole surrounded with concrete. No settlement has been observed since the completion of this underpinning.

The building foundations proper were not strengthened, and no settlement has taken place since the clay stratum was relieved of the weight taken by the piles.

Transmission Line.—The transmission line leading from the power station to the city of Victoria traverses the rough, heavily timbered country along the west coast of the island for a distance of about 40 miles. The first 15 miles of its course is located along the bluff shore line of the Straits of Juan de Fuca, the wires in some places overhanging the sea. No road or trail existed along this section at the time the line was built, and the materials, except poles, which were cut from the adjacent forest, were delivered with small boats along the beach. The remaining 25 miles of the line follows generally the Provincial Government highway, with more or less diversion to avoid acute angles and to shorten the distance.

The current is transmitted at 40,000 volts, 3-phase, 60 cycles.

Cedar poles (with a minimum diameter at the top of 9 inches) are used throughout, 50 feet, 55 feet and 60 feet in height, and spaced from 300 to 400 feet apart. Three steel galvanized cross-arms, each composed of two 1¾-inch by 1¾-inch angles 9 feet long with 1¼-inch angle iron branches are mounted on each pole, all bolts, lag-screws and washers being galvanized. The initial circuit is hung on one side of the pole, leaving space on the other side for the installation of a second and similar circuit at some future time. Brown glazed, two-piece suspension insulators, Locke Type No. 275, are used, one element only being installed for ordinary suspension. At dead end angle points, two elements were used to avoid trouble in adding the second element when the line voltage is raised to 60,000 volts, upon the completion of the second unit. Dead ends were made at all angles where the conductor is drawn toward the pole. Standard line insulators are used on either side of the cross-arm, and the conductor was taken across in a suspended loop.

The conductor is seven strand aluminum cable, No. 00 B. & S. gauge, and is designed to transmit the output of one generator at 40,000 volts, and two generators at 60,000 volts.

Angle Pole on Transmission Line.

A metallic circuit telephone line, No. 9 B.W.G. galvanized iron wire was installed on a short wooden cross-arm below the power wires.

The timber growth along the route of the line is exceptionally heavy, and a very extensive clearing was necessary along and on either side of the line for its protection, all trees being cut that could reach the wires in falling. For many miles a zone from 400 feet to 600 feet in width was cleared through the finest fir belt on the island, and an aggregate of approximately 20,000,000 feet, board measure, of merchantable timber was paid for and cut down in the course of the work, some of which may perhaps be put to profitable use before becoming useless by decay or being destroyed by fire.

Transportation.—One of the most formidable problems of this development was that of transportation. All machinery, cement, pipe, provisions and other supplies, as well as all kinds of labor had to be transported by sea from Victoria, 45 miles down the coast to the mouth of Jordan River. The Straits of Juan de Fuca at this point are exposed to the sweep of the open sea from the west and there was no pier and no natural or artificial protection at the point of landing. Bulky freight was loaded on scows at Victoria and towed by a small tug to Jordan River. The scows, on arrival at the Jordan River landing, were hauled up on runways laid on the flat beach until they were out of reach of the waves, and were then unloaded by derricks.

Making the journey to and from Victoria and beaching the loaded scows in stormy weather was precarious in the extreme, requiring a high degree of patience, courage and skill. Passengers, mail and light freight were landed on the beach in dories.

Although much trouble and some minor accidents occurred, not a single piece of the 6,400 tons of material and equipment handled, nor a single one of the several thousand passengers carried was lost.

From an engineering standpoint the development in its present initially completed state perhaps presents by itself no very unusual features. But when consideration is given to all the elements involved in carving out of a wild, remote and almost impenetrable and trackless wilderness a reliable and highly efficient hydro-electric system, planned for large expansion along accurately predetermined lines, this development presents very unusual interest. Very few hydro-electric developments have presented a greater array of formidable obstacles, many closely concealed, and few have been carried through to successful completion on lines as closely adhering to those originally planned, despite the meagre data on which these original plans were perforce based.

The entire work was under the direction of Mr. Wynn Meredith, of Sanderson & Porter, from the first pioneering to the final completion of the initial installation of the first 4,000-kilowatt unit.

The preliminary reconnoissance and surveys were under the immediate charge of Mr. A. B. Carey.

The final location surveys and all construction work were under the immediate charge of Mr. E. E. Carpenter, to whom we are indebted for the data forming the basis of this article.

ORE PRODUCTION IN MILLIONS.

Metal production at the Consolidated Mining and Smelting Company's smelter at Trail in September reached a value of $715,696, of which 38.2 per cent. was in gold, according to figures recently made public. This is the highest monthly production for the present year and exceeds the average for the previous two months by about $300,000. Ore treated at the smelter totalled 26,099 tons, so that the average value per ton was a trifle over $27. As the greater part of the ore smelted came from the company's Rossland mines which are regarded as low grade properties, this average is considered satisfactory. The Consolidated Company's metal production for the first three months of this fiscal year totals $1,567,867.

Ore production in the Kootenay and Boundary districts for first week in November totalled 51,014 tons, making a total for the year to date of 2,162,902 tons. Smelter receipts for the week were 44,756 tons; for the year, 1,939,934 tons.

THE HYDRO-ELECTRIC PLANT OF THE SHERBROOKE RAILWAY AND POWER COMPANY AT SHERBROOKE, P.Q.

An interesting hydro-electric plant was recently finished for the Sherbrooke Railway and Power Company, at Sherbrooke, Que. The plant was designed by Messrs. Ross and Holgate, of Montreal, and the work was done under their supervision. Mr. C. L. Cate, described the design and construction of the plant very fully in a paper read before the Canadian Society of Civil Engineers, on October 24th. The following abstracts are taken from the paper:—

The city of Sherbrooke is situated 100 miles south-east of Montreal on the main line of both the Canadian Pacific Railway—Montreal to Halifax—and the Grand Trunk Railway—Montreal to Portland. It is also the terminus of the Boston and Maine, and Quebec Central Railways. Excellent water power is provided by the Magog River, which joins the St. Francis within the city limits. The population, at present 17,000, is increasing at the rate of 5 per cent. per annum.

The Sherbrooke Street Railway Company was incorporated by Act of the Legislature of the Province of Quebec in 1895 and began operating in 1896. Power was supplied from a power house in the centre of the city on the south bank of the Magog River, about 1,200 feet from is junction with the St. Francis River. About 100 feet above this power house was a timber dam, built in 1860, and the company had rights to half the flow of the river, the other half being used by several factories on the north bank. The head was 19 feet and the power house capacity 350 K.W.

In the spring of 1910 the Street Railway Company was succeeded by the Sherbrooke Railway and Power Company. Following the inauguration of the old company the population had increased 70 per cent., and the railway had become inadequate, but its expansion was impossible because the old plant was barely able to carry the original car equipment and more power could not be obtained at that site.

The Railway and Power Company proceeded at once to secure the entire power at the old dam, and purchased rights higher up the river so that the water could be raised an additional ten feet. A power 600 feet farther down the river, having a head of 18 feet, was also secured, together with the drop between these two powers. The total head available was about 57 feet, and this has all be utilized in the new plant.

The drainage basin of the Magog River has an area of 815 square miles, of which 283 square miles are in Canada and 532 square miles in the United States. The soil is of comparatively slight depth and the small streams are nearly all rapid. This would tend to make the flow of the stream very irregular and not so valuable for power purposes were it not for the two large storage areas contained in the basin. The greater of these storage areas, Lake Memphremagog, is 30 miles long and has an area of 45 square miles. The difference between extreme high and low water in this lake is five feet, but only a little more than a foot is under actual control at present. In designing a plant, allowance was made for an improvement in this respect, which is likely to be realized shortly. The second storage area is provided in Lake Magog, lying some 8 miles down stream from the outlet of Lake Memphremagog, with an area of 4.8 square miles and a controllable variation of 4 feet.

This lower storage is under the control of the city of Sherbrooke, and the Memphremagog storage is regulated by the Magog Manufacturing Company at Magog. This in no way lessens their value to the Sherbrooke Railway and Power Company's present plant as it is to the general advantage that the flow be kept as constant as possible. Moreover, there is an agreement of long standing by which at least 500 cubic feet per second must be passed when available.

In estimating the rainfall and run-off it was desirable to find a stream having its basin as near as possible to that of the Magog River and on which measurements of flow, rainfall and run-off have been made over a considerable period. That portion of the Connecticut River lying north of Oxford, New Hampshire, was found to serve the purpose very well. The centre of its basin is only about 50 miles south of that of the Magog; the soil is of very much the same nature, and although the country slopes a little less abruptly, this can be allowed for. A Government station has been established at Orford for eight years and measurements of flow, etc., have been taken during that time.

The following table gives the rainfall and run-off for the Connecticut River and the estimated run-off for the Magog, allowing for the fact that the Magog Basin is farther north and the streams somewhat more rapid. Allowance was also made for the fact that in a north-flowing stream the period of heavy flow in the spring is somewhat shorter and more excessive than in a south-flowing stream, because in the latter case the floods from the head waters do not come down until the southern portion has returned to a more or less normal condition. The calculated flow of the Magog in cubic feet per second for each month is also given. In making these calculations a total run-off of 21.5 inches was used instead of 21.66 as given for the Connecticut.

	CONNECTICUT RIVER			MAGOG RIVER	
MONTH	INCHES RAIN	INCHES RUN-OFF	RUN-OFF IN % TOTAL RUN-OFF	RUN-OFF IN % TOTAL RUN-OFF	FLOW IN CU. FT. PER SEC.
Jan.....	2.28	0.76	3.5	3.5	413
Feb.....	1.60	0.54	2.5	2.5	295
Mar.....	3.44	3.91	18.04	14.	1,662
Apr.....	2.77	4.70	21.7	26.	3,060
May....	2.99	3.10	14.3	17.	2,000
June..	3.78	1.69	7.8	8.	944
July	4.34	1.09	5.04	4.5	531
Aug	3.88	1.09	5.04	4.5	531
Sep.....	3.73	1.03	4.75	4.	472
Oct.....	2.77	1.24	5.74	5.	590
Nov.....	2.17	1.23	5.68	6.	708
Dec.....	2.80	1.28	5.9	5.	590

The flow of the river for a dry year is 580 cubic feet per second, and the flow estimated by the power users on its banks was 550 cubic feet per second, a difference of only about 5 per cent.

With the full 5 foot storage in Lake Memphremagog the flow would be nearly 800 cubic feet per second.

The purposes of the new development are, first, to replace the old plant mentioned above, and secondly, to supply about 2,500 H.P. of electrical energy to power consumers within a radius of 20 miles of Sherbrooke. The greater part of this power will be sold to concerns at least 8 miles from the city and will be transmitted at 20,000 volts. This energy is for the most part already contracted for, and the pole line has been erected as far as the Eustis Copper Mines.

The development consists essentially of:—

(1) A concrete dam with a northern bulkhead section 225 feet long and about 20 feet high, a central overflow section 70 feet long and 44 feet high, a stop-log section 14 feet long,—used during construction to pass water for the old Sreet Railway power house, and which can be used in future as an adjunct to the overflow section, should this become necessary during spring freshets,—and a southern bulkhead section 42 feet long and 12 feet high. The dam contains about 3,400 yards of concrete.

(2) A steel penstock 660 feet long and 9 feet 6 inches in diameter with a standpipe 16 feet in diameter and 56 feet high.

(3) A brick and concrete power house 90 feet x 38 feet with hydraulic and electrical equipment for developing 3,000 H.P.

All concrete used on the work was mixed in the proportion of 1-3-5 except in beams and slabs where 1-2¼-4 was used. Suitable gravel was substituted for sand and broken stone.

Dam.—A 2-inch steel cableway was strung over the site of the dam and used both for excavating and for placing the concrete, bottom-dumping buckets of 1 cubic yard capacity being employed. A boiler and hoist shed was erected on the south bank. The location of the cable-way is shown by a dotted line on Plate III. and it will be seen that it lies just inside the upstream face, and nearly parallel to it, across the northern bulkhead section. At the overflow section it is about 20 feet back of the fact. This arrangement permitted the placing of 85 per cent. of the concrete without building runways.

The concrete mixer, a Ransome No. 28, was located just under the northern tower of the cableway with the gravel bin behind and above it and the cement shed above to the east. Steam for the mixer was obtained from the boilers of a factory on the north shore.

The new dam has been built 50 feet downstream from the crest of the old timber dam and is 10 feet higher. Plate III shows its location relative to the old dam, headrace, etc.

The factories on the north shore had power rights which have not yet expired. They were equipped with electric motors and supplied with power from the city power house and the head gates on that side of the river closed, but it was desired to keep the Street Railway power house in full operation until the power from the new development was available, in order to avoid installing motor generator sets and purchasing power for them.

The course adopted was as follows. The northern bulkhead section was first constructed, the old head gates serving as a coffer-dam. The excavation in this section was not very heavy and, aside from blasting a 3 x 4 cut-off trench, consisted for the most part of earth. A great many pot-holes were found in the rock, which must have been worn in some quite remote period as the river has not been running in that portion of its channel since the country was settled.

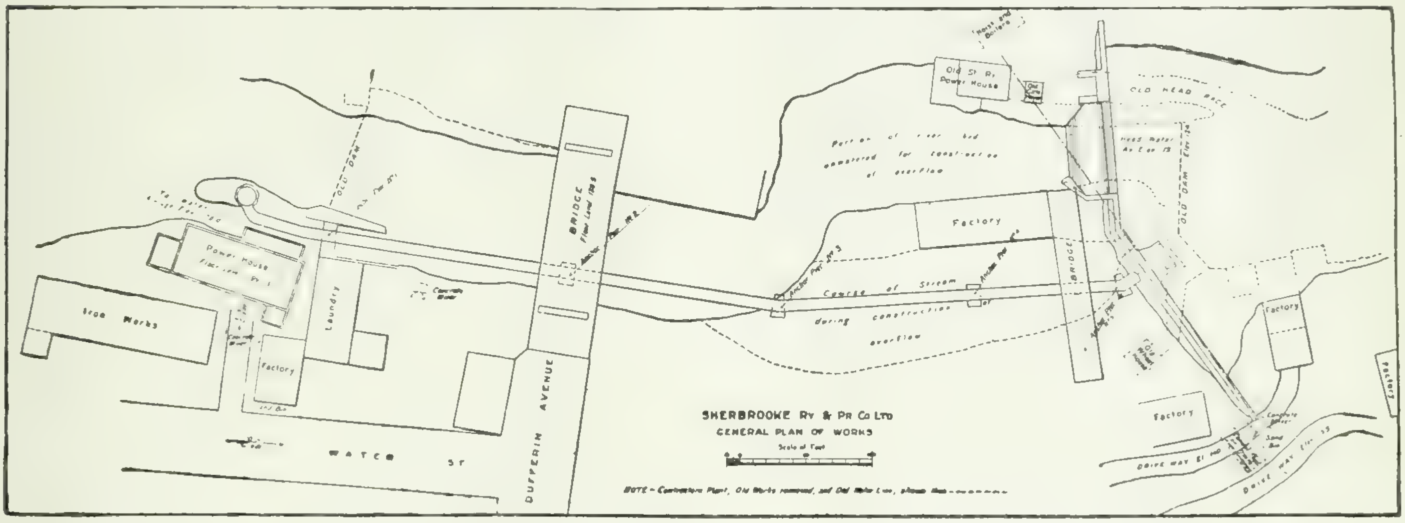
The work was commenced at the north shore and run southward, expansion joints being made every 35 feet. An opening 14 feet wide was left in this section to provide a passage for the flow of the river while the overflow section was being built. The bottom of this opening was about 2 feet below the crest of the old dam. The penstock thimble, which is located at about the middle of the section, was concreted in, and the first sections of the penstock riveted on and blocked up. The racks, which are of steel 3 inches x 5/16-inch spaced 1⅝-inch apart, were also erected, and stop-logs inserted to about 4 feet higher than the bottom of the opening referred to above, it being considered unsafe to leave the penstock entirely open on account of the thrust which would be caused by the swift flow around the 16° angle 10 feet from the dam.

The old north shore head gates were then blown out, permitting about half the flow of the river to go through the 14-foot opening. During the low water, which occurs on Sundays, due to the fact that the factories higher up the river are shut down, the height of the old dam was raised 4 feet by means of flash boards faced with gravel, thus forcing the entire flow through the 14-foot opening and the penstock.

Unfortunately, the old dam leaked badly, and although a diver was procured and everything possible was done to caulk it, it was necessary to construct a coffer-dam immediately below. A coffer-dam was also built about 10 feet below the tail of the new dam.

A flume 3 feet wide and 4 feet deep was built between these two coffer-dams. The nature of the river bottom (huge boulders and gravel) made it impossible to get these tight: Three turbine pumps, an 8-inch on the upstream coffer-dam, and a 6-inch and a 4-inch on the lower coffer-dam, were installed. The excavation for the overflow section was then begun.

Perhaps the most interesting point in the construction of the dam was the manner in which the first 20 feet of concrete was put into this section. The water situation stood thus:—the leakage of the old dam which was being used as upstream coffer-dam amounted to about 2,000 cubic feet per minute. This was caught by a coffer-dam, as above mentioned, and carried across the site of the dam in a flume. Nearly all the leakage of the coffer-dam was held by a natural wall of gravel and shale, and pumped into the flume by an 8-inch turbine pump.



A 4-inch pump, which was moved up from the lower coffer-dam after the river-bed was unwatered, was installed in a sump hole made with sandbags and blue clay just below this natural wall to take the leakage, which amounted to about one-half the capacity of the pump. Below this again, a diaphragm hand pump was placed to take the leakage of the sump hole wall.

The river-bed below the downstream coffer-dam had been pumped out, but the leakage from that side still amounted to about ¾ the capacity of a 6-inch pump. The form for the downstream face was built up to elevation 105, and the suction of the 6-inch pump placed between it and the downstream coffer-dam.

The concrete work was then commenced. A temporary form was built, as shown, just below the sump hole. When the concrete reached the suction of the diaphragm pump, the pump was removed and the leakage of the sump hole wall was forced back through the temporary form by the rising concrete.

When the concrete behind the temporary forms was about 2 feet above the suction of No. 1 pump, No. 3 pump was taken out, the sandbags and clay of the sump hole wall were removed and the temporary form pulled out. This had to be done quickly, as the volume to be filled was so small that the water rose very rapidly.

The concrete was then carried up to about 14 inches below the flume. This permitted the 6-inch pump (No. 2) to be taken out. The flume was cut off at the downstream coffer-dam and the old power house put in operation.

No form for the upstream face had been built up to this time, and although this involved the placing of some 40 yards of concrete in front of the intended face of the dam, it seemed to be the only practicable solution of the problem.

A form of temporary sluice through the dam was then built, the leakage water directed through it and the old flume pulled out. The forms for the upstream face and the remainder of the downstream face were then erected and the overflow section completed. The 70-ft. overflow section is built without an expansion joint, and in order to prevent cracks five 60-lb. steel rails were embedded near the crest. The strength of the concrete mixture was also increased to 1-2½-4¼ in the upper portion.

Four days after the completion of the crest the temporary sluice was closed by a reinforced concrete slab, and filled up through the opening provided. That portion of the Street Railway headrace wall between the dam and the Street Railway head gates was then lowered to the normal head-water level of the Street Railway plant, and the 14-foot opening in the northern bulkhead section was closed by means of stop-logs, checks for these having been provided. Additional stop-logs were also placed in the new head gates to prevent too much water passing through the penstock when the water came up.

In filling the 14-ft. opening it was found impossible to caulk the stop-logs tight enough to put in the concrete, and the following device was used. The back of the stop-logs was 4 inches in front of the face of the dam. A form made of inch boards was built and a 4-inch iron pipe inserted draining into a box 2 feet square at the downstream face. The concrete was put in and the pipe blocked by means of a wooden plug 3 feet long and a cap. The purpose of the plug was to prevent the pipe from freezing and bursting. The box was afterwards taken out and the void filled with concrete.

Two weeks after the completion of the overflow section, stop-logs were placed in the Railway headrace stop-log section and the water was forced over the overflow. The forms, however, were left on until spring. In putting in the stop-logs a space was left underneath them sufficient to pass the water necessary for the Street Railway, the idea in passing the water underneath being that the flow was in that way kept practically constant in spite of fluctuation of level in the river.

The water would probably have been passed over the Street Railway headrace wall for a much longer period had it not been for the large amount of spray caused by the water falling over the high bank. The weather had become bitterly cold early in December, and this spray froze to the walls of the factory building on the rock in the middle of the channel, to a thickness of nearly five feet, threatening to pull the building down. When the flow was passed over the overflow, this spray was eliminated to a large extent, and the ice was removed by means of steam jets and blasting.

Excavation for the dam was commenced on July 7th, 1910, the first concrete was placed August 14th, and the work completed December 10th.

The Penstock.—The penstock is 663 feet long. It is of steel 5-16 inch thick and in 9 feet 6 inches in diameter. The plates are 8 feet long and were riveted up into sections of two at the shops. The penstock is supported by concrete piers spaced approximately 16 feet centre to centre. No expansion joints were used, anchor piers 10 feet x 16 feet on top being placed about 175 feet apart to take care of the expansion and contraction. Three 4 x 5 x ½ inch angles bolted around the lower half of the penstock at each anchor pier to provide for the thrust.

View showing ice formation on walls of factory, (while flow of river was being passed over the old head-race wall).

The piers were built up to one foot lower than the bottom of the finished penstock. Steel rods aggregating 5 square inch cross-section were left sticking in the concrete to secure a good bond. Timbers were placed on the piers and the penstock sections brought to their proper positions, blocked to exact grade, and riveted. 5 inch wrought iron pipe supports were then substituted for the blocking, and the penstock contractor left the job. The concrete contractor built the forms for the upper portion of the piers, constructed a runway on top of the penstock and finished the concrete work.

This method was not adopted in the case of the anchor piers, which were built after the penstock and the ordinary piers were in place, it being specified that the anchor piers were to be of monolithic concrete. In the case of the power house anchor pier, which contains 115 yards of concrete and is 23 feet high, this could not easily be done. Steel rods aggregating 15 square inch cross-section were used in this pier to secure the best possible bond.

The first 8 piers west of the power house are about 15 feet high and average 25 yards each. The power house anchor pier contains, as above stated, 115 yards of concrete. At the time the forms for these piers were completed, the overflow section of the dam was being excavated, and no concrete was being placed at the dam.

The Ransome mixer was brought down to the power house and set up in place of the "Brantford." Steam was supplied from the boiler which had been used to operate the unwatering pumps.

A runway was built across the power house foundations which were at that time nearly complete except for a portion of the floor. The concrete was conveyed from the mixer to the piers in the high wheeled 10 cubic foot buggies which were used for this purpose throughout the work. All piers east of Anchor No. 2 were filled in this way.

Soon after the placing of this concrete the Ransome was required at the dam. The power house walls were also well under way by the time the penstock was in place, and it was therefore impossible to adopt this plan in filling the upper portion of these eastern piers.

A 12-foot Smith mixer was obtained and set up on the river bank between the Dufferin Ave. bridge and the power house and the concrete conveyed on the runway on top of the penstock referred to above. No. 2 anchor pier was also filled from this mixer. It was not practicable to use buggies for this work, as it was considered unsafe to put so much weight on the empty penstock. Barrows had, therefore, to be used.

The concrete for the western penstock piers was mixed by the Ransome at the dam.

The lower portion of several of the piers had to be placed in 5 or 6 feet of water. In such cases a wooden chute 2 feet square, and long enough to reach from the runway to rock bottom, was used. The chute was placed on the bottom and filled a little over half full. It was then raised by means of ropes until the concrete dropped a few feet below the half-way mark and the process repeated. No concrete was allowed to drop through free water.

Anchor piers No. 4 and No. 5 and the most westerly supporting piers could not be finished with the rest, on account of the fact that a portion of the river-flow was being passed through the penstock thimble, until after the concrete in the overflow section had set. These piers were completed on December 20th and this was the last concrete placed out of doors.

In all cases where concrete was placed in cold weather, the rock bottom and forms were steamed for several hours before the concrete was put in. The gravel, water and the mixer itself were also heated. Concrete was placed in this way at a temperature of—10° F. All riveting on the penstock was done by compressed air, pressure being obtained from a small electrically-driven compressor which was set up on the north bank near the power house.

The Power House.—The power house is located on the north bank just below the dam of the lower power purchased by the Company and referred to above. Here, as in the case of the dam, it was necessary to provide power for the factories, etc., and tear out the old flumes before the excavation could be proceeded with.

The earth excavation at the power house amounted to 866 yards and the rock to 1,600 yards. This latter was largely in the tailrace. The total length of the excavation in the tailrace is 130 feet. It was carried down 8 feet below river level. A coffer-dam was erected across the east end and the site unwatered by means of a 6-inch turbine and a 3-inch reciprocating pump. The excavated rock was lifted out by means of a derrick. It was placed in side-dumping hand cars and wheeled to the river bank 250 feet down stream where it was dumped.

The power house consists of a main building or power house proper 90 feet by 38 feet, a transformer house and high tension tower 16 feet by 23 feet, a valve room 50 feet by 10 feet, and an oil house and lavatory 10 feet by 16 feet. The power house floor is 21.25 feet above the tail water.

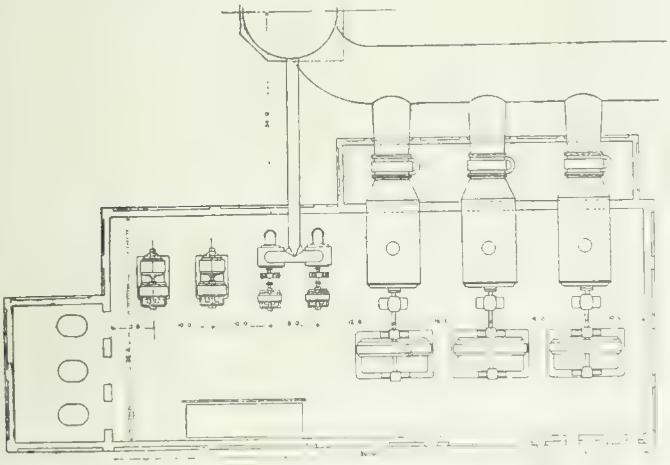
The distributor runs along the south face of the building to the end of the valve room where it is connected to the standpipe.

The valve room is between the distributor and the main building and the transformer house is at the extreme east. The oil house is at the south-west corner.

In the north half of the power house proper the floor is supported on a solid mass of concrete down to the rock. The generators are set on this part of the floor. The south half is suppored by 6 arches with columns running down to the rock. The turbines for the three main units are placed over three of these arches, and the two exciters over the fourth. These four arches have openings through which the draf tubes are let into the tailrace. The motor generator sets are placed over the two other arches.

The valve room floor is a reinforced concrete slab 12 inches thick, supported by four reinforced beams 4 feet by 2 feet, one end of which rests on the columns supporting the distributer and the other on the columns of the main building, with cross beams 3 feet by 18 inches between them.

It was necessary to make this floor very strong, as the 66-inch gate valves for the main units which stand on it weigh 15 tons each.



Plan showing layout of machinery in power house.

The transformer house is supported on 17-inch concrete walls. The floor is a reinforced concrete slab with 3 reinforced beams running along the 16-foot dimension. This floor slopes to the east 1 inch to the foot and a drain pipe is passed through the wall at the south-east corner. This provides for the disposal of any oil that might slop over from the transformers.

The stand pipe foundation is octagonal in section, 18 feet in diameter, and about 25 feet high. It is of solid concrete and contains nearly 200 c. yards. The stand pipe, or surge tank, is of steel, ⅝ inch thick at the bottom and 5-16 inch at the top. It is 16 feet in diameter and 56 feet high.

The roofs of the main building and valve house are built of 2-inch by 3-inch spruce strips covered with 28 gauge galvanized iron. The roof of the main building is supported by three steel trusses with columns running down to the foundations. These columns also carry the crane runs and strengthen the brickwork.

The excavation at the power house was begun on July 1st and the form work was commenced on July 31st. The forms here, as at the dam, were of 2-inch spruce and hemlock planed 3 sides and accurately sized to uniform thickness, band iron was used to hold them together. Clamps were also extensively used. The first concrete was placed on August 5th. The mixer used on this part of the work was a "Brantford Ideal," a machine of the continuous type, and the maximum output under the most favorable conditions was 40 yards per day. This mixer was set up to the north of the site on the west side of the entrance lane.

A glance at the contour lines on the plan of the site will show that the entrance lane slopes down with a 15 per cent. grade to the power house door. One floor of the old factory building is at ground level on the street side, and about 10 feet above the ground at the mixer. The cement was accordingly stored on this floor and emptied into the hopper of the mixer from a platform erected outside one of the windows.

The pocket between the street, which has a 10 per cent. slope, and the factory building was used as a gravel bin. About 30 yards could be stored here. The gravel was wheeled down the hill in 2 cubic foot barrows, that being the capacity of the bucket of the mixer. The concrete was conveyed to the forms by means of runways and 10 cubic foot buggies.

Power House Equipment.—The power house equipment consists of three 1,325 H.P. twin horizontal Crocker turbines with 30-inch runners, direct connected to 750 K.W. (940 K.V.A. at 80% P.F.), 2,300 v., 360 R.P.M., 60 cycle generators, with exciters, motor generator sets, etc., as below described. The supply of water to the wheels is controlled by balanced wicket gates connected by short links, to a rotating ring which is in turn connected to the gate operating shaft by two connecting rods. The whole setting is contained in a steel plate case with a cast-iron end towards the generators and a taper section in the other end connected with the 66-inch motor operated gate valve on the branch from the main penstock. Immediately outside the wheel case, the main shaft is supported by a ring oiling bearing arranged to take up any end thrust from the wheels. Each unit is equipped with a Lombard vertical type Q. 10 governor. Oil pressure is provided by three triplex pumps, one of which is belted to each turbine shaft. The three pumps feed through a common main, and as any two pumps are sufficient to carry the plant, a shut-down due to lack of oil pressure is practically impossible.

Each unit has a 66-inch gate valve with motor drive, one 15 H.P. 125 v. D-C series motor being arranged by means of a line shaft and disengaging gears to operate the three valves. The exciters are 50 K.W. 125 volt interpole machines direct connected to 100 H.P. Jenckes (Crocker) turbines with Woodard governors and hand operated gate valves. Each exciter unit is of sufficient capacity to excite the three main units.

Direct current for the Railway is provided by two motor generator sets consisting of 375 H.P., 2,300 v., squirrel cage rotor, induction motors with a synchronous speed of 720 R.P.M., and 250 K.W., 575 v. interpole generators.

Three 625 K.V.A. oil filled, water cooled, single phase transformers, with both primary and secondary connected delta, are used to step the voltage up from 2,200 v. to 22,000 v. for transmission outside the city. These are located in the transformer house, and are protected by horn and electrolytic lightning arresters and choke coils. All electrical machinery has overload guarantees of 25 per cent. for two hours.

The switchboard consists of:—three generator panels, one transformer panel, one A. C. feeder panel, one motor generator panel—A. C. side, one motor generator panel—D. C. side, one exciter panel, and one D. C. feeder panel. All cables leading from the machinery to the switch-board are laid in ducts embedded in the concrete floor. The generator panels are provided with main oil switches with overload time limit relays, voltmeters, ammeters, etc. The field rheostats are of the iron gird type, and are located in the cable pit behind the switch-board and operated by sprocket chains.

On the motor generator panel, A. C. side, are mounted the operating levers for the starting compensators which are set behind the board. The equalizer switch is mounted on a pedestal between the two motor generator sets. The equalizer connections are on the minus side.

On the exciter panel, besides the regular eguipment, are placed the switch for the gate valve motor, and the lighting switch. This latter is a D.P. D.T. switch permitting the lights to be connected to either the exciter busbars or a 125 v. lightning transformer located in the pit.

The power house is provided with a 10-ton, hand-operated, disturbances by multiple air gap arresters.

The power house is provided with a 10-ton, hand-operated, steel rope, drum hoist type crane of Whiting manufacture. The height of the crane rails above the finished floor is 15 feet 8 inches, and the height to the bottom of roof trusses is 22 feet. The distance from centre to centre of rails in 36½ feet. This crane was used to install the 15-ton gate valves and has given perfect satisfaction.

The contractors for the work were:—The Bishop Construction Company of Montreal for the dam, penstock piers, and power house building; the Jenckes Machine Company of Sherbrooke for the penstock, stand-pipe and hydraulic machinery; and the Canadian General Electric Company for the complete electrical equipment.

Transmission Line.—The 22,000 volts 3-phase transmission line is being built by the Railway and Power Company under the supervision of their own engineer. The line at present under construction runs from the power house in Sherbrooke to the Eustis Mining Company's and the Nichols Chemical Company's works at Capelton.

The poles are of cedar selected under the standard specification of the American Telegraph and Telephone Company both for city and cross country work. The standard length is 35 feet with 40, 45 and 50-foot poles in special locations. They are spaced not less than 50, and not more than 55 to the mile and they extend at least 5 feet into the ground.

The cross arms are 4 inches by 5 inches by 8 feet long with galvanized braces 29 inches by ¼-inch and 1¼-inches. Pins are of oak. The wire used is No. 4-B. and S. solid bare copper with conductivity 97 per cent. of Mathesen's standard.

25,000 volts Locke porcelain insulators will be used entirely for this work.

Costs.—The costs given are for the construction of the dam, penstock and power house, with complete equipment. They do not cover the cost of the site and power rights, as these are of purely local interest.

About one thousand dollars expended on a bridge to one of the factories near the dam and an approximately equal amount allowed the contractor on account of certain hold-ups due to legal proceedings are also omitted.

Dam:—

Excavation:		
Earth, 691 cubic yards at $1	$691.00	
Loose Rock, 100 cubic yards at $1.50	150.00	
Solid Rock, 799 cubic yards at $2...	1,598.00	
Solid Rock below Elevation 102	3,455.00	
		$5,894.00
Concrete, 3,430 cubic yards at $7.75		26,582.50
Stonework		500.00
Stop-logs and fittings		900.00
Total cost of Dam		$33,876.50

Penstock and Standpipe.

Excavation:		
Loose Rock, 362 cubic yards at $1.50	$543.00	
Solid Rock, 388 cubic yards at $4..	1,552.00	
		$2,095.00
Concrete, 744.6 cubic yards at $9......	$6,701.40	
Concrete, 200 cubic yards at $8.50......	1,700.00	
		8,401.40
Reinforcing steel, 1,000 lbs. at 4 cents		40.00
Permanent protecting cribs, etc.		625.00
Straight Penstock, 608 feet at $20		12,160.00
Stand pipe, elbows, thimble, etc., 125,000 lbs. at 6 cents		7,500.00
Total cost of penstock and standpipe		$30,821.40

Power House:—

Excavation (including tail-race):		
Earth, 924 cubic yards at $1.......	$924.00	
Solid Rock, 1,690 cubic yds. at $1.75.	2,957.50	
		$3,881.50
Concrete, 851 cubic yards at $8.50		7,433.50
Concrete in Beams and Slabs, 107 cubic yards at $12		1,284.00
Reinforcing Steel, 17,200 lbs. at 4 cents		688.00
Brickwork, 9,065 cubic feet at 50 cents		4,532.50
Earthenware Coping, 216 lineal feet at 40 cents..		86.40
Door		80.50
Windows, 748 square feet at $1.50		1,122.00
Roof lumber (laid), 16.5 M. feet B.M. at $45......		742.50
Roof Covering of 28-gauge galvanized iron, 55.5 squares at $12		666.00
Tar and gravel roof		32.10
Structural Steel		2,123.00
Crane		1,030.00
Painting		166.00
Total Cost of Power House		$23,868.00

Unwatering and removal of old works for the erection of Dam, Power House and Penstock	$8,600.00
Hydraulic equipment, complete	30,640.00
Electrical equipment, complete	38,000.00
Extras	1,200.00
Total cost of construction complete	$167,005.90

◆

CANADA'S IRON TRADE AND COMPETITION.

The reports presented at the annual meeting of the Canada Iron Corporation, Limited, covered the fiscal year ending May 31st last. During the period, as the president, Mr. T. J. Drummond pointed out the adverse conditions prevailing in the United States were severely felt in Canada. Since that date there has been a great revival in the iron trade, but the effect upon the corporation will not appear until next year's reports.

The mines at Torbrooke, N.S., have been re-opened, and shipments of ore from Port Wade will soon be resumed. Then the second new furnace at Midland, Ont., has been blown in, and both furnaces for the first time are now in full blast.

The financial statement shows profits for the year ending May 31st of $375,140. After the payment of interest on bonds and special loan, $265,426, applied in reduction of bond discount and expense, $6,800; merger expense, $9,505; and provision for sinking fund on original bond issue, $46,841, there was added to profit and loss account $46,566. With the $359,807 at credit from the previous year, the total is $406,955.

BRANTFORD CONCRETE PAVEMENTS.

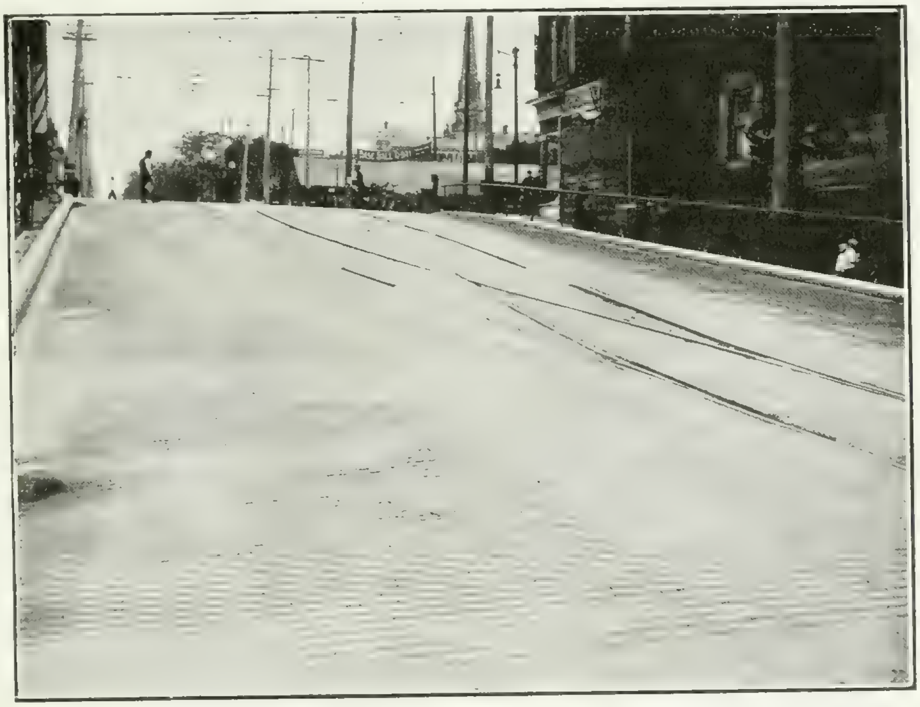
By T. Harry Jones, M.Can.Soc.C.E., City Engineer.

Concrete Walks.—Brantford, I believe, was the first city in Canada to undertake as a municipal work, by day labor, the construction of its concrete sidewalks. Since the first walk was laid, in 1890, by the present overseer of streets, Mr. Hugh Howie, there have been constructed some seventy miles of walks, none of which have required renewal, and only four miles of which were let by contract.

Concrete Crossings.—In connection with the walks, a great many concrete street crossings were put down, and some of these laid twenty years ago are still in good condition. The top surface, which was 1½ inches thick, was composed of 1 part of cement to 1½ of sand.

Private Concrete Driveways.—Some private driveways were also constructed, one put down in 1900 and subjected to the heavy traffic in connection with a wholesale warehouse, being in as good condition as when laid. This was 12 feet in width, 6 inches in thickness, the top coat of 1½ inches being mixed 1 to 1 and being corrugated every 6 inches.

Concrete Bridge Floors. — In 1908 the roadway of the concrete bridge, 85 feet long and 16 feet wide across the canal on Alfred Street, was laid with concrete. It was 6 inches in thickness, the top coat of 1½ inches being composed of 1 part of cement to 1½ of sand, with surface corrugations every 6 inches. This is in good condition and is wearing well. The floor of a steel bridge laid this year by the Hamilton Bridge Works Co., leading to the waterworks, was constructed by the city in concrete. It is 75 feet in length and 16 feet wide and is a one-course pavement, formed of a 1 to 5 mix with bank gravel, the thickness at the centre being 6½ inches, and 4½ inches at the sides. An expansion joint is left in the centre filled with a ¼ inch steel plate, with anchor bolts every three feet.



Concrete Pavements on Market Street, Brantford, Ont.

(Showing surface corrugations on an eight per cent. grade)

As regards permanent pavements, on our public streets, however, previous to 1908, the words of an old proverb were applicable, which spoke of a certain roadway, with a steep down-grade to an undesirable locality, as being paved with "good intentions."

Concrete Foundations, Curbs and Gutters.—In 1908 contracts were let on certain streets for bitulithic and westrumite pavements, including the concrete foundation, but since that year the top surface only of this class of pavement has been let by contract, the city doing the grading, concrete foundation and curb and gutter, resulting in the saving of about 25 cents per square yard on the 50,000 yards laid.

The thickness of the foundation is 5 inches on residential streets and 6 inches on business streets, the mix being 1 to 7 of pit gravel obtained in the city, it being very suitable for concrete work.

Instead of using broken stone spread over the surface of the concrete, as had been the custom of the paving companies, rammers with steel projections were used which gave the uneven surface necessary to bind the concrete with the top surface.

The cost has averaged about 12 cents per square yard for the grading, and 38 cents for the concrete foundations and 45 cents per lineal foot for the curb and gutter. The average depth of the curb face has been 6 inches, and the width of the gutter 15 inches.

Concrete Street Pavements.—Speaking generally, the sub-soil of the city is sand and gravel, and very suitable for this class of pavement.

After the sub-grade is shaped it is rolled with a 15-ton steam road-roller. On this the concrete is placed and thoroughly tamped, great care being taken to protect it from debris or from being walked upon by passers-by or the workmen on the pavement. The crown is shaped by a wooden template cut to the curve of the street, which on narrow pavements is worked from curb to curb, and on wider ones from the curb to a scantling 6 inches wide on top, 5 on bottom and 6 inches deep, placed in the centre of the street parallel with the curb.

This strip is afterwards removed, the sides broken in and filled with concrete, and the whole surface finished with a wooden float worked from a plank bridge extending from curb to curb. A drier of dry cement and sand mixed 1 to 2 is spread over the surface in finishing.

All the cement used was subjected in the city engineer's department to the standard tests prescribed by the Canadian Society of Civil Engineers, a Fairbanks testing machine being used for the purpose.

The crown of these pavements is now determined by the following formula by Ernest McCullough, published in *The Canadian Engineer* May 26th, 1909:

$$C = \frac{W\ (100-4p)}{6000}$$

C = crown in feet

W = distance between curbs in feet.

p = per cent. of longitudinal grade.

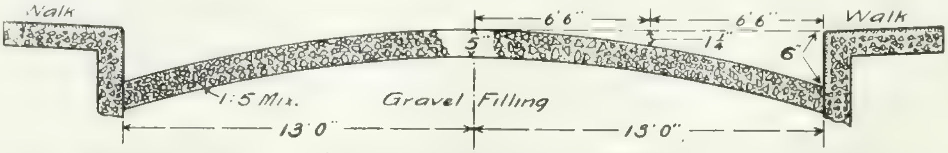
This works out a crown of 5 inches with a 26-foot pavement on a 1 per cent. grade.

The flat crown results in a more even distribution of the traffic over the surface of the street.

Lorne Crescent Pavement.—This is a one-course pavement laid in 1910, its length being 394 feet and its width 24 feet.

The depth of the concrete is 6 inches, being mixed in the proportion of 1 part of cement to 6 of pit gravel, the crown being 5 inches.

Transverse expansion joints, at right angles to the curbs were left about every 30 feet, some of the joints being filled with pitch, others with wood strips, and a few with neat cement. No contraction joints were left. No transverse cracks have appeared in the pavement, but most of the blocks have developed longitudinal cracks at the centre. The pavement, however, was laid late in the year and was caught by the frost. The cost was 80 cents per square yard, which includes in every case 5 per cent. for engineering.



Plan Showing Section of Concrete Pavement on Chestnut Avenue, Brantford.

Chestnut Avenue Pavement.—The length of this pavement is 535 feet and its width 26 feet. It is a one-course pavement and was laid in 1911. The grade of the street runs from less than 1 per cent. at the upper end to 5 per cent. at the lower end. The crown varies according to the grade, being about 5 inches at the upper end.

The depth of the pavement is 5 inches, the concrete being composed of 1 part of cement to 5 parts of crushed gravel and sand. Transverse joints, at right angles to, and extending from curb to curb were left every 33 feet. The joints were made by pine strips ¼ of an inch wide at the top and 1 inch at the bottom, extending the full depth of the concrete. A contraction joint was left in the centre of the pavement parallel with the curb for a distance of 110 feet of the upper part of the street. This was also filled with wooden strips similar to those used in the expansion joints. Although subjected to the heavy teaming from the gravel pit at the foot of this street, and also to the test of the last severe winter, no cracks have developed, even in the part of the pavement where no contraction joint was left.

Laying Concrete Pavements at Brantford.

It is our intention in future work to try a protecting plate at the contraction joints, as used in the Wayne County roads to prevent the wearing at this point. The cost of the pavement was 85 cents per square yard.

Market Street Pavement.—This pavement, laid this year, extends from Colborne Street to the new reinforced concrete Victoria bridge, its length being about 200 feet and its width from curb to curb 40 feet, the grade running from 8 per cent. at Colborne Street to 5 per cent. at the bridge. A single track of the street railway curves into double tracks at Colborne Street, the part between the tracks being paved with bricks.

This is a two-course pavement 6 inches in depth, the bottom course of 4½ inches being formed of 1 part of cement to 4 of gravel and broken stone. The top course of 1½ inches is composed of 1 part of cement to 1½ of clean sharp sand, and was put on immediately after the first course had been put in place.

Corrugations ½ inch in depth were left every 4 inches at right angles to the street and afford a sure foothold for horses.

This pavement, being at the intersection of the two main business streets of the city, is subjected to the heaviest traffic. No expansion of contraction joints were left. A slight transverse crack has appeared on the lower part of the pavement above the bridge.

General Remarks.—The sand, gravel and broken stone used in our concrete work is from our own pits, drawn in Brantford dump wagons. The road bed is rolled with a Brantford Waterous road roller, and the concrete mixed in a Brantford Goold, Shapley and Muir mixer. The cement is made by the Ontario Portland Cement Company of this city at their works at Blue Lake in this county, and Brantford labor alone in employed in the construction of these pavements.

It may be stated generally that the citizens are well pleased with the concrete pavements which have been laid.

Concrete Pavement on Lorne Crescent, Brantford, Showing Expansion Joints.

The cost is only about half that of the other kinds of permanent pavements, the cost of maintenance is less, they are low-crowned, less slippery and easily cleaned.

The white surface on residential streets, I consider attractive. If preferred, the surface can be colored.

It may be of interest to state that in addition to the cost of street intersections and exemptions on corner lots of half the total frontage (not exceeding 50 feet) that the city bears 40 per cent. of the cost of all pavements, and that the number of payments is extended over 10 or 15 years, according to the estimated life of the work.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.

ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, DECEMBER 5, 1912. No. 23

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Road Maintenance 831
Tearing Up Street Paving 831
Technical Schools 832

Leading Articles:

The Vancouver Island Power Company, Limited, Jordan River Development.—Part II. 819
Hydro-Electric Plant of the Sherbrooke Railway and Power Company at Sherbrooke, P.Q 823
Brantford Concrete Pavements 829
An Aerial Trolley Car 834
The Construction of a West African Railway 835
Telephone Train Despatching 840
Application of Concrete to Underground Work 842
The Hetch Hetchy Water Supply of San Francisco 844
A Gravel Washing Plant 845

Coast to Coast 846
Personal 847
Coming Meetings 848
Engineering Societies 848
Market Conditions 24-26
Construction News 65
Railway Orders

ROAD MAINTENANCE.

The maintenance and repair of roads after they are constructed is most important. There is little use in constructing new highways if they are not to be kept in the best of repair. The methods and experience of the New York State Commission of Highways is of interest in this connection, for they have at the present time upwards of 3,151 miles of State and county highways to be maintained. Many of these highways were constructed in the early years of road-building in the State, and of a material and character of construction that at that time was supposed to be the best. Just when it was thought that the problem of good roads had been solved, along came the automobile and its destructive accompaniment, as far as the highway surface is concerned.

The Commission state that after the use of various experimental materials they find that the more recently constructed macadam highways, with a bituminous binder, and those which have been resurfaced with similar top dressings, can be maintained under the patrol system at a minimum expense.

The cost of maintenance throughout the State appears to us abnormally large, the average cost per mile appropriated for 1912 being $926. About 1,000 miles of the 3,151 miles under maintenance, however, are being given a top course of fine stone or gravel and oil treatment.

The extension of the improvement of the highway system of the State has called into existence a class of traffic which was never contemplated in the original scheme. This is the use of traction engines in hauling heavily loaded cars and in the use of motor trucks. As a result, the roads, where regular freight lines of motor trucks have sprung into existence between large towns, and which were not built for such traffic, are being destroyed. The Commission suggest that the time has arrived when legislation should determine the economical limit of load per inch of tire.

◆

TEARING UP STREET PAVING.

With the introduction of street paving and community waterworks and other evidences of civilization into our cities and towns, the vexing question of alleged inefficiency in the matter of various civic departments overlapping, with a net cash loss to the ratepayers, became more and more evident; chief among these charges was the opening of recently paved streets for the laying of gas and water mains. In a Western city this old and time-worn question has cropped up, and one or two of the civic officials have striven to smooth out the ruffled tempers of the already overburdened taxpayers, and some of the points in their argument are worthy of consideration. They contend that the cost of installation of water and gas services into vacant lots prior to the erection of buildings is in excess of the paving repairs, and that the services and fittings lying in the ground are liable to deterioration and damage for their long burial, and they further contend that the holders of vacant property do not have the slightest idea as to what position they desire the services placed in.

In a city in Eastern Canada some months ago an appropriation was made to cover the cost of a new water main, and the plans were prepared, showing the line that the work was to follow, and a goodly portion of the pipe went up a residential street that was to be repaved, owing to the unsightly and unsafe condition of the asphalt owing to numerous openings and patchings. The pavement was stripped and a beautiful new coating of asphalt replaced, but the same was down only a few days when a deep trench was cut to allow of the placing of the water main. This was some weeks ago, but at the present time the trench is covered with the torn blocks, which are supposed to act as weights and compress the earth back into a sufficient degree of hardness to permit repairs. In the case of this water main, and in many other cases where this unnecessary and unbusinesslike work has been done, there have been considerable expanse of lawn offered as a desirable location for the pipes, but these apparently do not meet with favor, probably owing to there being no newly-laid pavement to rip up.

◆

TECHNICAL SCHOOLS.

As the remarks made by Mr. Walter Dixon, in his presidential address to the West of Scotland Iron and Steel Institute (to which reference was made in a recent issue of the London Times,) regarding the questionable benefits conferred upon manual workers by schools and technical colleges are based upon enquiries made in industrial districts throughout the British Isles among those who control many thousands of workpeople, they must be accepted as evidence that in the opinion of a proportion of employers most of the book-work beyond the rudiments of reading, writing, and arithmetic is superfluous for manual laborers; and they must be taken as indicating that the additional educational facilities scarcely afford real aid even to foremen, charge men, and other leaders in the workshops. In general terms this criticism may be said to accord with certain of the facts, but as an argument against those additional educational facilities it fails to convince, for the reason, recognized by Mr. Dixon, that the educational schemes in the Old Country, as applied to the industrial classes, have purposes beyond those appertaining to wage-earning, and in the main the United Kingdom is the healthier, the cleaner, and the happier for them. Consequently the "bread alone" principle cannot be accepted as a basis for criticism of a system of education for industrial localities. There is need, however, that great watchfulness should be exercised in regard to reading, writing, and arithmetic, for with the advance of mechanical appliances, instruments of precision, and manufacturing processes, the demand for proficiency in these subjects is daily increasing. If it can be shown that the teaching of additional subjects is detrimental to the acquisition of those cardinal elements of school work, the system stands condemned. The average employer, knowing humanity, however, will probably express the opinion that blame is due less to the teaching than to the learning.

◆

EDITORIAL COMMENT.

The current issue of the "Electrical Review," of London, England, has come to hand. With this issue our contemporary celebrates its fortieth anniversary. We extend our heartiest congratulations to the journal, with best wishes for its continued success.

LETTERS TO THE EDITOR.

LIGHT COMPRESSION MEMBERS.

Sir,—I have read with much interest the valuable discussion by the Western Society of Engineers on "Light Compression Members" printed in *The Canadian Engineer*. The variety of opinions is not only interesting, but valuable to all those who read your paper. Permit me to add, however, an opinion which seems to me to have been overlooked in the discussion.

One of the assumptions on which column design is based, whether long or short, is that, assuming a centrally applied load, the stress is uniformly distributed over the sectional area of the member, and that, assuming an eccentrally applied load, the stress is of a uniformly varying distribution. We know from experiment that the distribution of stress over the sectional area of a single piece of metal in simple tension is not uniformly distributed, but is greater at the edges of the section. Therefore, it would not be at all unreasonable to assume that the distribution of stress in compression would be higher at the edges than at the centre.

Looking at the matter in this way, one can easily see why the "built-up" member should fail by wrinkling of the plates between the rivets at a unit stress which we suppose to be much less than it really is.

The spacing of rivets in "built-up" compression members is based on the assumption that the plate between the rivets acts like a short column, and is limited in length, i.e., the distance between rivets along the axis of the column—by the ratio of $1/r$, which, coupled with the assumption of a uniform distribution of stress, goes to make up the present theory of rivet spacing in columns. A theory based on an assumption of higher stress at the edge of the section would lead to a shorter allowable rivet pitch per given thickness of cover-plate, and hence a much safer design; a state of affairs which we will probably reach sometime in the light of further experimental evidence.

Yours very truly,

I. F. MORRISON,

University of Alberta, Edmonton South, Nov. 23, 1912.

Sir,—I have read with interest Mr. I. F. Morrison's comment on the discussion of "Light Compression Members" by the Western Society of Engineers, which was recently published in *The Canadian Engineer*.

The effect of possible inequality of stress distribution over the cross section, apart from that due to eccentricity, imperfect materials or poor workmanship, is no doubt considerable, as Mr. Morrison points out.

His assumption that the stress at the edges of a compression member will be greater than at the centre, however, does not appear to be well founded. The fact that this is true for a simple piece subjected to tension in a testing machine is no indication that the same thing will be true of an ordinary column. The method of fastening a tension piece in a testing machine is largely responsible for the inequality of stress distribution, the grips applying the load to the edges of the piece instead of uniformly over the cross-section.

Our assumption of uniform stress per unit of area is based on the application of the load to all parts of the cross-section in equal measure. If the load is applied at a point on the cross-section, manifestly all fibres cannot be stressed equally. The elasticity of the material of itself, apart from the effect of slag threads, seams and longitudinal cleavage planes, precludes the transference of the load so as to give a uniform stress. The fibres close to the point of application of the load will be heavily stressed while those remote from it will bear a lighter stress. It would thus appear that with a central load on a column, considered as applied practically at a point, the outer edges would be stressed less than the portion of the cross-section directly under, or near, the point. For loads applied at other points than the centre of gravity of the column, the stress would vary in a similar manner, being most intense at the point of application of the load and least intense at the point most remote from it.

Yours very truly,
C. R. YOUNG,
Consulting Structural Engineer.

318 Continental Life Building, Toronto, Nov. 30, 1912.

THE FREEZING TEST OF STONE.

The Mines Branch, Department of Mines of Canada, is making a complete reconnaissance of Canadian stone resources, and Vol. 1, covering the southern part of the Province of Ontario, has just been issued by the Department. Professor W. A. Parks prepared this report. Most of the stones were tested, and in this work the following observations were made:—

The freezing test which was applied to the samples of stone is described in the report as follows:—

A 2-in. cube was carefully prepared and dried in the air-bath at a temperature of 110° C. for 24 hours, after which it was allowed to cool in a desiccator and was then weighed. The cube was then saturated with water under reduced pressure for 36 hours, after which it was exposed to 40 alternate freezings and thawings. The specimen was again dried in the air-bath, and crushed in precisely the same manner as the unfrozen samples of the same stone.

The freezing test in this form is not considered by Mr. Parks to be entirely satisfactory, as the soaking in water is likely to make the stone contain very much more water than it would contain when ordinarily exposed to the weather, and, therefore, the conditions of the freezing test are not closely parallel to natural conditions. On the other hand, to make a freezing test on stone when containing only a normal amount of water was regarded as impracticable because its moisture would be so low as to require a very great number of freezings and thawings to give appreciable results. In default of something better the above described method was adopted. It is thought to give results of only very approximate value; i.e., the figures obtained from the freezing test should not be interpreted directly as a gauge of the weather-resisting or freezing-resisting power of the stone.

The following remarks on the general results of this freezing test are given:—

In the case of granites, gneisses, crystalline limestones, and marbles, there was a uniform loss of strength, but in the case of the limestones and sandstones, while the majority of the specimens lost in strength, there were some which increased to an appreciable degree. As there could not well be an instrumental error to account for the high result of the frozen specimens, new cubes were made of the stones in question and the crushing strength of the unfrozen sample again determined with the greatest nicety possible. In every instance a result nearly identical with the original test was obtained, so that we are forced to conclude that, in some cases, stone actually increases in strength by being subjected to the operations described.

It is not to be inferred that the freezing and thawing has produced this result; the explanation more likely lies in the heating and drying. An increase in strength after freezing has been recorded by various authors, but it has generally been attributed to lack of care in preparing the material. Buckley evidently considered such results anomalous, for he explains them as due to imperfect cubes or to the manner of operating the testing machines. Merrill gives a table in which five stones out of fifteen increase in strength, but he does not offer any explanation of the apparent anomaly.

Mr. Parks explains the phenomenon as being due to the formation of fine fragments in the interior of the stone as a result of solution and the disintegration due to freezing and thawing, followed by a subsequent recementation of the fine particles. He has actually observed this cementation as follows:—

At the time the old lithographic quarries near Marmora, Ont., were in operation, the fine dust obtained in working the stone was barreled with the intention of using it as a polishing material. Several of these barrels were left in the mill, and by the simple process of becoming damp and drying out, protected from both sun and rain, the contents have been converted into a solid mass rivaling the stone itself in hardness.

Two specimens of almost identical appearance, one of which gained in strength under freezing test, while the other lost materially, were reduced to powder, wetted, raised to a temperature of 100°, again wetted and allowed to soak for a few hours. On being raised to a temperature of 110° C., the pellet obtained from the stone which gained in strength showed a very much greater coherence than that from the other.

Elsewhere in the report, in giving the detailed description of the Marmora quarries, the author says:—

It is an interesting fact that the shavings from the planers if wetted and allowed to stand, set to a cement of considerable strength.

The relation of this observed cementing of the stone powder to the result of the freezing tests is summarized by the author as follows, with an observation also on the effect upon strength of wetting the stone:—

If it should be definitely established that the operations of drying, freezing and thawing, and again drying, tend to raise the crushing strength of certain stones, it follows that the recorded loss of strength does not really represent the loss due to freezing, but that loss less an increase due to the resetting of the disrupted particles.

In this connection may be mentioned the fact that most of the sedimentary stones lose appreciably in strength on being wetted; this loss of strength is due to the softening of the cementing material, which holds the grains together. On again drying, the stone assumes its original hardness and coherence.

RAILROADS AND VANCOUVER.

It was stated in the city this week that the Grand Trunk Pacific was in the market for canneries, something along the same line as the principals of the Canadian Northern.

The Canadian Pacific Railway has big works on its hands. It will erect a large office building in Victoria for its own accommodation. In Vancouver, it is stated that the Canadian Pacific Railway is calling in on its wharfage. Mr. R. V. Winch has about 100 feet of Canadian Pacific Railway wharf frontage, while the Union Steamship Company has another section immediately east of that. Notice has been given Mr. Winch that the Canadian Pacific Railway will want the piece he occupies, and it is thought it is only a matter of time before the Canadian Pacific Railway will want all it holds. The railway company now occupies wharves equal to the frontage of nine city blocks, and this does not take into account a jetty several hundred feet long.

AN AERIAL TROLLEY CAR.

By L. McCully Edholm.

Although suspended cars have been used successfully in Germany for a number of years, many new features have been devised in the aerial trolley system at Burbank, California.

The car is torpedo shaped with a framework of steel covered with aluminum. It is fifty feet long, seats fifty-six persons, and has carried capacity load with ease.

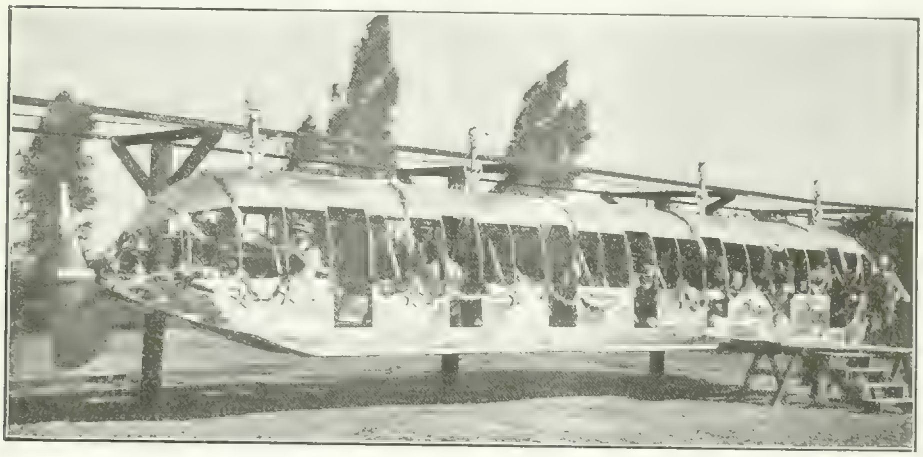


Fig. 1.—View of Aerial Trolley Car Ready for Operation, at Burbank, Cal.

The chief difference between this and other aerial cars is that it is driven by a six-foot propeller of unusual construction, having two fan-shaped blades of sheet metal, on ribs of steel tubing.

To serve in case of accident to the propeller and engine on the back of the car, a second propeller and motor will be placed on the front. This can also be used to double the power, if desired, or to hold back on down grades by reversing its motion.

This unique propeller is far more efficient than the kind used on aeroplanes because of its large surface. It is operated by a four-cylinder 25-h.p. gas engine, such as is used in automobiles. The propeller is capable of one thousand revolutions per minute and on a long stretch of track it is claimed that the car can easily make one hundred miles an hour.

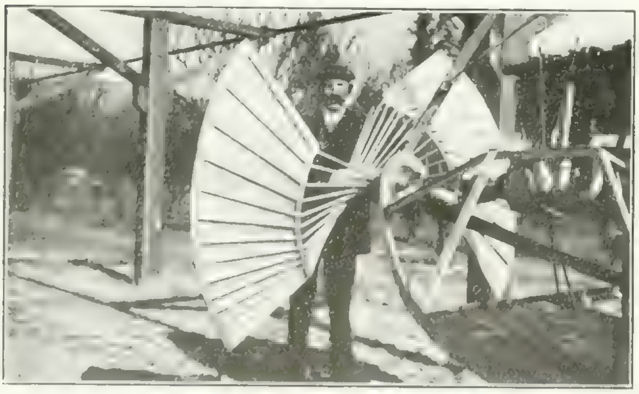


Fig. 2. View of Fan-shaped Propeller.

The track in use at present is six hundred feet long and it built on the estate of the inventor, Mr. J. W. Fawkes. The tracks are supported on posts, some of steel and some of wood, with cross beams to correspond. This is in [illegible] both kinds.

The rails used are steel T-beams three and a half inches broad, and three-eighths of an inch thick, and scientifically trussed to prevent sagging. The car is held securely to the rail by means of four sets of grooved wheels firmly clamped both above and below the rail, so that there is no danger of it jumping the track.

Another interesting point is the tilting planes to lighten the car by air pressure when it is in motion, and also an apparatus to lower and raise the cars at the stations.

It is claimed that this trolley line is much more economical to install, costing approximately $2,000 per mile and $1,500 for each car. It has many advantages over the old systems, as it can be built over hills and across rough country as easily as on the level stretches, the height of the track being regulated by the length of the pole. In fact, part of the Burbank system crosses a ravine by means of poles of various heights.

Mr. Fawkes is now considering the building of a double-track line between Los Angeles and one of the suburban towns. For commercial purposes his idea is to have a five-track system, the lower tracks for local transportation, while the upper one is for a "flyer."

This system will do away with all street congestion and collisions, so common under the present conditions, as all grade crossings are to be eliminated and the cars will be suspended at a height of twelve feet or more above the street.

Mr. Fawkes has proven his success as an inventor by a number of electrical devices which have won him a comfortable fortune.

◆

A NEW STEEL SCREW STEAMER.

A successful launch took place from the Neptune Works of Swan, Hunter & Wigham Richardson, Limited, on Thursday, the 7th ult. The vessel launched is a fine steel screw steamer which is being constructed to the order of the Cork Steam Ship Co., Limited, of Cork, and is the 24th steamer built and engined for that company at the Neptune Works.

The vessel is 285 ft. in length by 38 ft. beam, and is designed to carry over 2,700 tons deadweight on 19½ ft. mean draft. She is being built to attain the highest class in the classification of Lloyds registry.

The propelling machinery is also being constructed at the Neptune Works, and consists of a set of triple expansion engines supplied with steam by two boilers, and will propel the vessel at a speed of 11 knots per hour.

The steamer will be amply provided with the latest and most improved loading and discharging gear, including seven steam cranes, steam winch, etc., for her service in the line carried by the Cork Steam Ship Company between Liverpool, Manchester and Dutch and Belgium Ports.

As the vessel left the ways she was named the "Vanellus," the christening ceremony being gracefully performed by Miss M. E. Pease, of Middleton Lodge, Middleton Tyas, niece of Mr. Joseph Pike, the chairman of the Cork Steam Ship Company, Limited.

Amongst those present were Miss Pease and Miss Dorothy Pease, Mrs. Finch, Mrs. F. Christie, Mr. J. D. Christie, Mr G. F. Tweedy, Mr. G. B. Richardson, Mr. Rendall, Captain Hore, of Liverpool, marine superintendent to the Cork S.S Co., and Mr. J. A. Flockhart, of Liverpool, their superintendent engineer.

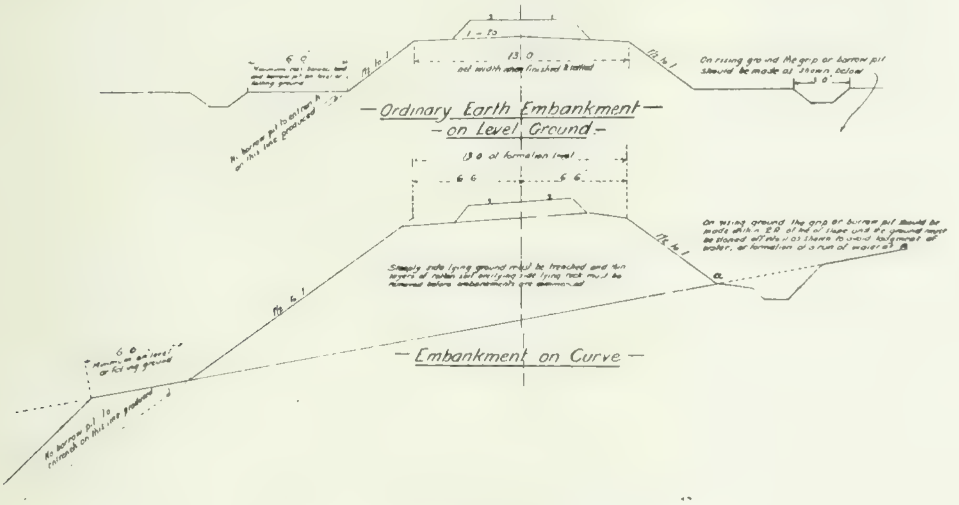
THE CONSTRUCTION OF A WEST AFRICAN RAILWAY.

The placing of the construction of the Accra-Akwapim Railway, in West Africa, in the hands of a contractor was an entirely new departure on the part of the Colonial Government. Previously all the railway construction in both the Gold Coast Colony and the adjacent colonies had been carried out by their respective governments departmentally, and a departure from that practice was looked upon as an experiment. Mr. William Martin Murphy, of Dublin, Ireland, was the successful tenderer, the official notification of which fact was sent him under date November 3rd, 1908.

Exactly one month afterwards the first party of engineers and foremen overseers sailed from Liverpool, arriving at Accra on the 20th December.

The construction of the work was described in a paper by Mr. G. M. Harriss, read before the Institution of Civil Engineers, of Ireland, recently. The following details are abstracted from that paper:

Amongst the West African natives are men gifted with intelligence of a high order, and in Accra are to be found craftsmen of nearly every kind, who, with a little direction, are capable of turning out excellent work.



1 - 10
13' 0"
net width when finished & settled
1½ to 1
6' 0"
On rising ground the grip or borrow pit should be made as shown below
No borrow pit to entrench on this line produced
— Ordinary Earth Embankment —
— on Level Ground —
13' 0" at formation level
6' 6"
6' 6"
On rising ground the grip or borrow pit should be made within 2' 0" of toe of slope and the ground must be sloped off as shown to avoid lodgment of water, or formation of a run of water at B
Steeply side lying ground must be trenched and thin layers of rotten soil overlying side lying rock must be removed before embankments are commenced
a
1½ to 1
6' 0"
Minimum on level or falling ground
No borrow pit to entrench on this line produced
— Embankment on Curve —

Sections Showing Types of Construction.

The ordinary laborers take to pick and shovel work well. They will not, however, under any circumstances, use wheelbarrows; everything is carried on their heads.

Female labor is available, and was largely used for carrying of all kinds, including the water for the concrete, the concrete when mixed, and the earth from the cuttings and for the banks. The women are very satisfactory, and are, as a rule, more industrious than the men. They will not, however, go far from the towns or villages.

The earth is carried in baskets holding about 55 lbs. when heaped up; the usual average working quantity would be between 30 and 40 lbs. Native-made baskets can be procured readily; they are made from a strong vegetable fibre plaited, but they are neither so strong nor so well liked by the natives themselves as specially imported English baskets. These are of a wicker-work construction, and last much longer than the native baskets. Both the water and the mixed concrete are carried in ordinary galvanized iron buckets.

One or two head-women go with each gang of twenty or more. They usually give a hand in lifting the loaded baskets on to the carriers' heads. The boys do the pick and shovel work, fill the baskets, make the concrete, and fill the buckets. If ahead of their work they will often help the carriers to get their loads up. A head boy or a second head boy will not, however, give any such assistance in the same way as a head woman will. If there is no other assistance at hand the carriers help one another, and will stoop down with their loads on their heads to assist each other.

Most of the stone-breaking for the concrete was done by female labor. The women are particularly fond of this work, though not very expert at it. They are, however, more satisfactory at the stone-breaking than boys, as they like the work and are more industrious.

The women like working, and are keen on making money; but they are independent of this class of labor. There is no poverty in the country; neither men, women nor children need go hungry. The ordinary rates for women is 25 cents per day, and for boys from 30 cents to 36 cents. Skilled native labor is dear—good carpenters get up to $1.20, blacksmiths and fitters more than this. The ordinary laborers come from various tribes, speaking different languages. Nearly all speak and understand a kind of English, only to be learned on the coast.

The ordinary hours of work were from 6 a.m. to 11 a.m., and from 1 p.m. to 5.30 p.m. Saturday was a half-holiday, work ceasing at 1 o'clock. This made a 54 hours' week.

The first sod of the railway was cut on January 7th, 1909. The railway runs due north for a distance of thirty-nine miles into the Akwapim district, where the cocoa plantations commence.

The site of the railway terminus is situated a mile and a half from the coast, in the hollow of a valley about fifteen feet above sea-level. A small branch line was constructed from an existing line, about two miles in length, already laid down for conveying stone for the harbor works. This put the new terminus in rail communication with the beach and breakwater, which was a first necessity, the available space at the beach being so limited that nothing could be stacked there, and all had to be cleared every day.

The country a few miles from the coast is densely covered with thick bush, which must have presented tremendous difficulties to the railway surveyor.

In the flying surveys through the bush some surveyors gain a great deal of information, and save a good deal of clearing, by the use of aneroid barometers, with assistants at either side, each assistant being furnished with a speaking trumpet, through which the barometer readings are transmitted to the surveyor—he taking the bearings judging direction from the sound.

For the finished survey a rough clearing was made along the centre-line with pegs at every chain (66 feet), and, where possible, the apex of each curve was marked by a concrete block, about 18 inches square and 2 feet 6 inches long, standing 18 inches above the ground.

These blocks were numbered, and so permanently marked the most important points for after reference.

The original survey, as well as the plans and specifications were prepared by the joint consulting engineers to the government, Messrs. R. Elliott-Cooper and Frederick Shelford, of London.

It may here be mentioned that the actual construction of the line was governed by the fact that the standard weight for transport is limited to what the natives can carry on their heads, on account of the tsetse fly which abounds inland and makes the use of beasts of burden impossible. The transport of tip wagons and the horses to work them, and the transport of locomotives before the rails are laid is therefore impossible. This causes an important departure from the ordinary practice, almost universal everywhere in railway work, of so setting out the line that the material taken from the cuttings bears a reasonable proportion to that required for the banks. The banks are in this case formed by digging trenches or "borrow" pits at both sides. These are kept well clear of the finished toes. The earth from the borrow pits goes to make the banks. The material from the cuttings is rarely or never used in banks, and goes to spoil.

Under these conditions the making of a bank costs per cubic yard about half that for a cutting, and of course in the cuttings there is always the danger of meeting rock, in which case the cost will be multiplied by five or six. These facts influence the building of the railway and show their mark on the finished work. The engineer in search of a cheap line avoids all the cuttings he can, and does not care how far they under-proportion the banks. The following are the figures for the first twenty miles section of this railway:—

	Miles.	Cu. Yds.
"Formation" (level with the ground)..	4.67	—
Cutting	3.11	28,070
Bank	12.25	222,098

It will be seen that the cuttings only provide some 12 per cent. of the material required for the banks, even if it were used in them. As a matter of fact none of it was.

It is provided that the banks have a camber below the ballast. It is very important that this camber be made in the first instance and maintained while the banks are standing for settlement; it prevents the water from collecting in pools or small lakes, which eventually break out in a stream down the slopes, and these streams in the heavy tropical rains become small rivers, cutting gullets, often five or six feet deep, in a short time. During the rains these gullets give great trouble. They have to be carefully watched and stopped, especially when the banks are new and soft, and uncovered by vegetation. This camber will not remain after ballasting, as practically all the first ballast will go down to formation level, and below it, when the traffic starts.

After twelve months' maintenance, with a reasonable train service over the first twenty miles section, the writer found from his own experience that three times the original ballast provided for in the contract was added. In some cases, such as in cuttings, and where the formation was hard, there would not be so much, but in some of the banks, where the earth was taken from the borrow pits, it was of a soft and spongy nature, and up to four times the original quantity of ballast was required in places.

The buildings at the Accra terminus are of a substantial concrete construction, and include a fine main station building and a building containing the manager's office and the general offices. There are also a large engine shed and repair shops, fitted with a 25 h.p. oil engine and a good supply of machine tools, and a well-equipped smithy, in addition to separate buildings for a general goods store and railway supply store. All these are of concrete. There is also a carriage shed, 250 feet long, of steel and iron, with two lines of rails. In addition, there are large bungalows for the first-class officers, smaller bungalows for the European foremen, and quarters for the native staff—all being included in the contract.

The rain-water from the roofs of the station buildings is led by stone-ware pipes to the principal underground tank [illegible] in the [illegible]

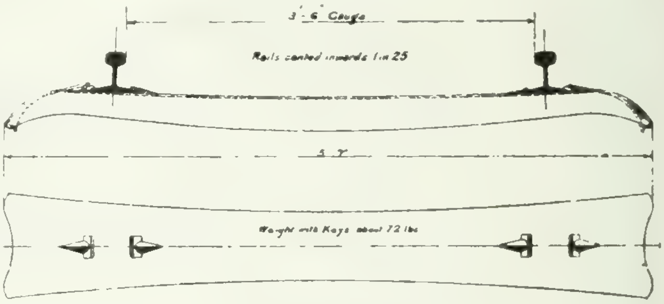
All the bungalows are provided with large cast-iron water tanks.

This is necessary, as the fresh water supply for the Europeans and the better class natives is that gathered from the roofs of their bungalows and houses, when it rains, and stored in tanks.

By the middle of February, 1909, laborers in gangs of from 100 to 200 boys were working at the clearing and earthworks, and gradually these were increased until there were gangs on different sections over the entire line. A white man, who was responsible to the engineers, looked after one and sometimes two of these gangs. As to the engineers, the line was divided into two sections, each under a district engineer responsible to the chief engineer.

At the same time that the clearing and earthworks were going on large gangs were working at the Accra terminus and the station buildings.

In the year 1909 the wet season was not a very severe one, and good progress was made at both the clearing and earthworks. When culverts were necessary, gaps or openings were left in the banks, and, as far as possible, the culverts were afterwards put in, in advance of the track-laying, using the line as much as possible to bring up the material for the culverts. But where the culverts were large, the openings for them were provided with temporary crossings to prevent holding up the linking-in gang.



Steel Sleeper.

The linking-in was started from Accra as soon as the banks had settled, but at an easy rate to allow of the culverts being completed, and avoid over-running them.

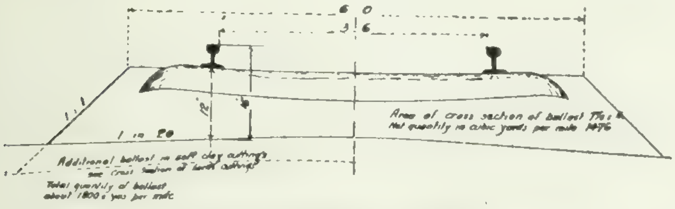
It was not until early in December, 1909, that much pressure was put on this work; but throughout that month the linking-in was done at the rate of a mile a day. This appears to be about the amount for efficient and economical progress, when rail head gets much beyond ten miles from the stacked material, except under very favorable circumstances, such as where there is flat and open country and a reasonable supply of water available for the locomotives, when, perhaps, another quarter mile might be added.

When the line is practically all carried on banks with stiff gradients and many curves, such as exist on the Accra-Akwapin line, a mile forward is a very good day's work. The trouble is not so much to get the actual linging-in done as to get the material to the plate-layers.

The gauge is 3 ft. 6 in., the weight of rails is 45 lbs. per yard, and the steel sleepers weigh 72 lbs. The latter are rather too heavy for one boy to carry, though there are numbers of them who do carry them with ease. The rails are 30 feet long, and eleven sleepers go to the length—distance centre to centre of sleepers 2 feet 9⅝ inches for 30 feet rail, and 2 feet 2 inches at the joints. Ballast is not easily got along the line, and is only to be found in a few places where pits have been made, and these average up to 5 miles apart. On that account the track was first laid direct on the formation level. Light engines were used to bring up the rails and sleepers, and these were brought along the track as fast as it was linked-in by the plate-laying gang. In this way the distance the rails had to be carried by the boys was kept as short as possible. The sleepers were usually thrown off, to be picked up and carried well ahead, when they were carefully laid on the formation square to the centre line and the correct distance apart. From ten to fourteen boys take a rail from the loaded truck, hold it above their heads, and carry it direct to its place, laying it on the sleepers to the satisfaction of the plate-layers. The plate-layers with their bars cant the rail, getting it under the clips of the sleepers. Considerable practice is necessary to do this quickly, and only well-trained gangs are of any use at the work. The bank at each side of the material train is reserved for the rail-carriers—the sleeper-carriers must go on the outside, either at the bottom of the bank or as best they can. As soon as a pair of rails are in place and fished up by the plate-layers the material train moves forward. The keying-up is usually left over for a more convenient time.

When three or four miles of linking-in had been done that work was stopped, and the ballast, which had been previously got ready at the ballast-pits, where separate gangs were engaged, was loaded and distributed over the length, and the first lift party, usually gangs of 100 to 200 boys, put in the ballast with a first lift from 8 inches to 10 inches. The remainder of the ballast was put in later in three or more lifts of from 3 inches to 4 inches each. A permanent gang was then left to maintain the line—the number varying from 4 to 6 to the mile; one native plate-layer with second man being in charge of a three-mile section, with a European plate-layer in charge of six or more gangs.

From the terminus the main line runs level for half a mile, then through a soft rock cutting, with a gradient of 1 in 100 falling 11 feet, to where the harbor line crosses and from that point the formation is level up to 2 miles 2 chains over open country and flats of grass land. These flats in places are marshy, the average height of the bank over them is about 3 feet. The flats continue for another mile at a slightly higher level, when the line is merely formation or level with the surface of the ground.


6 0
3 6
1½ : 1
1 in 20
12
Area of cross section of ballast
Net quantity in cubic yards per mile 1476
Additional ballast in soft clay cuttings
see cross section of earth cuttings
Total quantity of ballast
about 1800 c yds per mile

Standard Section of Ballast.

From 3 miles 0 chains the level rises in easy gradients up to 7 miles 63 chains. The country then gets more uneven, and is more or less covered with bush, but is still fairly open. At this point, which is the site of the first intermediate station—Dome—the level is about 79 feet above the flats. The line then rises with a gradient of 1 in 80 up to 8 miles 42 chains, then with an easy gradient down for 30 chains. It again rises to 9 miles 48 chains, when there is a depression, which the line crosses on a bank 7 feet high, with a gradient of 1 in 80—the line at this point being 55 feet above Dome station, or a total of 134 feet above the flats. It was between this point, 9 miles 48 chains, and the harbor line crossing that the most trouble with floods was afterwards experienced. From that point there is a stiff pull —1 in 80—up to 11 miles 14 chains to the top of a range of hills which runs parallel to the coast line. These hills must be crossed in getting from the coast to the interior. At the top there is a deep cutting mostly rock. This cutting is at a level of 216 feet above Accra terminus, and is the highest point on the line.

There is a long gradient of 1 in 80 down again to Ensaki Swamp at 13 miles 0 chains, then a rise to 15 miles, the site of the second station—Amasama—which is at the top of a second lower range of hills. After passing 11 miles the cooler sea breezes are lost, and the heat is much more intense—Ensaki being particularly hot and close in the middle of the day.

From Amasama the country is of a more undulating nature—thick and close bush continues in N'Sawam, and immediately after N'Sawam the forest is reached.

At the end of December the rails were laid for the first 27 miles, and in May practically the whole of this length was ballasted and packed, and was in good running order as far as N'Sawam.

The wet season of 1910, which started on June 6th, was, however, the most severe remembered, no less than 18 inches of rain fell between June 6th and 18th. This quantity very frequently represents the total rain-fall at Accra for a year. The whole of the Achimotah valley, through which the line runs, was one great running river. The banks were carried away at 5 miles, 5 miles 27 chains, and 5 miles 47 chains, and in many other places they were totally submerged.

In the wet season of the year 1908 this valley was quite dry. In 1909 very little water ran through it. These great floods were quite unexpected, and did tremendous damage to the line, making it quite impossible to get any material up, so that all progress was stopped for a time. As soon as it was possible every effort was made to repair the damage. Where the banks were carried away timber sleepers were built up in the form of cribs to support the lines, and openings were left. The cribs were so arranged that the concrete foundations, abutments, and wing walls for permanent openings could be put in without interruption to the traffic. Rail girders, consisting each of nine rails packed together, were used to carry the line over the cribs.

Early in August, 1910, through communication was again established, and on the 27th of August the line was publicly declared open for traffic as far as N'Sawam.

The original contract provided for a line to Mangoosi, and the earthworks were completed and the rails laid to that point, but the ballasting was stopped at a point one and a quarter miles short of Mangoosi, as it was then practically decided that an extension would be made to the town of Komfrodua, about fourteen miles further on: under those altered conditions the original site for the Mangoosi station was not suitable, and a new site on the opposite side of the hill upon which the town stands was selected.

Pending a final decision as to the extension, this line remains unfinished for the last mile and a quarter from the point where the route to the proposed new station site would commence.

In the meantime, the end of the line, as far as regular passenger and goods traffic is concerned, is at present at Pakro, which is thirty-four miles from Accra, or six miles beyond N'Sawam, and the contractor, under agreement with the Gold Coast government, is working the line over this length.

It is difficult, if not practically impossible, in the first survey, in tropical countries to reasonably estimate the effect of heavy rain-falls, especially where, as at Accra, the natives can give no reliable information of any kind on the point, and no previous records are to be found, and observation of old watercourses and flood-water marks are also impossible, owing to the luxuriance of the tropical growth which conceals all evidence of previous floods.

In consequence of these June floods it was found necessary to increase the openings under the line either by additional openings or by substituting culverts of greater width for those originally constructed.

In addition to the flood-water openings, the banks were raised over several miles of the line, principally through the Achimotah Valley, but also near twenty-three miles and over the Pom-Pom swamp, which is above N'Sawam.

The whole of the above work, including the addition of the bridges and the raising of the banks, was done without interruption of the daily traffic.

It will be readily understood that the successful carrying out of such an undertaking as the building of a railway in West Africa largely depended upon the perfect organization at home, as the mail boats take seventeen days in the passage from England, and the cargo boats five weeks. One large ship, containing a supply of coal for the engines, was wrecked on the coast, and the work would have been much hampered if there had not been a reserve supply on hand. Another cargo ship, containing some materials for the railway, was lost with all hands and never heard of. Everything that may be conceivably wanted has to be sent with a margin to spare, and well in advance of requirements. Great precision and a highly-organized system directed from home is an absolute necessity to prevent the work from coming periodically to a standstill. Everything required for railway track and station building construction, and for housing provisioning, and furnishing for the staff had to be anticipated and sent out in advance, so as to be available when required.

Bungalows for tne officers and quarters for the men and a fully-equipped hospital building were sent out in sections ready for erection.

The rolling stock for the construction consisted of two 6-wheeled locomotives (duplicates) with outside cylinders, 12-inch diameter, 18-inch stroke, 6 wheels coupled 3 feet 1 inch diameter, gauge 3 feet 6 inches, fire-box of best selected copper with brass tubes, 84 in number, 2-inch diameter, with 2 special hot water injectors, side tanks, holding 470 gallons of water; wheel base 8 feet 6 inches; weight, loaded, about 24 tons.

One with 9-inch cylinders, 15-inch stroke, 4 wheels coupled, 30½ inches diameter, gauge 3 feet 6 inches, fireboxes of copper with brass tubes, 50 in number, 2 inches diameter, 2 sirlus type injectors, saddle tank, holding 300 gallons of water, wheel base 5 feet, weight, loaded, 12½ tons.

The government provided the permanent rolling stock. This includes licomotives, weight 50 tons, covered-in carriages, with both first- and second-class, fitted with lavatories, also brake-vans for the guards. For the passenger traffic a very comfortable corridor train can be made up with this rolling stock.

For the goods traffic both open and closed trucks are provided. These are of steel construction. Hand-brakes are fitted on each carriage and truck. These can be operated from one of the platforms at the end of the carriages, and in the case of the trucks, both open and closed, either the hand-brakes or the couplings can be attended to when standing on a small platform which is hung on buckets at a height of about 12 inches above the rail.

Only European engine drivers and guards are allowed with the regular goods and passenger traffic. Mostly native drivers attended to the ballast and material trains while the line was being constructed and before it was opened to public traffic.

A five-chain curve was put in at the junction of the main line and the harbor branch, so arranged as to complete a third side of a triangle. This provides a means for turning an engine or the whole train if desired.

All the engines take water at Accra, which is taken from the well. When water is scarce the well is kept continually pumped to get the best supply, and the large underground tank is kept filled. Both are drawn from when the demand is heavy; when not heavy the underground tank is filled up.

During the dry season of 1911 there was always enough fresh water from this source for the railway requirements, and frequently there was some to spare for the harbor works where they were at times very badly off, and were obliged to get fresh water brought from N'Sawam by rail.

There is a good supply of fresh water at N'Sawam, which is on the Densu River, and also a fair supply at Ensake Swamp, 13 miles. At these two places there are tanks fitted for watering the engines.

The joint consulting engineers for the line are Messrs. R. Elliott Cooper and Frederick Shelford, of London. The resident engineer is Mr. Douglas Grey. Mr. Arthur J. Salter represents Mr. Muphy on the Gold Coast, and Mr. T. E. Etlinger is his chief engineer.

◆

REPORT ON HAMILTON SEWAGE DISPOSAL WORKS.

A report was made recently on the sedimentation tank. which is located in the north-east corner of the city of Hamilton, by Dr. John Amyot, Provincial Bacteriologist. Dr. Amyot visited the plant in the early part of November, and on November 23rd made his report to Dr. McCullough, Secretary of the Provincial Board of Health. The following is the text of the report:—

As a sedimentation basin, which was intended for a septic tank, it is too small for the purpose. It was reported to me that the sludge had never been removed from it, thus its capacity is much reduced over what was first intended. There are no means provided for handling the sludge if they desired to handle it.

According to the engineer, the hydraulic head provided for the carrying of the effluent from this tank to the sprinkler filters is not sufficient to reach the lower end of these beds. The beds themselves are built of very irregular material as to size and quality, much of which is crumbled by weathering, and possibly by the action of the sewage sprinkled upon them. The greater bulk of it is in good condition if it were properly sorted and could be made use of.

There is no foundation to the beds; the slag has been thrown right on the clay, thus making one of the most serious mistakes in its construction. Such beds, in order to work efficiently, must have a straight-away, unimpeded flow of drainage.

On account of the diminished sedimentation and the presence of iron waste in the sewage, heavy deposit of hydrate of iron and clay has taken place over practically the whole surface of the beds, thus sludging them completely and preventing them being put to the use they ought to be. If the sedimentation tank had been efficient, most of the iron would have precipitated in the tanks and not gone on to the beds and destroyed them.

I also found a lack of appreciation of the principles of sewage disposal in reference to these beds, and would in consequence advise as strongly as possible that a sanitary engineer accustomed to this particular type of sewage plant be employed by the city of Hamilton before any alterations are made.

Much of the plant can be used over again but special advice should be received in reference to this.

DEVELOPMENT OF POWER IN EASTERN CANADA

The latest factor in the power field is the Eastern Canada Power Company, it being through the instrumentality of that company, apparently, that Mr. McGibbon is putting forward the following scheme. The formation of this company was announced fully a year ago, it being stated that a wonderful scheme of power development was contemplated by the concern. Sir Max Aitken was said to be the organizer of the company, and it was stated that the amount of power to be produced was very large. The story attracted considerable interest at the time, especially as there then seemed a probability of keen rivalry between the Montreal Light, Heat and Power Company and the Canadian Light and Power Company, each of which companies possessed hydraulic developments thirty miles from the city in the vicinity of Cedar Rapids. About the same time, also, Mr. D. Lorne McGibbon had succeeded in getting control of the Cedar Rapids power. Just where the Eastern Canada Power Company was going to get its enormous power from was somewhat of a mystery.

In the course of the following year Mr. McGibbon's plans for developing the Cedar Rapids Power were matured, and it began to be rumored that he was selling out control to certain other interests. The story was at first denied, but its truth was ascertained later. It was admitted that some of the principal interests in the Montreal Light, Heat and Power Company and the Shawinigan Water and Power Company were the purchasers. This meant that the Montreal, Light, Heat and Power Company was now in control of practically all the sources of hydraulic power located within commercial distance of Montreal.

A recent dispatch from Ottawa is to the effect that Mr. McGibbon now appears in a larger power scheme. It is proposed to build an enormous dam in the vicinity of Coteau, Cedar, Split Rock and Cascade Rapids for the purpose of developing an hydraulic power with an estimated capacity of 1,000,000 h.p. The dam will connect up a number of islands in the vicinity mentioned, and will have a total length of, perhaps, fourteen miles. The rapids will thus be dammed up to a level with Lake St. Francis, thus obliterating them and flooding a portion of the Soulanges Canal. The proposal is from the Eastern Canada Power Company, and behind it are Mr. McGibbon, and with him Sir Max Aitken. The proposal has already been brought before the government at Ottawa, and, so it is believed, has made progress with the powers there.

The other big power scheme is the Long Sault Development Company, which is backed by the Aluminum Company of America. This, also, is before the government at Ottawa, but whether it is in any way opposed to the Eastern Canada Power scheme or not is impossible to say at this moment. It may be remembered that the Long Sault scheme was brought up at Ottawa during the regime of the Liberal Government and met much opposition from the Conservatives, and, on the recommendation of the conservation commission, was not adopted. For some time past the Long Sault Scheme has been showing new life once more. It has been written much about and discussed, and there is no doubt that another attempt will be made at Ottawa.

The Long Sault scheme is not quite so ambitious in some respects as the Eastern Canada Power Company. Instead of a development of 1,000,000 horse-power, one of but 600,000 to 800,000 horse-power is claimed, and the engineering problem, it is stated, would not be anything so vast or complicated. On the other hand, however, the consent of both the United States government and the Canadian government would have to be obtained. These governments both refused consent in the past. Subsequently, the governments have been changed in both countries, and the new governments may feel more kindly disposed to the proposals.

Canadians must feel that the leasing of these powers in the St. Lawrence River is one of the most serious matters dealt with by parliament in many decades. They are the last big, commercially available powers in Canada, and their absorption by private interests can only mean that the advantages of ownership will be absorbed by the owners, whether these be the private interests or the country at large. The Hon. Clifford Sifton, as head of the conservation Commission, made the statement that "leases of these powers for limited periods" was the proper method, and in his suggestion there is much to commend.

INTERNATIONAL PAPER COMPANY AND CANADA

The report of the International Paper Company for the year ended December 31st, 1912, will likely show the largest net earnings in any year since 1905, the directors anticipating that it will total about $6,000,000. Discussing the decline in this company's stock, it was suggested in New York last week that if a reduction were made in the paper tariff, the plants of the company in the United States might be transferred to Canada with very little expense.

The company is producing at the rate of about 1,750 tons of paper a day. The production varies from 1,746 to 1,777 tons. Of this, 80 per cent. is news print. The remainder of the output consists of tag paper, box paper and supplement paper. It is selling its product at $2.25 per 100 pounds and finds the market favorable, so that its entire output is sold. Beginning next year, International Paper will begin supplying news print on several new contracts, of which the New York Sun is the largest. The Sun contract calls for 40 tons of news print per day. The Sun is now receiving its paper from the Great Northern Paper Company and is paying less than it will have to pay on the new contract at the first of the year.

International Paper is spending considerable money in improving its property and has expended a large amount of money for this purpose during the last three years, and now has a profit and loss surplus of approximately $9,000,000. One of International Paper's greatest assets is its ownership of timber lands in Maine and Canada. The policy of the company is not to use its own wood where it can buy in the open market at a reasonable price. Directors of International Paper believe that the timber lands should be held as a final reserve, and should not be used until the price for wood pulp timber in the open market advances too much.

The International Paper Company was incorporated in 1898 in New York for the manufacture and sale of pulp and paper, and was a consolidation of nineteen paper producing companies. Among the concerns it controls are the Miramichi Lumber Company, incorporated in 1905 in Maine. It has rights to cut timber on about 415,000 acres of Crown land limits in New Brunswick. It also controls the St. Maurice Lumber Company, incorporated in 1891 in New York. This company owns cutting up and wood preparing mills at Batiscan, Three Rivers and Pentecost, Quebec, with water powers and rights to cut timber on more than 2,000,000 acres of Crown land limits in Quebec.

The International has authorized common stock of $20,000,000; 6 per cent. cumulative stock, $25,000,000; and a bonded debt of $16,473,000, exclusive of $1,189,000 bonds of controlled companies.

TELEPHONE TRAIN DESPATCHING. †

By Mr. Hatton. *

How many are there in speaking of the transportation of the country's products, or in travelling by train, ever give a thought to the principle of train operation, or the problem of train reverse movements; in other words, the indispensable train order system?

It is not necessary for me to enter into that subject to-night, suffice it to say, that the system dates back to 1851, when Superintendent Minot, of what is now part of the Erie Railroad, issued the first train order, after vainly trying to run trains without it. The system has undergone many changes since that time, having been the subject of discussion by some of the brightest minds in the country at conventions and elsewhere, until the present almost perfect system has been evolved. From the first, the telegraph, which at that time was also only in its infancy, was the instrument of transmission of the train order. A few years later the telephone was invented, and, while it was the subject of much wonder and admiration, and likely to revolutionize methods of communication, it was not looked upon seriously by railroad men as a competitor to the telegraph, in so far as train operation was concerned. People evidently had no idea at that time of the vistas of usefulness that would later be opened up to it along that and other lines. The question of using it in place of the telegraph did, however, come in for discussion at different times, and it was actually put into use in a small way for the handling of trains as early as 1883. A few interurban electric lines adopted it some years afterwards, but it was not until 1907 that the steam railways experimented with it to any extent. Probably the first real experiment was made by the New York Central Railway in October of that year, when a telephone despatching circuit was installed between Albany and Fonda, New York, a distance of forty-six miles, followed by the Chicago, Burlington and Quincy Railway in December of the same year, with forty-five mile circuit on one of their lines running into Chicago. The trial in each case was so successful that other lines became interested, and these circuits were inspected by a great many of their representatives during the following year. In every case I believe a favorable impression was made, and those who came prepared to scoff put in a report recommending it, which resulted in the installation of a number of additional circuits on other lines, including the Canadian Pacific. The extension has since been so rapid that to-day of 87,700 miles of road on seventeen American railways over 38,000 miles are operated by telephone. I have not the figures for Canadian lines, except the Canadian Pacific, but this line has kept pace with its American neighbors by installing telephone despatching circuits on 4,858 miles of track, or on over 40 per cent. of its entire mileage, the circuit extending, with but two short breaks, from the Atlantic to the Pacific and on several of the most important branches. Before attempting to explain the reason for this remarkable growth I will give a brief description of the equipment.

The best results being obtainable from a metallic circuit, a pair of heavy copper wires is used for the line, these being transposed at frequent intervals to eliminate interference through induction from other wires as much as possible. By this means and with the use of good telephone apparatus, etc., a very clear transmission has been secured. It is not affected by wet and foggy weather, as is the telegraph, nor is the circuit as liable to interruption from other causes. The average circuit is from 110 to 140 miles long, but that is not the limit by any means, for in one or two instances of 250-mile circuits the result is almost as satisfactory as with the shorter ones. The number of offices on each varies, of course, but often runs as high as 25 and 30. These can be cut in singly or collectively. The apparatus consists of a signalling device and the necessary telephone equipment, the latter being very similar to the ordinary telephone, the despatcher using breast transmitter and head-band receiver, which gives him the free use of both hands, and is always accessible to call from any station. The station telephone is much the same, except that in some cases an arm with adjustable transmitter and receiver attached are used. There are several varieties of signalling devices, but all work practically on the same principle, the equipment in each case consisting of what is called a master selector in the despatcher's office, whose action is semi-automatic, and a sub-selector with bell attached, in each of the stations. In the case of one of these devices the master selector consists of a number of units, that is, a separate arrangement for every office, the whole enclosed in a small cabinet, and placed in a convenient position on the despatcher's table. Each of these has a different combination, and to each is attached a small key. By giving this key a quarter turn it continues mechanically until the contact point is reached, when the circuit is completed and the bell is rung in the office having a similar combination. From five to six of these operations can be made in a minute, which, of course, means that many offices can be called in that space of time. This constitutes one of the many advantages the telephone possesses, for, in addition to the ease with which the calling is done, the responses are usually more prompt than with the telegraph, as many of our agents and operators having duties, such as checking baggage, etc., taking them from the immediate vicinity of the office, may not hear the telegraph at once, while their attention is immediately arrested by the telephone bell. It is also possible to work with one office at the same time that other offices are being called without the transmission being in any way interfered with. These features are appreciated by all despatchers, meaning a great saving of time, labor, and sometimes temper. A great amount of time is also saved in the repetition of orders, for with the telegraph a distinct operation is necessary in transmitting each character, while with the telephone the order may be repeated as fast as the operator can talk. By reason of the quickness of transmission the despatcher is also able to keep his train sheet up in better shape than ever before and with much less actual effort. There is not the same necessity for condensing or restricting information in connection with train movement, etc., which might be of great value if given, but with the telegraph is omitted, because of the time it takes to spell out letter by letter every word of such information. The despatcher is also able to speak direct with conductors and engineers if necessary, thereby securing more accurate knowledge of details than was ever possible with the telegraph. In order that train crews may get in touch with despatcher in case of a delay between stations a portable set is furnished every passenger and freight train, making telephone connection possible at any point on the line by simply hooking a jointed pole with flexible cord, which is also carried on the train, on to the proper wires and connecting it with the portable set.

By talking with agents and operators, the trick despatcher saves many messages a day that would otherwise be necessary regarding cars, etc. In fact, in a hundred ways the telephone not only saves time, but labor.

It is not easy to figure out just what these several advantages mean in dollars and cents, but it is variously

---

* Superintendent Car Service, Canadian Pacific Railway, Winnipeg.

† Paper read before Western Canada Railway Club, [illegible] 14th, 1912.

estimated that the capacity of the despatcher is increased from 25 to 50 per cent. It is also only reasonable to conclude that on account of the contact between despatcher, operator and trainmen being of a more personal character results in a closer co-operation and a more efficient service.

Now, with regard to the most important point of all, the question of safety, the telephone again has the advantage. In the first place, the despatcher in sending an order by telegraph does so without a written copy for reference, and has no record until the first operator repeats it. With the telephone he copies the order at the same time he is sending it to the different offices, so that the repetition can be checked directly against his own copy and an error on the part of the operator immediately detected. Numbers of trains and engines names of stations and other essential words in order are spelled out by letter as well as pronounced, so that a mistake is almost impossible.

In conclusion, I venture to say that, while great advancement has been made in the selective and telephone apparatus and installations in the short space of five years, still further improvement is in store, and the time is not far distant when the telephone will have almost entirely supplanted the telegraph for the despatching of trains. It is also coming into use quite extensively for the transmission of local messages and in this respect also will run the telegraph a hard race.

In speaking thus, I am not oblivious of the telegraph's wonderful achievements in the past, nor blind to its future possibilities, but I am convinced that for the purposes I have described the telephone has triumphed over it.

VANCOUVER'S PROPOSED HARBOR COMMISSON

As noted previously in *The Canadian Engineer*, at the next session of the federal parliament a bill is to be introduced by Mr. H. H. Stevens, M.P., to provide for placing the port of Vancouver under a commission of three, two members to be appointed by the government for terms of five years, and the other by the city council, for a term of three years. The commission, if the bill passes, will be empowered to improve, operate, maintain and govern Vancouver harbor.

The proposed port limits will include Burrard Inlet with the North Arm and Port Moody, False Creek and English Bay; in fact, all tidal waters to a line drawn from Port Atkinson to Point Grey. The commission is to be the pilotage authority.

The commission may acquire, expropriate, lease and dispose of lands deemed necessary for development, improvement, maintenance and protection of the harbor; may acquire movable property, plant, vessels, machinery, etc. It can acquire property for wet or dry docks, warehouses, elevators and railways in connection with the harbor, and all tidal lands within the harbor limits shall be under its jurisdiction. Further, the commission may construct and operate tracks and harbor lines and may make agreements with railroads, affording all companies whose lines reach the harbor equal facilities for traffic. Laws governing the harbor not contrary to laws existing or the jurisdiction of the corporation may be enacted, fairways, special anchorages, etc., regulated, and the navigation of the harbor will be generally managed by the commission. The harbor master will be appointed by the commission.

Rates will be levied at discretion upon all goods landed or shipped in the harbor, moved by rail on the harbor tracks, excepting military supplies. Powers will be given the commission to borrow such moneys as are necessary to carry on its work, and debentures may be issued to cover such loans. The governor-in-council may advance funds necessary to complete the harbor works. Salvage disputes will be heard by the commission and all wreckage or flotsam dealt with.

Upon certain conditions the commission may seize vessels or goods, the detention being effected upon order of any judge or magistrate having power of two justices of the peace. Judicial powers will be given the commissioners to cover infringements of the Canada Shipping Act within the harbor limits. The government may waive duties on all merchandise required for the port commission work.

HARBOR IMPROVEMENTS AT NEW WESTMINSTER

New Westminster is seemingly entering the most active building period of its career. A statement which is creating great interest in New Westminster, Port Mann and every part of the Fraser River is that Messrs. Mackenzie and Mann have rejected the agreement between Vancouver and the Canadian Northern Railway.

It is stated that the clauses which Messrs. Mackenzie will not accept are those binding them to make Vancouver their home port, to enter the city by a tunnel and to purchase additional property in the city for their hotel site. If this report ultimately proves to be correct, it will only be in accordance with the steady conviction of a great many that the Canadian Northern Railway would never go to a vast expenditure to make Burrard Inlet their shipping point when they already owned a port capable of magnificent development at Port Mann.

New Westminster's harbor developments may also have had some influence on the Canadian Northern Railway's decision. These are taking concrete shape, and the expenditure of the $500,000 worth of bonds that have been sold for this work will begin very shortly. Mr. Powell, the engineer in charge is calling for tenders for 3,000 linear feet of cedar pile quay wall and 1,000,000 yards of back filling with rock rivetted slope. This is for the widening of Front Street to 192 feet, and the construction of a straight municipal quay of over a mile in length.

COSTS ON THE PANAMA CANAL.

The annual report of Col. Gorthals, chief engineer of the Panama Canal, gives some interesting unit costs on the work during the past year.

Excavation in the prism by steam shovels was cheapest in the Central division, averaging $0.5101; in the Atlantic division a lower cost is shown than during the previous year —$0.5952 against $0.6010—while in the Pacific division it is higher—$0.7527 against $0.6960. There was a total of 1,443,570 cu. yd. of masonry laid in the locks and spillway during the year. The unit costs for the masonry were: Gatun Locks, $7.7552; Gatum spillway, $7.0988; Pedro Miguel Locks, $6.4640; Miraflores Locks, $4.7675. The labor costs for the year per cubic yard of plain concrete at the various locks and spillways show lowest at Miraflores, $0.8394; next, Gatun Locks, $1.3840; Pedro Miguel Locks, $1.4733; and Gatun spillway, $1.5425.

The cost of concrete piling at Gatun was $0.0679 less during the year than in 1911, while the cost in place was $0.7088 less. The total amount driven was 83,670 lin. ft., at a cost of $1.5719 per lin. ft.; in addition, 51,450 lin. ft. of wooden piles were driven, at a cost of $0.6516 per lin. ft. On this basis had wooden piling only been used for the south approach pier a saving of $77,000 would have resulted.

APPLICATION OF CONCRETE TO UNDERGROUND WORK.

Concrete has been used for many years in building underground dams, bulkheads, etc., some notable examples of which can be seen at the Chapin mine at Iron Mountain, Mich. Mr. H. T. Mercer, in a paper presented to the Houghton meeting of the Lake Superior Mining Institute, describes some of the applications of concrete in mining work. He states that the principal uses of concrete in mines are in connection with shaft support. Good examples of concrete shaft collars can be seen at many of the mines, and although the details vary somewhat, a description of one or two will perhaps suffice to illustrate this form of construction.

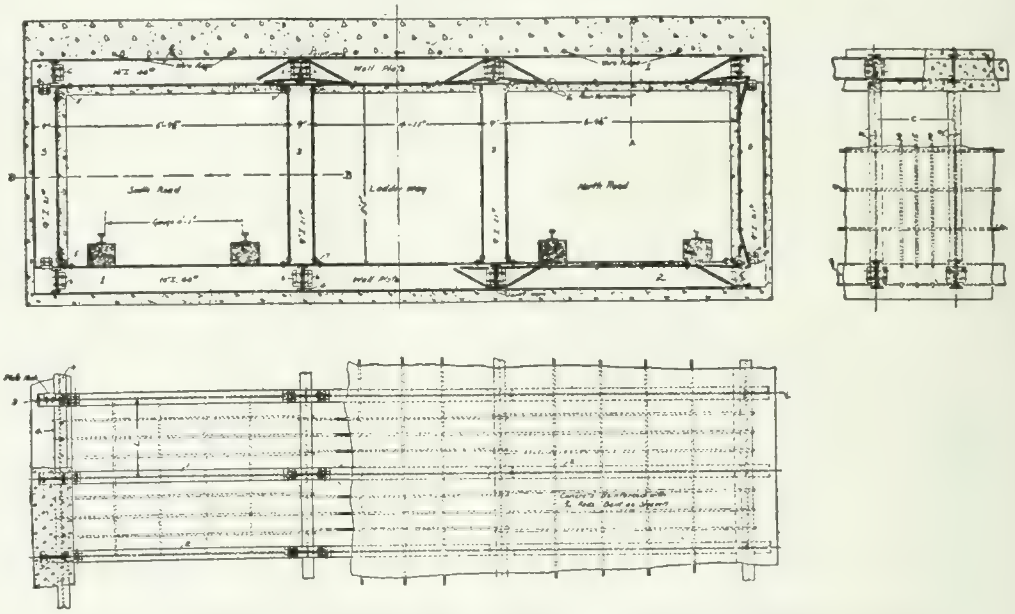


Fig. 1.—Details for Steel-Concrete Collar No. 2. Shaft Trimountain Mine, Plan and Elevation.

At the Trimountain mine it was decided to replace the old timber collars with concrete, and work was begun at No. 2 shaft, where the overburden was 80 ft. deep, consisting for the most part of sand, with more or less clay and some boulders. To guard against any possible "running" of the sand, and to make the operation of the shaft during construction easier, as well as to reinforce the concrete, it was decided to replace the timber with steel I-beam sets, and then concrete between and around the steel sets. The sets would provide a support in case it became necessary to put in lagging to hold back the sand before the concrete was placed. A foundation was first prepared at the ledge by placing heavy steel beam box girders across the shaft from foot to hanging under the dividers and under the south end plate. At the north end there was a natural rock ledge or shelf. Starting from the foundation thus formed the steel sets were built up, two or three at a time, and concreted in. The work proceeded as follows:

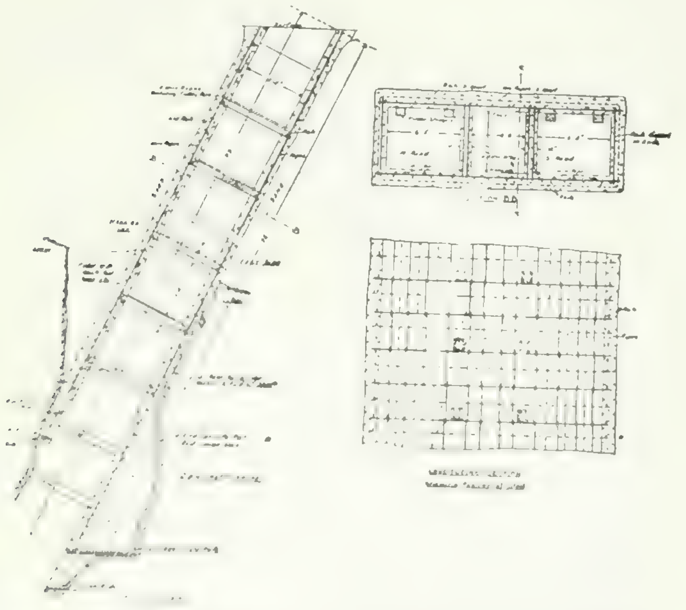


Fig. 2.—Reinforced Concrete Collar, No. 3 Shaft, Trimountain Mine.

First, the old timber on the ends and foot wall was taken out for as great a height as was deemed safe, then two or three of the steel sets were placed and bolted up, after which the forms were erected, and the concrete poured. Then another space would be opened up and the operation repeated, and so on until the surface was reached. Fortunately the old hanging-wall plates did not have to be removed, as there was sufficient clearance to permit the new concrete lining being carried inside of them. Care was taken to leave no timber or blocking under the foot-wall side of the concrete lining which might by rotting permit settling. The sand was carefully tamped along the foot wall as the concrete was finished. One skip road and the ladder way were built first, hoisting going on meanwhile in the other compartment. The skip was then changed over to the completed road, and the other road was built up. The steel sets were 2 ft. 4 ins. apart in the lower half of the collar, and 3 ft. apart in the upper half, centre to centre. The concrete between the sets was reinforced with ¾-inch rods, as shown by Fig. 1, which also shows the construction of the steel sets and the position of the concrete.

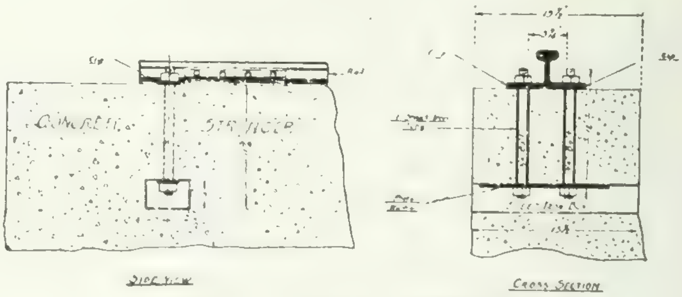


Fig. 3.—Details for Concrete Stringers, Showing Old Method of Fastening Rails.

The materials used for the concrete were: Portland cement, coarse amygdaloid stamp sand and crushed trap rock. They were mixed by hand in the proportion 1:3:5, in the shaft house just back of the shaft and lowered by a bucket and trolley, the trolley rope being concreted in on the hanging side as the work progressed. As no difficulty was experienced at No. 2 shaft with the sand running in, or otherwise, it was decided to build the Nos. 3 and 4 collars of reinforced concrete only, leaving out the steel sets. Fig. 2 shows the construction of the No. 3 collar, which was started in June, 1910, and finished in August, 1910. The materials for the concrete were the same and work was carried on in the same manner as at No. 2, except that there were no steel sets. The collar at No. 4 shaft was similar to the one at No. 3, except that the dividers were made 12 by 48 ins. instead of 12 by 12 ins. The overburden at No. 4 shaft was 128 ft. deep on the pitch of the shaft (71°), that at Nos. 3 and 2 being 60 and 80 ft. respectively; but in order to secure a suitable foundation, the No. 3 and No. 4 collars were started some distance below the ledge in the solid rock. The length of No. 3 collar was 93 ft. and of No. 4 was 158 ft.

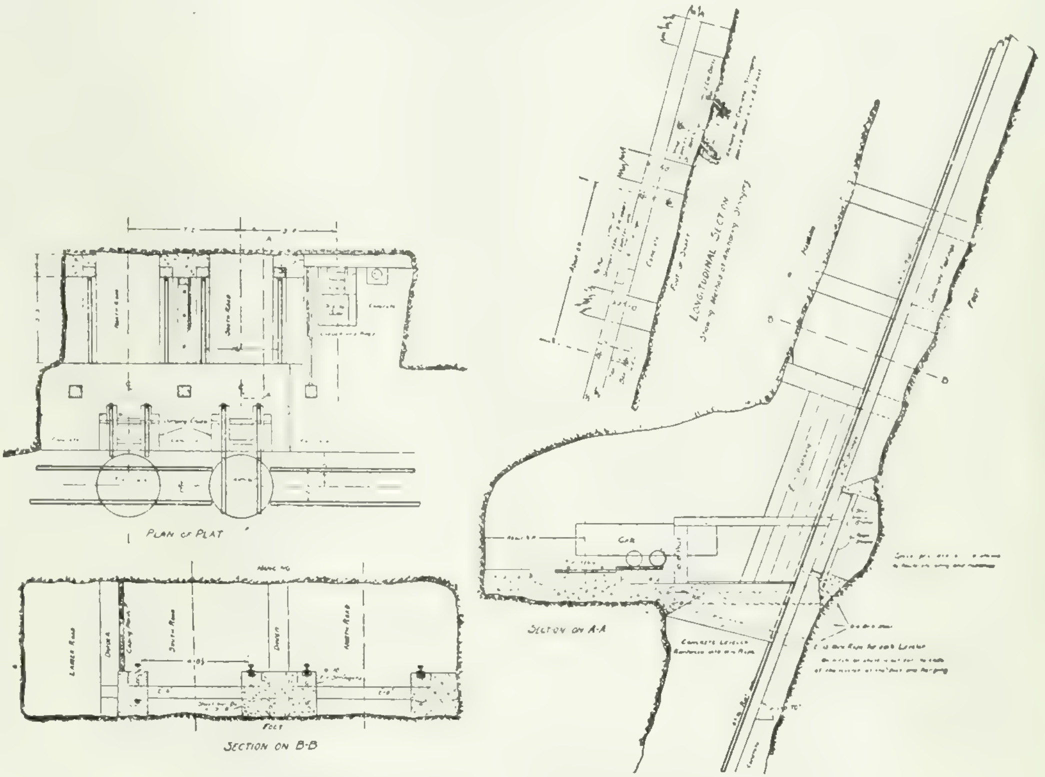


Fig. 4.—Underground Concrete Construction, Champion Mine.

Comparative Statement of Cost of Concrete Shaft Collars.

	No. 2 shaft.	No. 3 shaft.	No. 4 shaft.
Labor.			
Length, to foundation	80 ft.	93 ft.	158 ft.
Shaftmen	$2,019.10	$1,028.85	$1,994.70
Masons	528.51	......	......
Surface labor	301.80	295.50	192.45
Blacksmith labor	360.41	67.55	40.50
Machinist labor	311.76	41.82	27.85
Carpenter labor	144.97	42.73	54.69
Electrician labor	10.84	8.82	8.96
Teaming labor	120.56	74.46	56.64
	$3,797.95	$1,559.73	$2,375.79
Supplies.			
Structural steel	$2,180.56	......	$ 136.00
Cement, 1,252 sacks No. 2..	588.83	......	......
Cement, 1,238 sacks No. 3..	......	$ 470.80	......
Cement, 2,169 sacks No. 4..	......	......	810.09
Stamp sand, 11 cars No. 2..	159.50	......	......
Stamp sand, 3¼ cars No. 3.	......	45.70	......
Stamp sand, 8½ cars No. 4.	......	......	123.25
Fine rock, 3 cars..........	90.00	......	......
Sundry supplies	261.75	102.55	75.91
Freight	215.33	......	......
	$3,495.97	$ 619.05	$1,145.25
Total cost of shaft collars.	$7,293.92	$2,178.78	$3,521.04

No. 2 shaft collar commenced February, 1907, completed August, 1907.

No. 3 shaft collar commenced June, 1910, completed August, 1910.

No. 4 shaft collar commenced March, 1911, completed August, 1911.

Cost per ft.	Labor.	Supplies.	Total.
No. 2 shaft	$47.47	$43.70	$91.17
No. 3 shaft	16.77	16.66	23.43
No. 4 shaft	15.04	7.25	22.29

Fig. 4 shows a station or plat in one of the Champion Copper Company's shafts, and indicates the manner in which the levelers are reinforced. This illustration also shows the method used for concrete stringers. At first an all concrete stringer was built after the manner in use at the Ahmeek mine as designed by W. J. Uren, to which the rail was bolted by means of bolts and clips as shown in Fig. 3, but because

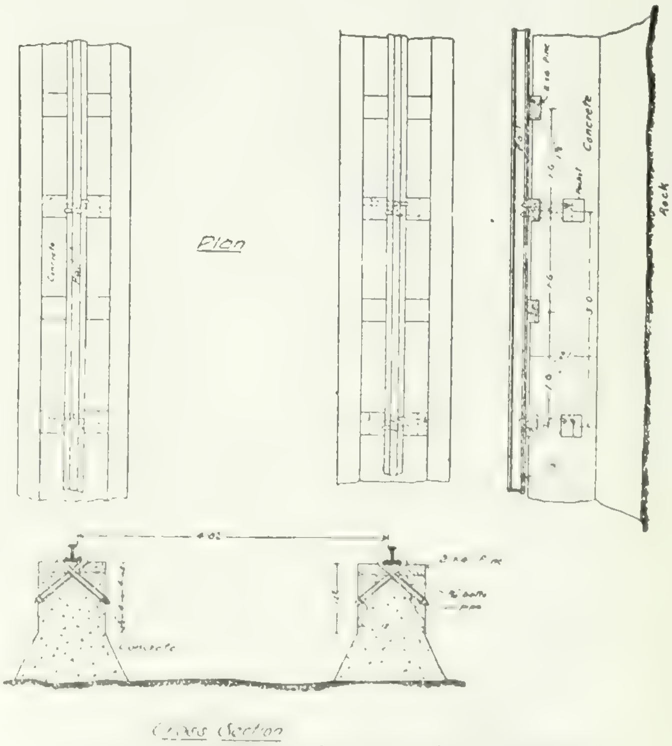


Fig. 5.—Concrete Stringers, Mohawk Method.

of the hard rigid roadbed thus formed the wear and tear on skip and rails was very great, and the bolts and clips were continually working loose. The scheme was therefore abandoned in favor of a combination wood and concrete stringer.

Fig. 4 shows the method in use at the Copper Range Con. Company's mines, and the Mohawk and Wolverine scheme is illustrated in Fig. 5. Both methods made a very satisfactory road bed.

At some of the mines where the foot is subject to "heaving" concrete stringers cannot be used advantageously.

In sinking through some loose ground at one of the Champion shafts it became necessary to close-timber, or line the shaft. Concrete 12 to 18 inches thick was put in, reinforced with old rails and wire rope. The concrete extended across the hanging and down on both ends, and sometimes across the foot, and there were also heavy concrete dividers 4 feet high by 10 inches thick, placed 10 or 12 feet apart. At several levels the whole plat was arched over with reinforced concrete. The lining has been in place about two years and has proven satisfactory.

Drift sets built of concrete have been tried to some extent at the Wolverine and Mohawk mines in some of their crosscuts where loose ground was encountered. These sets consisted of legs 6 by 6 inches in section, and a cap 6 by 8 inches, reinforced with ½-inch rods and wire rope. Concrete planks, reinforced with Kahn expanded metal, or woven wire, were used for lagging. Above the caps they were 4 by 14 inches in section and behind the legs 2½ by 14 inches.

The use of reinforced concrete in the form of shaft sets and lagging is well described in a paper read before the Michigan College of Mines Club, at Houghton, Mich., by E. R. Jones.

Concrete floors for shaft houses are being tried at several places and are proving satisfactory in many respects, although subjected to the hardest usage. The floors built at the Champion Copper Company's shaft houses were made 6 inches thick of 1:3:5 concrete, with a top finish 1-inch thick of 1 to 2 Portland cement and coarse stamp sand. The total cost was 13 cents per square foot. The materials used for the concrete were crushed trap rock, coarse stamp sand and Portland cement.

Question has been raised from time to time as to the suitableness of wire rope for reinforcement. Some tests of concrete beams reinforced with wire rope strands were made at the Baltic mine in 1910 by C. G. Mason.

◆

THE HETCH HETCHY WATER SUPPLY OF SAN FRANCISCO.

For the past ten years, the engineering force of the city of San Francisco has been scouring the State for possible means of future water supply. A dozen different projects have been examined, and the one which has seemed the most feasible is that of the Hetch Hetchy development, the principal reasons for this adoption being that of lower cost, more abundant supply and purer quality of water than any other obtainable. In May, 1908, the permit was obtained to use Lake Eleanor, situated near the Hetch Hetchy Valley, as a site for a storage reservoir, with further permission to use the Hetch Hetchy Valley when the limit of storage of Lake Eleanor had been reached. This latter permit was later called in question by the Department of the Interior, as two objections had been raised to its granting. The one was, that prior rights to the waters were being jeopardized, and the other that the natural beauty of a great scenic national park would be destroyed.

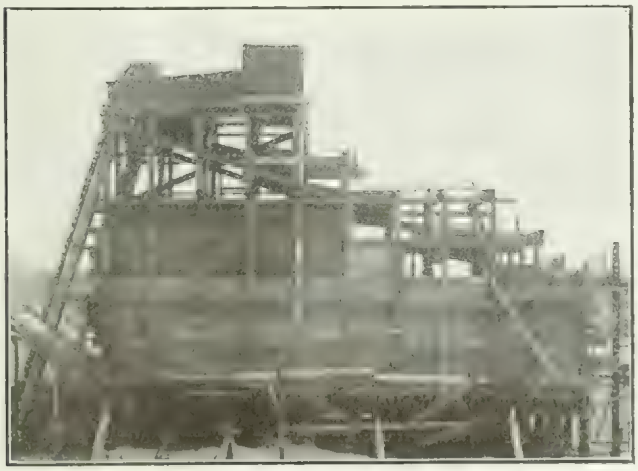
The first proposition, to bring these waters to San Francisco, outlined by C. E. Grunsky, engineer of the city of San Francisco, was to bring the water from Lake Eleanor and the Hetch Hetchy down across the San Joaquin Valley to Altamont. At this point he proposed to pump these waters over the coast range into San Francisco. The power for this pumping was to be gotten from power generated in the drop of the water from the Sierra Nevada side of the valley. During the last season, however, Mr. John R. Freeman, the noted water expert, has been called into consultation by the authorities in San Francisco to outline a comprehensive plan of development. Mr. Freeman's report is by far the most daring and all-comprehensive of municipal projects ever proposed. He has carefully estimated that by the year 2000 the population in the cities around the Bay, including San Francisco, Oakand, Berkeley, Richmond, Alameda, San Jose, Palo Alto, Redwood City and San Mateo will total 3,632,000, and will require a daily water supply of 441,000,000 gallons. In addition, it is proposed to obtain a supply of about 100,000,000 gallons a day for irrigating 95,000 acres. The general features of Mr. Freeman's scheme are as follows:—

A dam 300 ft. high is to be erected at the dam site of Hetch Hetchy by which the floor of the valley will be flooded to a depth of 270 ft.; a wagon road is to be built to Hetch Hetchy Valley equal in point of construction to the State highways with no grade exceeding 8 ft.; a scenic road is to be constructed at Hetch Hetchy Valley on both sides of the lake— this, as shown in the illustration, will make available the wonderful attractions of a region now inaccessible. And finally, the Hetch Hetchy aqueduct is to be built from this valley to San Francisco. This aqueduct will consist largely of a tunnel 10 ft. in diameter, for the most part deeply below the surface of the ground. This tunnel extends to the easterly edge of the San Joaquin Valley. Thence continuing westward across the valley, the suggested aqueduct will consist of one steel pipe 7 ft. 6 in. in diameter, and ultimately of two steel pipes side by side of similar proportions, about 45 miles in length. On the westerly side of the San Joaquin Valley the steel portion is to end about 8 miles westerly from the San Joaquin River. From this point the aqueduct proceeds westerly for the most part in the form of tunnels about 12 to 13 ft. in diameter to a point near the village of Irvington, at which point the terminal chamber and gate-house will be built, and branch aqueducts lead off as desired to Oakland, San Jose, San Francisco and other communities. From this point the aqueduct would proceed in the form of a steel pipe submerged across the Dumbarton Narrows near the head of the Bay, or it could be carried on dry ground around its head to a suitable point in San Mateo County, whence it could discharge by gravity at an elevation of 320 ft. through a new tunnel into Crystal Springs Reservoir or could feed branch lines leading to neighboring communities and to a main aqueduct line leading directly to San Francisco. The proposed aqueduct between Hetch Hetchy and the Irvington gate-house would be designed to deliver by force of gravity without pumping a quantity somewhat in excess of 400,000,000 gallons daily, equivalent to 620 ft. per second. All the tunnels will from the first be built to their full size and smoothly lined with concrete. During the early year, with only the single pipe line across the San Joaquin Valley, the delivery of the aqueduct would be in excess of 200,000,000 gallons daily, possibly 240,000,000. The branch line to supply the San Francisco peninsula will have a capacity of about 100,000,000. It is proposed to utilize the water until the population requires it for domestic use in the reclamation of arid land in and about the Bay region.

That portion of the tunnel, as shown in the illustration, which is about 12 miles in length and lays down stream from Hetch Hetchy, is to be delayed in construction for some years. Eventually, however, the construction of this tunnel will afford the development of 75,000 horse-power. At the point on the illustration marked "Power House No. 1" is seen a drop of 1,425 feet into Moccasin Creek, where 70,500 horse-power is developed. In addition to this it is proposed to construct a canal 8 ft. in diameter from the Hetch Hetchy Reservoir to the reservoir site in Cherry Valley, passing beneath the Lake Eleanor Reservoir site, with intake shafts at Cherry Creek and Lake Eleanor for the purpose of diverting their waters into the Hetch Hetchy reservoir. Only temporary dams are to be constructed at these two latter points, reserving for future demands a more permanent and substantial form of construction. The drop, as shown on the profile of this tunnel work, allows an additional development of power to the extent of 12,500 horse-power. Hence, in all, there is a total possible power development of 157,500. The entire project as proposed for immediate construction is estimated to cost $38,500,000. Mr. Freeman makes note of the fact that standing water tends to purify, and hence the purest supply of water is to be expected from this high Sierra construction. Indeed, he has stated in public before the Commonwealth Club, of San Francisco, that in comparing the softness of this supply to the softness of supply that might be developed from the Sacramento rivers, the saving in soap alone to the community about the Bay would eventually pay the interest on a $3,000,000 investment. To insure sanitary perfection and non-corrosion of the steel material in the pipe line, the pipe conduit is to be lined with concrete throughout its entire length.

A GRAVEL WASHING PLANT.

The gravel washing plant of the T. R. Nickson Company, which is shown in the illustration, is located within the business district of Vancouver, B.C., on the water front. Unwashed gravel is brought to the plant on barges, is washed and sized here, and delivered by teams as required in various parts of the city.



A Gravel Washing Plant at Vancouver, B.C.

As all towing is paid for by the yard, it is cheaper to bring in the raw material on barges than the sized, as in the former case, the fines fill the voids between the larger stones, allowing the unsized gravel to occupy about 20 per cent. less space and it is on this account that the plant is located within the city.

Gravel is unloaded from the barges by means of a grab bucket delivering into a receiving hopper at the plant. This hopper feeds an elevator, 56 feet centres, and equipped with 18 x 9 x 12-inch continuous buckets. The discharge from this elevator passes into a double chute feeding two rows of 54 inch Gilbert washing screens. These screens are all of the improved type, being provided with removable inner wearing skirts; these skirts increase the capacity of the screens and practically double the service of the outer screen plates. The typical arrangement of the screens in each row is adhered to, each screen successively separating the larger sizes into the bins and passing the fines and the water to the next screen. The last screens each deliver to a single discharge settling tank for separating the sand from the clay and loam in the water.

The first screens reject all the stone over two inches back to a jaw crusher below. This crusher delivers to a crusher elevator, 40 feet centres, with 9 x 9 x 9-inch continuous buckets, discharging to a small revolving screen. From here, the stone is passed to three bins, which supply the trade with crushed gravel.

All bins are equipped with swinging cut-off valves, which are operated from the wagons. These valves are balanced so as to be self-closing and they are consequently very easy to operate. They are entirely of cast iron, giving a very simple, rugged construction that can not get out of order and that can not choke up or spill.

This plant was designed and equipped by the Stephens-Adamson Manufacturing Company, of Aurora, Illinois.

CAUSE OF THE DESTRUCTION OF THE CANADIAN TAMARACK.

The almost total destruction of the tamarack, or larch, which took place throughout Eastern Canada almost thirty years ago, was caused by an insect, the Larch Sawfly. It appeared again about eight years ago, and in its spread westward it is repeating its former devastation on the younger tamaracks.

To all who are interested in our forests the appearance of a comprehensive account of this insect entitled "The Large Larch Sawfly, with an account of its Parasites, other Natural Enemies and Means of Control," by the Dominion entomologist, Dr. C. Gordon Hewitt, will be welcome. This has been published by the Dominion Department of Agriculture as Entomological Bulletin No. 5 and Bulletin No. 10 of the Second Series of the Experimental Farms Bulletins, and may be had free, on application to the Publications Branch, Department of Agriculture, Ottawa.

Dr. Hewitt has studied the life-history, habits and means of control of this injurious sawfly, both in England and North America. In England, it was found that the natural enemies, especially parasitic insects, effectively gained control of outbreaks of the insect. Other natural enemies were mice and birds and a system of bird encouragement was started on a large scale. The devastating spread of the sawfly in North America was due to the comparative absence of the natural means of control. Several important species of parasites new to science were discovered and have been studied and described. To increase the number of natural enemies of the sawfly, attempts are being made to introduce and establish in Canada parasites which were discovered in England and which appeared to control the pest there. An account of these interesting experiments and of the methods devised to encourage the birds and other means of control are described in this bulletin which consists of forty-two pages and contains twenty-six figures, including a colored plate. The publication of this bulletin is indicative of the attention which the Division of Entomology is now devoting to the insect pests of our forests which are responsible for incalculable loss each year.

COAST TO COAST.

Fort William, Ont.—David Johnson, a young clerk, was electrocuted in the show window of a men's furnishing store by an ordinary tungsten lamp when he was endeavoring to replace the broken light. It was only a 110-volt line. He died instantly.

Strathcona, Alta.—Extension lectures have been arranged in seven towns of Southern Alberta by the Department of Extension of the University of Alberta. These towns are Red Deer, High River, Macleod, Pincher Creek, Lethbridge, Taber and Medicine Hat.

Kaifers, B.C.—The entire top of a section of Jackass Mountain, opposite this place, on the line of the C.P.R., collapsed a few days ago, hurling into the Fraser River hundreds of thousands of cubic yards of rock, ruining a 249-foot tunnel of the C.P.R. The slide made a noise that was heard for miles. No lives were lost.

Toronto, Ont.—The employees of the Consumers' Gas Company, this city, are to be afforded the opportunities and benefits of a course of training along the lines of salesmanship and general education. This company recently joined the membership of the National Commercial Gas Association and in this connection the employees are entitled to instruction from the correspondence department of the parent offices.

Moose Jaw, Sask.—City Engineer Antonisen, after an inspection of the mines and property of the Consumers' Coal Company, has stated that a supply of coal for economical power purposes may be secured from the areas of coal south of this city. His plan includes the erection of a power plant at the mines and the construction of a high-voltage transmission line into a municipal step-down station. It is reported that there are ten million tons of coal easy of access in this region.

Provinces of Ontario and Quebec.—A deputation of five representing the Ontario Government, occupied seats on the floor of the Legislative Assembly, November 27th, to confer with the government regarding certain suggestions that have been made for the celebration of the peace century between Canada and the United States. The members of this deputation were Hon. Jas. Duff, Minister of Agriculture; the Hon. Mr. Reaume, Minister of Public Works; Mr. John G. Kent and Dr. J. O. Orr. They were entertained by the Speaker, Hon. Mr. Delage.

Hamilton, Ont.—City Engineer A. Macallum has submitted to the works committee a plan for a cross-city flood sewer. He said the cost of sewer to cover 75 per cent. of the district would be $360,000, and to cover 95 per cent. $596,679. Controller Allan suggested that if the sewer project were in shape they could submit a by-law to the people to raise money at the same time as the Hydro-Electric Commission was to be elected, in May. The city engineer also submitted plans for improving the sewage disposal works in the east end, and was instructed to submit them to an expert.

Ottawa, Ont.—The Board of Railway Commissioners of Canada have issued specifications dealing with the erection of highway crossing signals. They are as follows: The signal must be placed upon a post of suitable structural material. If the post is made of wood, it must be of sound timber not less than 8 x 8 inches and 18 feet long, and shall be firmly set in the ground to a depth of four feet. If it is made of iron or steel, it shall be not less than 4 inches in diameter, shall extend at least twelve feet above the ground, and shall be firmly bolted to a concrete or other foundation constructed below the frost line. A bell which shall emit a clear, loud volume of sound under all weather conditions must be used. A sign shall be placed upon the same post as the bell, with the word "danger" upon it in letters not less than 6 inches in length, to be illuminated, so as to be plainly visible after sunset. There may be added to the post, if so desired, the railway crossing sign provided for by Section 243 of the Railway Act.

Regina, Sask.—The proposal to divert water from the South Saskatchewan River to supply the needs of Regina, Moose Jaw and many of the towns to the southern part of the province has been taken up by the Federal Government. It will be remembered that during the latter part of last year and the early part of this the Provincial Government had T. Aird Murray, consulting engineer, of Toronto, go into the question fully and it is understood his report was favorable to the furtherance of the scheme. The Federal Government has three parties of men at the Elbow and Tugaske to take levels at the river bend, about thirty miles west of Elbow, and to secure other information relative to the matter. H. E. M. Kensitt, the inspector of the water powers branch, Department of the Interior, has been in charge of the work. It is understood that all the preliminary work has been completed, and it is expected that an official statement concerning the matter will be given out within the near future. To carry out the proposed scheme would require the laying of a pipe line about 140 to 170 miles in length, according to a statement made by Mr. Kensitt, and the cost would be between $5,000,000 and $7,000,000.

Ottawa, Ont.—Judge Gunn's report on the recent waterworks investigation was received by the city council on December 2nd. It places the blame for the typhoid epidemic on the waterworks coimmittee, board of health, City Engineer Ker, and Medical Health Officer Sherreff. The waterworks committees from 1908 to 1912 are censured for failure to give their duties the consideration warranted by their importance. The board of health is held responsible through failure to undertake earlier investigation of the polluted water situation. Judge Gunn says: "I place on the committees of 1910-11 the responsibility for the conditions of the steel and concrete piers, because these committees were in a position to exact that the new pipe be tested and laid by experienced workmen, and I regard that testing and laying of the new pipe, steel and concrete as the most important element to be considered in this investigation. Because of the many new duties thrown upon him by the Public Health Act, I do not consider that the present medical health officer will, to his own or to the satisfaction of the citizens, find that office acceptible, and a grave injustice was, in my opinion, done Dr. Sherreff when he was placed by his friends and supporters in a position that was in every way a difficult and most trying one. I unhesitatingly acquit of any irregularity or attempt other than lawful means to secure his appointment. The appointments to the board of health should not be made for the purpose of giving municipal office to an ex-alderman or prominent citizen who has no other qualifications. I would recommend that in order that the new council might have a free hand in the reorganizing of the department, these gentlemen, (present members with terms still to run) throw up the seals of office."

PACIFIC COAST COLLIERIES.

The Pacific Coast Collieries, Limited, has been formed with capital of $3,500,000 bonds, $1,500,000 6 per cent. preferred stock, and $3,500,000 common stock, which has taken over the Pacific Coast Coal Mines, Limited.

LARGE PIPE FITTINGS.

Three special fittings of large size have just been made for the Crane Falls Power and Irrigation Company, of Caldwell, Idaho.

The three cast-iron bell-end fittings have a combined weight of 19,150 pounds, the larger one in the figure weighing 10,850 pounds, the smaller one 4,200 pounds, and the third 4,100 pounds.

View of Large Fitting.

The dimensions are, respectively: 5 feet with three 24-inch flanged outlets. 4 feet 4½ inches with two 24-inch flanged outlets, and 3 feet 10 inches with two 18-inch flanged outlets.

These are all discharge fittings for pumps and were ordered through the Portland branch of Crane Co. by Smith, Kerry & Chase, engineers for the power and irrigation company. The fittings connect at the bell-end to wood pipe and at the flanged ends to spiral steel pipe penstocks. The largest fitting will work under a static head of 159 feet, the next in size under a head of 89 feet, and the smallest under a head of 54 feet.

◆

PERSONAL.

E. L. COUSINS, B.A.Sc., harbor engineer for the Toronto Harbor Commission, delivered an address to the Toronto branch of the Canadian Society of Civil Engineers on Thursday evening, November 28th, on the new plans for Toronto harbor. The meeting was very well attended, about one hundred and fifty being present.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., professor of highway engineering in Columbia University, on November 25th delivered an address entitled "The Art and Science of Highway Engineering" at the celebration of Founders' Day at the Clarkson School of Technology.

STANLEY M. OBORN, who is in the main drainage department of the Department of Works, Toronto, has been elected an Assoc. M. Can. Soc. C.E. Mr. Oborn has had a varied experience in municipal engineering in England, and has been in Canada about six months.

JOSEPH OWEN, of London, England, has been appointed assistant to Mr. John Wilson, city engineer, of Fort William Ont.

JAMES WALKER, Assoc. M. Inst. C.E., M.I. Mech. E., we are informed, is about to join the staff of Messrs. Boving & Company, Limited, water power engineers, of 9½ Union Court, E.C., and will also join the board of directors. After a long and extensive experience with the contracting firm of Messrs. S. Pearson & Son, of Westminster, he was engaged by Messrs. J. G. White & Company, Limited, of 9 Cloak Lane, E.C., with whom he has been for the last nine years, acting as construction superintendent on large works abroad, and latterly as engineer in charge of construction in the head office in London. With his wide experience in hydro-electric undertakings and civil engineering work in general, he will undoubtedly be a great acquisition to the firm in its already large and rapidly increasing business. It will also interest our readers to learn that Mr. Reginald K. Morcom has also consented to act on the board of Messrs. Boving & Company.

VIRGIL G. BOGUE, a New York engineer, has been retained in a consulting capacity by the Canadian Pacific Railway in connection with double-tracking of the main line between Vancouver and Calgary.

Hon. Robert Rogers, Minister of Public Works.

◆

MEETINGS.

Mr. C. C. Cariss, of E. Leonard & Sons, lectured on the "Clayton, Logarithic Analysis of Cylinder Performance" before a large audience at London, Ont. Mr. Cariss showed how improved performance could be obtained from steam and other heat engines by improved methods of indicator diagram analysis.

◆

OBITUARY.

JAMES M. SHANLEY, one of the best known civil engineers in Canada, died on November 28th, at Montreal. The deceased was born in Illinois 55 years ago, but came to Canada at an early age. He was educated at Galt Collegiate Institute and Toronto University. After graduating he started practising in Montreal. One of the first pieces of work done by the late Mr. Shanley was in connection with the Beauharnois Junction Railway, now a part of the New York Central's road into Montreal. He is survived by Mrs.

Shanley, who is a daughter of Mr. Robert Conroy, of Aylmer, three sons and three daughters.

C. W. LEONARD, of the firm of E. Leonard and Sons, of London, Canada, passed away on November 22. Mr. Leonard was born in 1852 and at the time of his death was just 60 years old. He was educated in the London public schools, and at Upper Canada College. After completing his course at the latter institution he entered the employment of his father, the late Senator Elijah Leonard. Later on he was admitted to partnership, and after the death of his father, Mr. Leonard and his brother carried on the business under the name of E. Leonard & Sons. Mr. Leonard's death, which was due to heart failure, was very sudden, as he had been at work in the office the night before until nearly 6 o'clock, as usual. He is survived by his widow and one daughter, Mrs. Dr. Fitzgerald, of California.

COMING MEETINGS.

CANADIAN SOCIETY OF ENGINEERS.—Mechanical Section Meeting will be held in the rooms of the Society, 413 Dorchester Street West, Montreal, December 5th, 1912. Chairman, H. H. Vaughan.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

UNION OF MANITOBA MUNICIPALITIES.—Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg, Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W. Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of	Page.
Edmonton, Alta., paving	Dec. 10.	Nov. 21.	74
Kamloops, B.C., steam power station equipment	Dec. 5.	Nov. 21.	76
Kerrisdale, B.C., steel pipes	Dec. 2.	Nov. 7.	76
Louiseville, P.Q., erection of public buildings	Dec. 9.	Nov. 28.	65
Monteith, Ont., frame schoolhouse	Dec. 14.	Nov. 28.	65
Montreal, P.Q., railway ties	Dec. 20.	Nov. 14.	65
Moose Jaw, Sask., steel bridge	Dec. 6.	Nov. 21.	74
Ottawa, Ont., timber purchases	Dec. 5.	Nov. 28.	65
Ottawa, Ont., conveyance of H.M. mails	Dec. 13.	Nov. 7.	76
Regina, Sask., power house, laundry and refrigerating plant	Dec. 14	Nov. 28.	65
Rocky Island Park, Alta., timber purchases	Dec. 12	Nov. 28.	65
St. Joseph, N.B., extension of college	Dec. 31	Nov. 28.	65
Toronto, Ont., four steel bridges	Dec. 20.	Nov. 28.	65
Toronto, Ont., erection of school	Jan. 7	Nov. 28.	65
Toronto, Ont., engines and boilers	Dec. 10	Oct. 31	74
Vancouver, B.C., steel pipe, etc.	Dec. 11	Nov. 28.	66
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., turbines and governors	Dec. 16	Nov. 28.	66

TENDERS.

Bassano, Alta.—George B. R. Bond, secretary-treasurer of the corporation of this town, will receive sealed tenders, accompanied by a marked cheque equal to 5 per cent. of the tender price, up to 8 p.m., Monday, December 9th, next, for the following work:—

Contract T—All labor and materials for constructing a concrete pump shaft, 130 feet deep, and laying 18-inch steel intake pipe in tunnel from shaft to Bow River, 225 feet in length, and constructing intake crib in river.

Contract H—All labor and materials for constructing frame power house at Bow River.

Contract F—All labor and materials for constructing frame frost casing for stand-pipe, 25 feet in diameter and 112 feet high.

Plans and specifications for all contracts may be obtained from the John Galt Engineering Co., Limited, Winnipeg and Calgary, on deposit of cheque for $10, which will be returned to bona fide tenderers.

Province of British Columbia.—Mr. P. Welch, railway contractor, has recently awarded a number of sub-contracts for the construction of the Pacific and Great Eastern Railway.

Dunnville, Ont.—Messrs. Heap and Partners, Montreal, have been awarded a contract for the installation of turbine pumps as required by this municipality.

Eau, Ont.—The management of the Lake Erie Coal Company have awarded a contract to Messrs. Morgan & Tifft for the erection of a roundhouse and other buildings at this point, which is not far from London.

Kamloops, B.C.—The date for receiving tenders, steam, pumping and electrical equipment for the new civic power house, has been extended to December 19th, 1912. (See advertisement in Canadian Engineer.)

Moncton, N.B.—Sealed tenders, addressed to L. K. Jones, Esq., Assistant Deputy Minister and Secretary, Department of Railways and Canals, Ottawa, and marked on the outside, "Tender Freight Car Repair Shop, Moncton," will be received up to and including Monday, December 16th, 1912, for the construction of an addition to the freight car repair shop at Moncton, N.B. Plans and specification may be seen at the office of the above and at the office of the Engineer of Maintenance, Moncton, N.B., at which places forms of tender may be obtained.

Ottawa, Ont.—R. C. Desrochers, Secretary Department of Public Works, will receive sealed tenders up to 4 p.m. Monday, December 30th next for the supply of machinery for a 3½ yard dipper dredge. (See full particulars in Canadian Engineer, advertising section.)

Quebec, P.Q.—R. C. Desrochers, Secretary Department of Public Works, Ottawa, will receive sealed tenders for the erection of an addition and certain alterations to the Central Post Office, Quebec, P.Q., up to 4 p.m. on Monday, December 23rd next. (See advertisement in Canadian Engineer.)

Toronto, Ont.—The municipal Board of Control will receive tenders for supplies up to noon December 10th, 1912, (See full particulars in the advertising section of this paper.)

Vancouver, B.C.—Sealed tenders for the construction and engining of two twin-screw steamers, 95 ft. long, 18 ft. beam and 9 ft. depth, fitted with triple-expansion, surface-condensing steam engines and water tube boilers, will be received up to December 12th next by the West Vancouver Ferry Board, care of Messrs. Morris, Bulkeley & Halliday, Vancouver. The plans, specifications and conditions of contract may be obtained from Messrs. Morris, Bulkeley & Halliday, naval architects, 610 North-West Trust Building, Vancouver, on payment of fee of $5. Separate tenders will be considered for the construction of the hulls, and for the machinery and installation, but preference will be given to firms who will undertake the building and equipping of both vessels complete.

Yorkton, Sask.—The contract for the equipment of the electrical plant for this town (pending certain changes in the financial aspect of the deal) have been awarded to the following companies: Canadian Boving Company, Diesel engine; Westinghouse Company, switchboard; Siemens Company, alterator and exciter. The cost of this work is given at $39,453.30.

CONTRACTS AWARDED.

Ottawa, Ont.—The Wm. Hamilton Company, of Peterborough, Ont., will supply two boilers or apparatus needed here for thawing out frozen water services. Their tender of $427 for the total was the lowest.

Port Arthur, Ont.—The contract for the construction of a breakwater at this point has been awarded to the Thunder Bay Contracting Company, Limited, of Port Arthur. The price is not made public.

St. Boniface, Man.—The contract for the furnishing and installation of a motor and motor-driven pump, as required by this municipality, has been awarded to the Canada Foundry Company, of Winnipeg, at a price of $2,732. Other bidders were the John McDougal Caledonian Iron Works, Limited, Montreal; Escher, Wyss & Co., Montreal; Heap & Partners, Limited, Montreal; Chapman and Walker, Montreal and Winnipeg; Drummond McCall & Co., Montreal; Goold Engineering Co., Winnipeg.

RAILWAYS—STEAM AND ELECTRIC.

Edmonton, Alta.—The civic railway department are considering the extension of the car tracks in a northerly direction.

Montreal, P.Q.—The Canadian Pacific Railway will spend $48,000,000 in new rolling stock.

North-Eastern Ontario.—It is reported that the Grand Trunk Pacific Railway has entered an agreement with the North Railway Company whereby the Grand Trunk Railway will secure running rights over that line from Montreal to the Bell River, where the North Railway crosses the Transcontinental 250 miles from Montreal and half way to the James Bay.

Province of Saskatchewan.—Railroad construction during the last half decade has added 2,847 miles to the lines in this province.

Toronto, Ont.—The operation of the Temiskaming and Northern Ontario Railroad for the twelve months ending October 31st last resulted in a balance of $510,000 to the credit of earnings. This is $10,000 in excess of expectations.

◆

LIGHT, HEAT AND POWER.

Fort William, Ont.—Mr. M. O. Robinson, manager of the joint board of street railway commissioners, has stated that the power-house in this city is working at maximum output, and if additional cars are required a sub-station and generator will have to be added to the service.

Lindsay, Ont.—The Light, Heat and Power Company have been instructed to install ten additional arc lamps on the streets of this town.

New Westminster, B.C.—Application for extensive water rights on Brandt Creek, Indian River, Young Lake and Norton Lake are to be made very shortly by the New Westminster Power Co., Limited, as a preliminary to the establishment and erection of a power plant to supply the Fraser Valley district with current for lighting and power purposes. The New Westminster Power Company is composed of a number of local parties backed by English capital.

Regina, Sask.—Mr. Wynne-Roberts has reported that the two thousand million tons of lignite in the southern portion of this province is suitable for power production.

St. Thomas, Ont.—It is reported that the Hydro-Electric department of this city has 4,800 consumers.

◆

GARBAGE, SEWAGE AND WATER.

Arcola, Sask.—The Canadian Pacific Railway surveyors have located a desirable source of water supply for this town in the Moose Mountains, a distance of ten miles. This railway have planned extensive developments at this point, and it is probable that the water will be piped into the town.

Brantford, Ont.—The municipal water commissioners are considering the extension of the waterworks as required by the fire underwriters. The cost of this work is estimated at $150,000, and this includes considerable iron pipe.

Calgary, Alta.—The municipal council have been asked to approve the purchase of a motor-driven pump of 10,000,000 gallons capacity. This is to be placed one mile west of the present pumping plant and will cost $20,000.

Hamilton, Ont.—There is a probability of the council appointing an engineer to prepare a report on the matter of sewage and sanitation now before the consideration of the authorities.

London, Ont.—Mr. Willis Chipman, of Toronto, is examining and checking the plans, already prepared, for a storm sewer system for this city.

Ottawa, Ont.—The civic incinerator is now operating under a test which is likely to continue for about two weeks.

Ottawa, Ont.—The plans for the Ottawa filtration plant have been unanimously approved by the Provincial Board of Health.

BUILDINGS AND INDUSTRIAL WORKS.

Estevan, Sask.—Mr. Geo. Barr, of Gladstone, Sask., will erect a plant at this point for the manufacture of bricks.

Fredericton, N.B.—According to an announcement recently made by Hon. John Morrissy, Chief Commissioner of Public Works, a large addition will be added to the Normal School in this city in the spring of 1913. This work will cost about $35,000.

Guelph, Ont.—The ratepayers will be asked to vote the sum of $15,000 to be used in the erection of a fire hall and equipment for the same. T. J. Moore is clerk of this municipality.

Hamilton, Ont.—Mr. Griffin, well-known theatre owner, states his intention of erecting a $75,000 playhouse in this city.

London, Ont.—The Eisendrath Glove Company, of Chicago, will establish a branch factory in this city.

Medicine Hat, Alta.—The Alberta and Saskatchewan Paper and Strawboard Products Co., Limited, of Calgary, will erect a factory in Medicine Hat. It will cost in the neighborhood of $150,000. Messrs. C. F. Schaub and F. A. Burton, Calgary, are directors of the company.

Medicine Hat, Alta.—Mr. J. H. Tabor, of Calgary, is a member of a recently formed company that are about to erect a plant in this city for the manufacture of confectionery.

Montreal, P.Q.—The various athletic associations of McGill University are agitating for the erection of a modern dressing-room with all suitable fittings, such as steel lockers, etc.

Montreal, P.Q.—Messrs. Putnam and McCrory were agents for parties who purchased a site fronting on Dominion Square with the intention of erecting a large hotel.

Norwich, Ont.—The Dominion Canners according to report, will establish a large factory at this point.

Regina, Sask.—The Minneapolis Threshing Company, of Minneapolis, Minn., U.S.A., will erect a plant in this city for the manufacture of their products. Mr. T. H. Roney is in charge of the branch office.

Sault Ste. Marie, Ont.—The steel plant of the Lake Superior Corporation is to be greatly extended at once at a cost of several millions. Another blast furnace will be built and the coking plant increased. Mr. J. Fraser Taylor is an official of this company.

South Vancouver, B.C.—Mr. Walter Thomas is negotiating for the installation of a gas plant in this municipality.

St. Catharines, Ont.—Griffin's family theatre is to be enlarged to double the present dimensions.

St. Thomas, Ont.—The management of the Erie Iron Works have notified certain contractors of their intention to call tenders for the enlargement of their works. Much new machinery is also to be purchased.

Toronto, Ont.—The Civic Works Commission have voted the sum of $147,420 to be expended in additions to the plant for the roadway and sewer sections of the engineering department.

Vancouver, B.C.—Tenders for the erection of a five-story mill construction stores and apartment building on Robson Street, near the corner of Thurlow, to cost about $100,000, will be called for soon. Mr. Emil Guenther is the architect for this building.

Victoria, B.C.—The British Columbia Electric Railway Company will erect terminal facilities in this city to facilitate the operation of their line to Saanich.

Weyburn, Sask.—The management of the Weyburn Sash, Door and Glass Company will increase their present plant

Copies of The Canadian Engineer dated October 24th, Volume 23, No. 17, and November 14th, Volume 23, No. 20, 1912 are required. Subscribers sending in copies will have their subscriptions extended one month without extra charge.

Barrett Specification Roofs

A Mile of Barrett Specification Roofs

The wonderful Bush Terminal in Brooklyn, New York, illustrated below, includes 181 buildings, comprising tremendous warehouses, enormous pier sheds for docking ocean steamers, huge factory buildings, a large modern power house and an enormous freight structure. These buildings stretch for a mile along New York harbor. Their total roof area is 3,100,000 square feet—more than seventy acres.

The entire area was covered with Barrett Specification type of roofs, for the following reasons:

1. Low first cost.
2. No maintenance expense, such as painting, etc.
3. They are not injured by steam, gases and acid fumes.
4. They are fire retardent and take the base rate of insurance.
5. The net unit cost, that is, the cost per foot per year of service, is lower than that of any other type.

Although some of the buildings are fifteen years old, the roofing contractor states that the expense for maintenance of this entire roof area has been less than $10.00. He estimates that if metal or ready roofings had been used, it would have been impossible to keep the buildings free from leaks and that the painting bill alone up to date would probably have amounted to at least $50,000.00.

We wrote to the Bush Terminal Company, asking what they thought about Barrett Specification Roofs. The Vice-President replied:

> "We use this kind of roofing because our experience has shown it to be the best and cheapest. Our analysis of first cost of application and cost of maintenance entitles us to speak with some measure of authority."

We shall be pleased to mail architects, engineers or owners of buildings copy of the Barrett Specifications with diagrams from which blue prints can be made. Address our nearest office.

Special Note

We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—The ratepayers endorsed a by-law calling for the erection of a high-level bridge across the Bow River, together with two smaller structures. Eight hundred thousand dollars is the preliminary estimate, but the actual cost of this work will be almost $1,000,000 before completion.

Calgary, Alta.—The municipal council propose to charge a rate of $2.10 against property owners benefiting from pavements laid from the new civic plant. The net cost of this work is $2.02 which leaves a gain of $2,192.63 from one year's operation.

Fort Francis, Ont.—The Board of Trade of this municipality are arranging with the Ontario Crown Lands Department for the construction of a highway between this point and Rainy River. The cost of this work is estimated at $200,000 for the sixty-mile stretch, and if completed will give one of the best automobile and wagon roads in Canada. J. F. Whitson is chief engineer of this department.

Moose Jaw, Sask.—It is reported that the proposal to divert the South Saskatchewan River to Regina and Moose Jaw is receiving considerable attention from the Federal government.

Toronto, Ont.—Owing to indications of inferiority in the creosote-treated wood blocks that have been supplied to the engineering department of this city the department will purchase blocks of southern pine and treat them before laying in order that a comparison may be established. R. C. Harris, Commissioner of Works.

Toronto, Ont.—Works Commissioner Harris has been given authority to call tenders for a stone quarry containing suitable materials for road construction in the recently acquired sections of this city.

Victoria, B.C.—A report, dated November 27th, states that street paving work has closed for the winter in this section of the country.

◆

FIRES.

Bremner, Alta.—A large elevator at Bremner, fourteen miles east of Edmonton, the property of the Alberta Grain Company, was totally destroyed by fire. Over 11,000 bushels of grain was consumed.

Dryden, Ont.—Fire destroyed the power house and sluice-gates of the Dryden Timber and Pulp Company November 28th, entailing a loss of $100,000. The loss falls on Harris & Harris, contractors, Toronto, who had about completed work.

◆

CURRENT NEWS.

Province of British Columbia.—Telegraphic communication has been established by the Government line between Fort George, on the Grand Trunk Pacific main line, and Stuart Lake, the old Hudson Bay post of Fort St. James, a distance of about 60 miles, thus marking another step in the progress of development in the central interior of British Columbia. The rate on this new line will be 75 cents for a 10-word message and 5 cents a word for every additional word.

Calgary, Alta.—Dr. Mahood, recently appointed Medical Health Officer for this city, is to make a strenuous effort to have all possible places of contagion eradicated. He will direct his first efforts toward several doubtful eating houses.

Edmonton, Alta.—It is reported that contracts for 511,533 square yards of paving will be awarded about December 16th.

Galt, Ont.—It is reported that the Board of Health will appoint a sanitary inspector.

Hamilton, Ont.—Certain aldermen are negotiating for a revolution in the method of conducting business at the city hall. Alderman Horning, who is interested in the matter, declares that the present system is years out of date, and what is needed is modern methods of system and office appliances for the proper working of the various offices.

Hamilton, Ont.—Alderman Newlands has been making some slight investigation into the amount of work accomplished by the average civic laborer, and has stated one or two instances which would tend to show lack of organization in this department.

Hull, P.Q.—A delegation from this city have requested assistance in the proposed erection of a technical school.

TRADE ENQUIRIES.

The following were among the enquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending 18th November 1912:—

A co-operative shipping agency in Ireland make enquiry for the names of reliable shippers of wood in Canada suitable for the manufacture of butter boxes.

A correspondent in North Wales, interested in several slate quarries, is desirous of opening a market in Canada for roofing slates, and would like to hear from importers.

A well-known Lancashire firm of solid woven belting manufacturers desire to appoint a first-class Canadian agent.

A London correspondent, stated to be interested in a new tree-felling device, makes enquiry for names of Canadian lumber firms.

A North of England firm manufacturing filtering cloths for all kinds of oils, for paper soap, paint and varnish, glue and porcelain manufacturers, sugar refiners, flour millers, etc., and specializing in a feed-water heater filter cloth for marine and land engines, wish to enter the Canadian market.

A West of England firm of architectural metal workers, who make electric light fittings, and every kind of ornamental metal work, wish to appoint a reliable agent to represent them in Canada.

Enquiry is made by a firm at Copenhagen for the names of Canadian agricultural implement manufacturers desirous of doing business in Scandinavia.

A Montreal firm of leather merchants are in the market for supplies of best worsted, cheviot, vicuna and beaver cloths, and would like to receive quotations and samples from United Kingdom manufacturers.

From the branch for city trade enquiries, 73 Basinghall Street, E.C.:—

A London firm which does the whole of the buying for its branches in Cape Town, Johannesburg, and Port Elizabeth, would be pleased to get into touch with Canadian manufacturers of lines suitable for the South African market. These include agricultural machinery and implements, printing and wrapping paper, stationery, furniture, hardware, brushes, paints, wearing apparel, boots, etc.

The London manufacturers of a patented wire netting fastening machine seek suitable Canadian resident agents

◆

DISSOLUTION OF PARTNERSHIP.

The firm known as Vandeleur and Nichols, Dineen Building, Toronto, Ont., comprising Mr. J. B. Vandeleur and Mr. R. H. Nichols, is in process of dissolution. The business, however, has been actively managed by Mr. Nichols for the past few months, and it is the intention of Mr. Nichols to carry on business in the same lines as heretofore.

◆

WITH THE FAIRBANKS-MORSE COMPANY.

Mr. Cyril J. Atkinson, M. I. Mech. E., inventor and patentee of the Atkinson gas producer and a number of special devices pertaining to gas producers, has severed his connection with the Dornfeld-Kunert Company, of Watertown, Wisconsin.

Mr. Atkinson's services and the use of all his patents have been secured by Fairbanks-Morse & Co., and a number of Mr. Atkinson's valuable patents will be incorporated in the Fairbanks-Morse gas producers at once. This company will place Mr. Atkinson's services at the disposal of the public for adapting the Fairbanks-Morse gas producers to meet the requirements of the various industries desiring to substitute producer gas for fuel oil. This will be of particular service and effect large economies in forge shops, malleable iron foundries, galvanizing plants, enameling works, brass foundries, etc.

◆

The Tiffin Wagon Company of Tiffin, Ohio, who have manufactured for many years a complete line of dump wagons and carts, are commencing to build motor trucks. The company expect to be ready to supply trucks for spring delivery. They are represented in Montreal, Toronto and Vancouver by Messrs. Francis Hankin & Company.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire
Machine Banded

WOOD
STAVE PIPE

CONTINUOUS
STAVE PIPE

RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

'CARLTON' SPRINKLERS AT LINCOLN (ENGLAND)

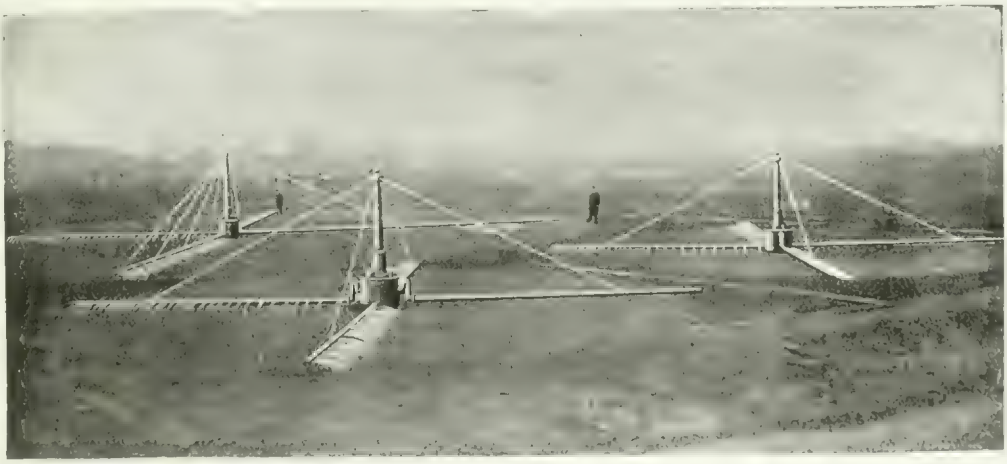
The City Engineer, R. A. MacBrair, Esq., writes:

DEAR SIRS, *April 18th, 1910.*

I have to inform you that the three sprinklers, one 107 ft. 6 in. and two 45 ft., which you supplied us with and fixed in November last, are working well and giving me satisfaction.

Yours sincerely (Signed) R. A. MACBRAIR.

A Detailed Specification giving thicknesses of metal, is sent out with every estimate.



Every machine is guaranteed to be of the best workmanship and material.

TUKE AND BELL, LTD.,

69 LEADENHALL STREET,
LONDON, E.C.

AGENTS FOR CANADA:

LAURIE AND LAMB, 211 BOARD OF TRADE BUILDINGS, MONTREAL

2

RAILROAD WORK IN THE ARGENTINE.

J. G. White & Company, Inc., have just received telegraphic advice of the award to their London associates (J. G. White and Company, Limited), of railroad construction work in the Argentine, amounting to about $4,000,000, from clients for whom they have carried out several previous contracts; this new contract, like the others, being on their usual basis of cost plus a fee.

The railroad to be constructed constitutes the connecting link in the through system between Brazil and the Argentine Republic, the terminal at Buenos Aires and Rio de Janeiro.

◆

RECENT ADDITIONS TO FACTORY OF VICTOR BALATA AND TEXTILE BELTING COMPANY, EASTON, PA.

It is the exception rather than the rule that manufacturers are compelled to increase their production facilities during the year of a Presidential election. Heretofore the general rule has been to curtail expenses and await the immediate developments following a change of administration, and consequently a change of policy.

While business in general during the past six to eight months has been hardly more than normal it is a matter of considerable gratification that the Victor-Balata and Textile Belting Company, of New York city and Chicago, with factories in Easton, Pa., has been compelled to build additions with added machinery to its already large textile factories where Victor-Balata and Victory and Ampere canvas-stitched belting are made.

It is generally well known that increased facilities, more machinery, etc., have been forced by the rapidly increasing demand for Victor-Balata belting since it has been made in America, and the many friends of the company will be pleased to learn of the much-needed factory increase now in the course of construction, in the canvas-stitched belting department to accommodate the expanding trade in this particular line.

This pleasing condition has been brought about by universal recognition of the superior points of excellence contained in the two noted brands—Victory and Ampere. The ordinary lines of canvas-stitched belting on the market have nothing of especial significance to commend them to the buyers, and the selling proposition is one where "all belts look alike," and simply a matter of "price" or of personal influence, or both.

Both Victory and Ampere canvas-stitched belting have characteristic points of construction that place them in a distinctive class by themselves, commending them to discriminating buyers, who purchase on a "quality" basis and not on price only.

The principal points of excellence are the inside hardened edges, the absence of undesirable stretch, and the special impregnation and painting processes, these latter being two entirely separate processes, thus allowing the use of different ingredients for impregnating and painting, in contrast to the one mixture and one process common to other makes of canvas-stitched belting. The inside hardened edges of Victory and Ampere canvas-stitched belting allow it to be used for drives requiring shifters which are harmful to the edges of belting. The hardened edges prevent the belting from fraying out, tearing, etc., when the edges come in contact with parts of machinery, installation work, etc., of elevators and conveyers, as is often the case.

The absence of stretch is the result of a strictly individual and scientific method of stretching the belting during the course of construction.

The special impregnation mixture used makes the duck absolutely waterproof and preserves the life of the belting, which will never dry out but will always remain pliable, strong and free from cracks.

With the great advantages gained by the features mentioned, both Victory and Ampere are lifted out of the ordinary class of this kind of belting and then present points of long life, efficiency and economy that are easily appreciated and recognized by the purchaser who wants the best of the kind.

Both grades are made in many commercial plies, widths and lengths. The company makes a specialty of wide and heavy belts for long conveyer work, elevators, etc., and is prepared to handle promptly all orders. Full information will be cheerfully given upon request and samples and prices sent to those interested.

NEW INCORPORATIONS.

Victoria, B.C.—Adkison & Dill, $150,000 (builders).

South Wellington, B.C.—Wellesley Lumber Co., $32,000.

South Vancouver, B.C.—Cement Products Co., $10,000.

New Westminster, B.C.—Westminster Development Co., $150,000

Saskatoon, Sask.—Canadian Clay Products, $150,000. Monarch Construction Co., $25,000.

Tilbury, Ont.—F. S. Carr Rubber Co. of Canada, $40,000. J. E. Day, J. M. Ferguson.

Peterboroughh, Ont.—Forest Products Co., $40,000. H. G. Rogers, H. G. Logan, W. H. Hill.

Caledonia, Ont.—Haldimand Gypsum Co., $150,000. J Old, G. H. Hornibrook, J. W. Avery.

Thorold, Ont.—Fibre Products, $250,000. F. W. Manson, G. J. Manson, W. McA. Marquis.

Moncton, N.B.—Vye Sectional Brake Shoe Co., $100,000. B. D. Vye, J. H. Rogers, S. Humphrey.

Port Arthur, Ont.—Russell Timber Co., $50,000. W. H. Russell, T. A. Read, W. F. Langworthy.

Brockville, Ont.—Gilbert Motor Boat Co., $100,000. F. R. Gilbert, J. E. Lowey, S. J. Kilpatrick.

Regina, Sask.—Regent Motors, $100,000. Coal Savers, $260,000. Great West Textile Co., $1,000,000.

Quebec, Que.—Eagle Battery Co. of Canada, $100,000. A. Galipeault, L. S. St. Laurent, H. LaFerte.

Fort Frances, Ont.—Canadian Message Irons Co., $250,000. O. C. Damm, L. H. Nord, D. C. McKenzie.

Winnipeg, Man.—Canadian Pulp and Lumber Co., $1,000,000. L. E. Brownell, R. Brownell, T. R. Ferguson.

Victoria, B.C.—Vancouver Island Hydro-Electric Tramway Co., $500,000. Telkwa Light and Power Co., $500,000.

Windsor, Ont.—Canadian Roofing Manufacturing Co., $75,000. L. H. Cheeseman, C. J. Cheeseman, Detroit; H. W. Unsworth Sarnia.

Bridgeburg, Ont.—Economy Fuse and Manufacturing Co. of Canada, $10,000. G. E. Bennett, E. B. Mallory, New York; W. B. Stephenson, Pittsburg.

Ottawa.—National Saw and Forge Co., $500,000. N. A. Belcourt, J. A. Ritchie, E. R. E. Chevrier. French Industrial Co., $500,000. J. A. Therien, R. Beaudry, L. R. Beaudry, Montreal.

Vancouver, B.C.—Fraser Mills Sash, Door and Shingle Co., $500,000. Barrow Contractors (mining), $30,000. Granville Construction Co., $100,000. Canadian Brewing and Malting Co., $250,000. Union Brewing Co., $200,000.

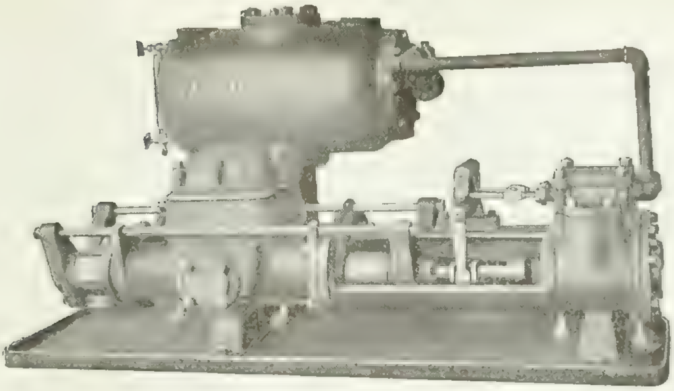
Berlin, Ont.—Acme Furniture Co., $40,000. J. Lauffer, J. Hunt, P. L. Kroetsch. Wino Manufacturing Co., $40,000. C. M. Zuber, J. M. Zuber, H. B. Taylor. Chippewa Oil and Gas Co., $50,000. E. Shantz, A. Cressman, M. C. Bowman.

Vancouver, B.C.—Alberta and British Columbia Oil Lands, $10,000. Purdy & Lonergan (builders), $10,000. Lito-Silo (acquire patents, including one for compounding plastic composition for use as flooring wainscoting, etc.), $10,000. Middlewest Lumber Co., $100,000. Vancouver Reinforced Concrete Co., $100,000.

Toronto.—Northern Quarries, $50,000. J. H. Young, A. Todd, L. W. Archer. Medina Shale Brick Co., $180,000. A. W. Holmsted, W. L. Carr, C. J. F. Collier. Radcliff Saw Manufacturing Co., $40,000. W. E. Radcliff, F. Watts, T. M. Mulligan. Floating Castile Soap, $100,000. J. L. Galloway, T. M. Mulligan, W. E. Whitehead. Dominion of Canada Postage Stamp Vending Co., $2,000,000. W. A. J. Case, J. B. Taylor, G. C. Loveys.

Montreal.—Guarantee Plumbing, Heating and Ventilating Co., $10,000. W. H. Dunn, Maisonneuve; J. Stopford, A. Hall, Montreal. United Railway Supplies, $20,000. E. E. Howard, H. U. P. Aylmer, J. Dewitt. Canada Stone Co., $1,000,000. W. H. Fulton, J. B. Kenny, D. C. Sinclair, Halifax. Fyfe Scale Company, $10,000. J. A. Mann, C. G. McKinnon, T. B. Gould. Atlantic Sugar Refineries, $10,000,000. A. Chase-Casgrain, E. M. McDougall, J. J. Creelman.

Montreal. Kraemer Manufacturing Co. of Canada, $10,000. A. A. Bittues, Montreal; C. A. Wilkinson, Westmount; S. L. Zink, New York. St. Maurice Sand Co., $50,000. C. A. Goyette, J. C. H. Trudeau, T. Girard. Lubricants, $200,000. C. Arnold, Westmount; T. Cozzolino, Sydney; G. A. Snider, Montreal. Newfoundland Slate Quarries, $500,000. H. J. Elliott, L. A. David, E. C. Baker. Canadian Incinerating Co., $100,000. Hon. F. E. Gilman, Westmount; P. R. Schravesande, L. H. Boyd. Canadian Filter Faucet Co., $250,000. J. R. Middlemiss, New York; W. J. Poupore, Sir E. R. Murray. Hadrian Flooring Company of Canada, $20,000. F. G. Bush, G. R. Drennan, M. J. O'Brien.



This Feed Pump and Receiver Is More Reliable Than a Steam Trap

It can handle sudden rushes of water better. By the use of this Pump the annoyances experienced with steam traps, tanks and similar devices are entirely eliminated.

This is a simple and effective combination of our duplex steam pump attached to a receiving tank, which receives the water of condensation and the pump automatically returns it to the boiler at the highest possible temperature.

It is especially useful for returning water of condensation from steam heating coils, drying cylinders, evaporating effects or in any place where it is desirable to return such condensation to the boiler at as high a temperature as possible.

The tanks used with our pumps and receivers are made strong enough to stand a pressure of 100 lbs. per square inch.

The capacity of the Fairbanks-Morse Duplex Ram Pattern Pump and Receiver shown above is 50 gallons per minute. Full details furnished upon request.

ASK FOR CATALOG No. 13.

THE CANADIAN FAIRBANKS-MORSE COMPANY

LIMITED

MONTREAL ST. JOHN OTTAWA
TORONTO WINNIPEG SASKATOON
CALGARY VANCOUVER

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

18093—November 21—Authorizing C.P.R. to construct spur for the Brick & Supplies, Ltd., Sec. 20, Tp. 25, R. 3, W. 5 M., at Glenbow, Alta.

18094—November 21—Authorizing C.N.R. to construct spurs in city of Regina, Saskatchewan.

18095—November 21—Authorizing C.N.O.R. to construct across Sanguinet St., Montreal, Que., by means of overhead structure.

18096—November 20—Authorizing C.N.O.R. to construct across G.T.R., at Stoney Creek, Tp. Saltfleet, Co. Wentworth, Ont.

18097—November 19—Establishing the collection and delivery limits of the Dominion Express Co., in town of Macleod, Alta.

18098—November 20—Establishing the collection and delivery limits of the Dominion Express Company, in town of Windsor, N.S.

18099—November 20—Establishing the collection and delivery limits of the Dominion and Canadian Express Companies, in Sackville, N.B.

18100—November 20—Establishing the collection and delivery limits of the Dominion Express Co., and the Express Department of the Halifax and South-Western Ry. Co., in the city of Yarmouth, Nova Scotia.

18101—November 19—Recommending to the Governor-in-Council for sanction the Indenture of Conveyance, dated Oct. 3rd, 1912, between the Cap de la Madeleine Ry. Co., and C.P.R.

18102—November 19—Recommending to the Governor-in-Council for sanction the Indenture of Lease, dated Oct. 2nd, 1912, between the Kingston & Pembroke Ry. Co., and the C.P.R.

18103—November 18—Directing C.N.R. to construct a third-class station at Waldheim, Saskatchewan.

18104—November 22—Authorizing C.P.R. to construct additional track across two (2) highways on Swift Current Subdivision, Saskatchewan Division, mileage 52.34, to mileage 53.36.

18105—November 20—Restoring, subject to certain conditions, Order No. 16460, dated May 7th, 1912, authorizing C.P.R. to construct branch line at Merritt, B.C.; and rescinding Order No. 17549, dated September 21st, 1912.

18106—November 22—Authorizing the payment of $350 to the Vancouver, Westminster & Yukon Ry. Co., deposited to credit of the Board to defray expenses of constructing a spur.

18107—November 22—Disallowing Supplement No. 6 to Central Ontario Ry. Co.'s Special Joint Freight Tariff on Canned Goods, C.R.C. No. 298 (G.T.R.'s C.R.C. No. E. 1928); and restoring Tariff C.R.C. No. 298.

18108—November 18—Directing C.N.R. to appoint a caretaker to take care of station and freight shed at Beadle, Saskatchewan.

18109—November 22—Directing C.P.R. and C.N.R. to jointly publish and file a tariff of through rates on grain products from Grenfell, Sask., via Regina, to Glenavon at 18½c. per 100 lbs., and 19c. per 100 lbs., to Kipling.

18110—November 23—Authorizing G.T.R. to construct siding and spurs therefrom, for the Canadian Rumely Co., Ltd., Toronto, Ont.

18111—November 22—Approving proposed location C.P.R. station at Sumas Junction, B.C.

18112—November 11—Directing C.N.R. to immediately repair its fences along right-of-way between Dufresne and St. Ann, Manitoba.

18113—November 22—Directing G.T.R. to provide proper accommodation for live stock at Mildmay, Walkerton, Brussels, Waterloo, Chesley and Elora, Ontario.

18114—November 25—Authorizing T. H. & B. Ry. to construct spur in the Twp. of Saltfleet, Co. Wentworth, Ontario.

18115—November 25—Authorizing Algoma Central and Hudson Bay Ry. Co., to open for traffic its main line from mileage 93 to Hawk Lake Junction, mileage 164.5.

18116—November 25—Authorizing Algoma Eastern Railway Company to open for traffic main line from Crean Hill, mileage 22.7, to West River, mileage 60.76.

18117—November 25—Authorizing C.P.R. to open for freight traffic its Bassano to Irricana Branch between Bassano and Standard, a distance of 35.62 miles.

18118—November 25—Authorizing C.P.R. to open for traffic new second track of Chapleau Subdivision, from Cartier to Geneva, a distance of 3.6 miles.

18119—November 25—Authorizing C.P.R. to open for traffic its second track between White River & Tarpon, mileage 0 to mileage 3.5, Lake Superior Division.

18120—November 25—Amending Order No. 17715, dated October 10th, 1912, by substituting the words, "Franktown Road" for the words, "Main Street," in second line of recital to said Order.

18121—November 26—Suspending, for 60 days from December 1st, 1912, pending a hearing of application by Board, the Pere Marquette R.R. Co.'s Tariff C.R.C. No. 1539, and rate on coal from Detroit, Mich., to Windsor, Ont., as published in C.P.R. Supplement No. 9, to C.R.C. No. E. 1676.

18122—November [illegible]—Amending Order No. [illegible], dated April 26th, 1911, and [illegible], dated May 4th, 1911, authorizing C.N.R. to use certain lands of the C.P.R.

18123—November [illegible]—Establishing the collection and delivery limits of the Canadian & Dominion Express Companies, in town of Sussex, New Brunswick.

18124—November 11—Directing C.N.R. to file with the Board plan showing a [illegible] to be constructed at about mileage [illegible], Sec. 9, Tp. [illegible], R. [illegible], W. First Principal Meridian.

[illegible]—November [illegible]—Approving C.P.R. plan showing proposed reconstruction of [illegible] No. [illegible] of [illegible] Subdivision, Ontario Division.

18126—November 26—Authorizing C.P.R. to construct its Suffield to Kipp Branch across highways from mileage 0 to mileage 32.85; approving revised location of said Branch from mileages 0 to 21; and approving location of said Branch from mileage 21 to mileage 32.85, Alberta.

18127—November 25—Granting leave to C.P.R. to operate trains over diamond at the crossing of its railway with the Hull Electric Railway, until January 31st, 1913.

18128—November 26—Authorizing C.P.R. to construct two spurs, crossing the highways in Townsite of Bull River, B.C., and the Government Road in Lot 118.

18129—November 26—Authorizing C.P.R. to construct two spurs on the property of the Montreal Light, Heat and Power Company. on Lot Cadastral No. 159, Incorporated Village of Hochelaga, Que.

18130—November 26—Authorizing C.N.O.R. to construct across two highways in the District of Nipissing, Ontario.

18131—November 26—Authorizing G.T.P. Branch Lines Company to construct its Biggar-Calgary Branch across highway between Secs. 3 and 4, Tp. 31, Rge. 26, W. 3 M., mileage 85, Rural Municipality of Prairiedale No. 321, Dist. Saskatoon, Saskatchewan.

18132—November 25—Extending for a period of 30 days from the date of this Order, the time within which C.P.R. complete spur to connect present spur with present G.T.R. spur, which serves the Agricultural Implements Works of D. Maxwell & Sons, Lot 19, Con. 17, Tp. of Blanchard, Co. Perth, Ont.

18133—November 20—Authorizing C.N.R. to construct second track across Dawson Road in city of St. Boniface, Manitoba.

18134—November 28—Approving Marconi Wireless Telegraph Co.'s Tariffs of tolls C.R.C. Nos. 6 and 7, and cancelling C.R.C. No. 4.

18135—November 27—Directing that C.P.R. interswitching charges for any distance within, and including, 4 miles from Point-a-Carcy Wharf, not exceed 1c. per 100 lbs., minimum $3 per car, to or from private sidings, and 1½c. per 100 lbs., minimum $5 per car, to or from public team tracks, to become effective not later than December 9th, 1912.

18136—November 28—Extending until December 15th, 1912, the time within which the Dominion Atlantic Railway install electric bell at highway a short distance east of Berwich Station, N.S.

18137—November 28—Authorizing Algoma Eastern Railway to construct spur to Mond Nickel Mine, Lot 8, Con. 5, Tp. of Denison, Ont.

18138—November 27—Authorizing Michigan Central Railway to construct proposed bridge as part of No. 1 Government Drain, Tp. of Tilbury East, Ontario.

18139—November 28—Approving location C.N.O.R. station at Newburg, Ont.

18140—November 27—Authorizing Canadian Northern Montreal Tunnel & Terminal Company to construct across Vertu Road, between Lots 258 and 359, Parish of St. Laurent, Co. Jacques Cartier, Que.

18141—November 27—Authorizing C.N.R. to construct Morris-Portage Branch across Souris Branch of C.P.R. in S.W. ¼ Sec. 7, Tp. 9, R. 3, W.P.M.

18142—November 28—Approving revised location C.P.R. through Tps. 30-31, Rgs. 17-20, W. 4. M., Alberta, mileage 280.62 to mileage 303.03.

18143—November 28—Authorizing G.T.R. to construct siding for the Orillia Building and Realty Company, Limited, Orillia, Ontario.

18144—November 28—Approving proposed diversion of G.T.R. siding constructed to premises of Cleveland-Sarnia Saw Mills Company, Ltd., on Lots 1, 2, 3, and 4, Block S, and Lot 4, Block A, town of Sarnia, Ont.

18145—November 28—Authorizing C.L.O. & W. (C.P.R.) to construct bridge No. 33.2 over 4th Depot Lake, near Parham, Tp. Hinchinbrooke, Co. Frontenac, Ontario.

18146—November 27—Authorizing C.P.R. to open for traffic its second main line track from 1 Acadia, mileage 24.46, to St. Constant, mileage 35.9, Farnham Subdivision, Eastern Division; rescinding Order 17999, November 15th, 1912.

18147—November 28—Authorizing C.L.O. & W. (C.P.R.) to construct bridge No. 34.01 across 3rd Depot Lake, near Parham, Tp. Hinchinbrooke.

18148—November 28—Authorizing C.P.R. to construct spur for the Booth Lumber Company, Limited, situated on northerly side of right of way north of road allowance, between Cons. 1 & 2, Tp. of Etobicoke, Co. York, Ontario.

18149—November 26—Rescinding Order No. 18030, dated November 15th, 1912, in so far as it authorizes the crossing of Liberty Street, mileage 148.46, (by C.L.O. & W.) in town of Bowmanville.

18150—November 27—Authorizing C.P.R. to construct two spurs in the city of Sherbrooke, Que.

18151—November 28—Authorizing C.L.O. & W. to construct across highway between Lots 8 and 9, Con. 1, Tp. Brighton, Co. of Northumberland, Ont., at mileage 99.15.

18152—November 27—Authorizing C.P.R. to construct spur for the Monarch Lumber Co., Ltd., Saskatoon, Sask.

◆

RAILWAY ORDER AFFECTING CARGO AND TRAFFIC EMBARGO.

The Board of Railway Commissioners for Canada have recently issued the following order:—

Whenever a railway company subject to the jurisdiction of the Board, issues an embargo against any traffic, it shall, within forty-eight hours thereafter, file with the Board a copy of such embargo, with a statement of the conditions rendering such embargo necessary, the action required to remove such conditions, and the probable time such embargo will be continued. And when such embargo is withdrawn or cancelled, the company shall forthwith file with the Board a copy of such withdrawal or cancellation.

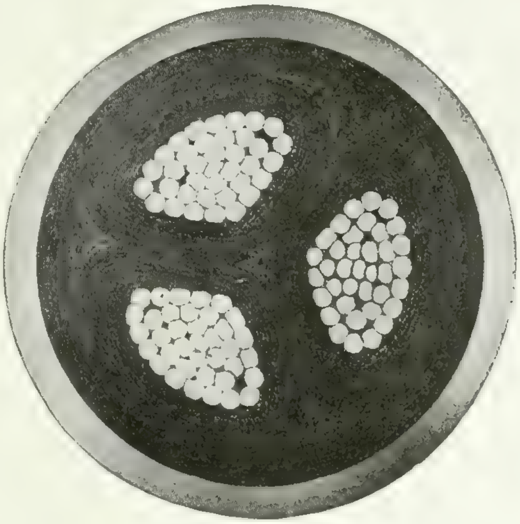
Power Cables

Manufactured by British Insulated & Helsby Cables, Limited

Paid-up Capital $8,500,000.00

HEAD OFFICE - PRESCOT, ENGLAND
Works at Prescot, Helsby and Liverpool

WORKING PRESSURE 13,200 VOLTS



300,000 CM. Three Conductor, Paper-insulated, Lead-covered Cable supplied to the Montreal Light, Heat & Power Company to the Specification of R. M. Wilson, Esq., M. I. E. E., Chief Engineer.

Sole Canadian Representatives:

Canadian British Insulated
Company Limited
MONTREAL

TENDERS CALLED FOR

TENDERS FOR ANNUAL SUPPLIES, DEPARTMENT OF WORKS.

Tenders will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, Canada, up to noon on **Tuesday, December 10th, 1912,** for

Refined Asphalt,
Brass and Bronze Castings,
Brass Work for House Services,
Cast-iron Pipes,
Crushed Stone,
Cement,
Cedar Posts,
Field Tile,
Granite Boulders,
Hardware,
House Numbers,
Hydrants,
Treated Wood Blocks,
Iron Valve and Stop Cock Boxes,
Iron and Steel,
Lead Pipe,
Limestone Dust,
Lubricating Oils,
Lumber,
Paving Blocks,
Rubber Valves, etc.,
Sand and Gravel,
Special Castings,
Sewer Pipe,
Stop Valves,
Street Signs,
Sewer Brick.

Specification and tender form for any of the foregoing may be obtained upon application at the Head Office of the Department of Works, City Hall, Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

The usual conditions relating to tendering as prescribed by city by-law must be strictly complied with, or the tenders may be declared informal.

Tenderers shall submit with their tenders the names of two personal sureties, approved by the City Treasurer, or in lieu thereof, the bond of a guarantee company as aforesaid.

The lowest or any tender not necessarily accepted.

H. C. HOCKEN (Mayor),
Chairman Board of Control.

City Hall, Toronto, November 10th, 1912.

CITY OF KAMLOOPS, B.C.

STEAM POWER STATION EQUIPMENT.

EXTENSION OF TIME.

Tenders will be received up to noon Thursday, **December 19th, 1912,** for 1,000-h.p. Steam, Pumping and Electrical Equipment for the New Power Station for the City of Kamloops, B.C.

Plans and Specifications may be seen at the office of the City Clerk, and at the office of DuCane, Dutcher & Co., Consulting Engineers, Vancouver, B.C., or at the office of R. S. Lea, New Birks Building, Montreal.

Duplicate tenders must be addressed to the City Clerk, Kamloops, in a sealed envelope marked "Tender Power Station Equipment," and accompanied by a certified cheque for five per cent. of the amount of the tender.

Plans and Specifications may be obtained by making a deposit of $15, which will be returned on receipt of a bona-fide tender. The lowest or any tender not necessarily accepted.

J. J. CARMENT,
City Clerk.

Sealed tenders addressed to the undersigned, and endorsed "Tender for Addition and Alteration to the Central Post Office, Quebec, P.Q.," will be received at this office until 4.00 p.m., on **Monday, December 23rd, 1912,** for the work mentioned.

Plans, specification and form of contract can be seen and forms of tender obtained on application to Mr. A. R. Decary, Esq., District Engineer, Quebec, P.Q.; at the office of Mr. R. L. Deschamps, 103 St. Francois Xavier Street, Montreal, and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 2nd, 1912.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—30508.

CITY OF EDMONTON,

ENGINEERING DEPARTMENT,

1913.

Sealed tenders addressed to the undersigned and endorsed "Tenders for Paving, 1913," will be received at the office of the City Commissioners, Edmonton, Alberta, until 12 o'clock noon (12.00 N.) on December 10th, 1912, for approximately 400,000 square yards of Asphalt and Bitulithic Pavement.

Plans, specifications and all information may be obtained at the office of the City Engineer, or plans and specifications are on file at the office of The Canadian Engineer, 62 Church Street, Toronto, and the Contract Record, Toronto.

Companies wishing to tender on Asphaltic concrete pavement must submit their own specification, with tendered prices.

A deposit fee of fifteen ($15.00) dollars is required when plans and specifications are taken away. This fee will be refunded, provided that the plans and specifications are returned within 10 days after closing of tender.

An accepted cheque for the amount of five thousand ($5,000.00) dollars must accompany each bid.

The lowest or any tender not necessarily accepted.

CITY COMMISSIONERS.

Office of the City Commissioners,
Edmonton, Alberta, November 6th, 1912.

For further Tenders see page 76.

"STEELCRETE"

Expanded Metal Reinforcement

Twenty years ago the best—the best to-day. A reinforcement in readily handled sheets. Avoid labor costs—use the reinforcement suited to unskilled labor—STEELCRETE—it stays where put.

THE METHOD BY WHICH WE MANUFACTURE IS AN ABSOLUTE TEST OF THE STEEL.

Our automatic machines slit and open the meshes simultaneously from the cold sheet, thus increasing the elastic limit and the ultimate strength. The meshes are diamond shaped, the joints absolutely rigid. There are no corrugated or twisted strands—expanded metal lies flat.

NO STRAIGHTENING OUT ensues when load is applied to split the concrete before the reinforcement comes into tension. Once placed, disarrangement is impossible, as with rods. The required sectional area placed precisely as designed. Profit by others' experience. Use our "STEELCRETE."

Manufactured in Canada only by

STEEL AND RADIATION, LIMITED

TORONTO
Head Office, Fraser Avenue

MONTREAL
138 Craig Street West

QUEBEC: 101 St. John Street
WINNIPEG: N. J. Dinnen & Co., Canada Building

OTTAWA: 83 Banks Street
VANCOUVER: D. G. Collen, 418 Pacific Building

TENDERS CALLED FOR

Sealed tenders addressed to the undersigned, and endorsed, "Tender for Machnery for 3½ Yard Dipper Dredge," will be received at this office until 4 p.m. on **Monday, December 30th, 1912,** for the construction of machinery for a 3½ Yard Dipper Dredge.

Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of T. H. Schwitzer Esq., Mech. Superintendent, Birks Building, Ottawa, Ont.; A. E. Dubuc, Esq., District Engineer, Merchants' Bank Building, Montreal, Que., and J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.
Department of Public Works,
Ottawa, December 2nd, 1912.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—31360.

CITY OF REGINA.

TENDERS FOR POWER HOUSE, LAUNDRY AND REFRIGERATING PLANT AT REGINA GENERAL HOSPITAL.

Sealed tenders, endorsed "Tender for Construction of Power House, Laundry and Refrigerating Plant, Regina General Hospital," and addressed to the City Commissioners, Regina, will be received until 12 o'clock noon, Saturday, December 14, 1912.

Full particulars may be obtained upon application to Wenger & Cockburn, Room 208, Aldon Block, 12th Avenue, Regina.

Each tender must be accompanied by an accepted cheque for $2,500.00 made payable to the order of the city of Regina, which will be forfeited if the tenderer fails to execute the contract and bond when requested to do so.

The deposits of the unsuccessful tenderers will be returned when the contract is signed.

A deposit of $10.00 must be made with the application for the plans, as a guarantee of their return.

Proposals must be upon form of tender to be supplied upon application and must be in accordance with the provisions of the specifications.

Plans may be seen on file at the office of the Builders' Exchange, Winnipeg, and the Consulting Engineer, Regina.

The lowest or any tender not necessarily accepted.

L. A. THORNTON,
City Commissioner.

NEW YORK LEATHER BELTING COMPANY.

Notwithstanding that the price of leather is soaring to such an extent that its effect has been felt by leather belting manufacturers, whose business has been cut into by increased sales of textile belting, the New York Leather Belting Company has found it necessary to greatly increase its power plant and other parts of the factory owing to the recently former condition being inadequate to take care of increased business.

The power plant has been more than doubled, the heating system enlarged to heat increased space, and many other changes all through the large Brooklyn factory have been made and are now under construction.

When finally completed these will place the company in a better position to protect its friends in the way of deliveries, especially in very wide belts, a great number of which have been made and are now on order, contrary to the theory that such belts are being replaced by the use of direct connected installations.

The company's manufacturing facilities have not been equal to keeping up with the orders for Wetite, the waterproof leather belting, which is known the world over, and many thousands of feet of which have been sent to different parts of the United States and foreign countries.

It is but a very short time since the large additions to the lace leather tannery in Brooklyn were made to supply the demand for the company's lace leather products. The tannery is operated to its greatest capacity, such is the call for Victor brand of rawhide lace leather.

All of this goes to prove that the belting buyers of America readily recognize the economy of using high-grade quality leather belting distributed through jobbers only.

GET THIS FREE BOOK!
It points the way to a better understanding of
Cost Accounting — Storekeeping
Expense Distribution
The "SHAW" WAY
The SHORT WAY
The SURE WAY
Cut this out and mail today!
WE TEACH BY MAIL
The Shaw Correspondence School
Shaw Correspondence School, Yonge & Gerrard Sts., Toronto
Mail me post paid and free of all charge or obligation my copy of
"MANUFACTURING ACCOUNTING".
(Name)........................
(Address)........................
(City)........................
Canadian Engineer Offer.

OUR stock of supplies for the Civil Engineer, Surveyor, Architect is the LARGEST and MOST VARIED on the Coast.
Mail Orders Have Our Prompt Attention.
Write for Catalogue.
The Clarke & Stuart Co., Ltd.
320 Seymour Street, (Corner of Cordova) Vancouver, B.C.

What would be your answer?

IF a layman asked you—an engineer or a contractor—what you thought of concrete roads, what would you tell him?

You're likely to be asked—if someone hasn't already put the query to you. "Good roads" is a subject of vital interest to Canada and Canadians just now.

You're used to questions. People have a habit of asking men in your business about everything from aeroplanes to filtration plants.

You can answer most of them off-hand; but have you taken time yet to thoroughly post yourself on this big question of the day—"Good Roads"?

We've saved you most of the trouble of doing so, by collecting and "boiling down" a great amount of information on highway construction and especially on concrete highway construction. This information is complete and definite. It is yours—free for the asking.

A LETTER requesting our "Good Roads" literature will put you in possession of facts that will enable you to answer any questions on the subject of "Good Roads."

ADDRESS PUBLICITY MANAGER

Canada Cement Company
Limited
Herald Building - - MONTREAL

Sales Offices
MONTREAL TORONTO WINNIPEG CALGARY

CONCRETE highways are not experiments. Their wonderful possibilities are proven by years of experience.

CONDENSED ADVS.

Advertisements on this page are at the following rates per insertion: "Positions Wanted" advs., one cent per word; "Positions Vacant," "Agents or Agencies Wanted" advs., two cents per word; all other advertisements, three cents per word. The minimum charge per insertion is fifty cents.

POSITION WANTED as manager or superintendent of waterworks. Fifteen years' experience as manager, construction engineer and installing meter system with private company. Thoroughly familiar with all branches of waterworks business, especially in dealing with the public and employees. Open for engagement now. Address Box 298. Canadian Engineer, Toronto.

MECHANICAL ENGINEER, with large experience, is open for engagement. Box 294, Canadian Engineer, Toronto.

MECHANICAL ENGINEER seeks position. Large experience high-class machinery. Design, Manufacture, Estimating, Selling; held departmental charges with large firms. Good technical and practical experience. Box 278, Canadian Engineer, Toronto.

YOUNG MAN, GRADUATE OF A CIVIL ENGINEERING COLLEGE, experienced structural draughtsman, at present employed as structural draughtsman with a bridge concern near Montreal, is willing to do some work of engineering nature during his spare time. Write to Box 300, Canadian Engineer, Montreal.

MECHANICAL AND STRUCTURAL ENGINEER, with technical training, 18 (eighteen) years' experience in office and shop, wishes position as engineer with some company. Ready at short notice. Reply, with full particulars and salary offered, to Box 268, Canadian Engineer, Toronto.

HORNSBY'S CHEAP POWER.—$1.50 per h.p. per annum and upwards. Sixty to eighty b.h.p. in stock at Montreal; other sizes promptly. Address, Richard Hornsby & Sons, Limited, 212 McGill Street, Montreal, for Cheap Power Bulletin if you wish to generate your own power economically.

ONTARIO LAND SURVEYOR with 5 years' municipal and 4 years' railroad experience, at present in charge of railroad location party, wants permanent employment in former branch. Box 244, The Canadian Engineer, Toronto.

BLUE PRINT MACHINE—Buckeye electric, 42 inch by 5 ft.; two plates; used for 18 months; perfect condition. Full equipment of washing trays, etc., $200.00. First cost, $340.00. Box 296, Canadian Engineer, Toronto.

PRACTICAL ENGINEER and draughtsman, English, age 42, life experience in the design and manufacturing of locomotive and derrick cranes and other contractors' plant, seeks situation. Box 290, Canadian Engineer, Toronto.

WANTED AT ONCE, for about five weeks, by company at Niagara Falls, a first-class draughtsman who understands plant design. Travelling expenses will be paid to and from Niagara Falls. Apply stating qualifications. Salary $100 to $125 per month, depending on experience. Box 292, Canadian Engineer, Toronto.

CITY ENGINEER WANTED.

Applications will be received by the undersigned up to December 15th, 1912, for the position of City Engineer of the City of Peterborough, Ont. Applicants will state qualifications, experience and salary expected.

S. R. ARMSTRONG,
City Clerk.

November 19th, 1912.

TAKE NOTICE—That the undersigned are prepared to supply at a reasonable price Rolling Mills for I girders, described in Canadian Patent No. 103,260, or to grant anyone a license to have the same manufactured for him at a manufacturing establishment in the Dominion of Canada. They are also prepared to receive offers for the purchase of the patent or for licenses to manufacture under the same. Ridout & Maybee, 59 Yonge Street, Toronto, attorneys for Hugo Sack.

PATENT NOTICE.—Anyone desiring to obtain the invention covered by Canadian Patent No. 129,669, granted on December 6th, 1910, to C. Glaser and G. J. Muller, of Baltimore, Maryland, U.S.A., for Process of Refining salt, may do so upon application to the undersigned, who are prepared to supply all reasonable demands on the part of the public for the invention and from whom full information may be obtained. Fetherstonhaugh & Co., 53 Queen Street, Ottawa, Canada. Russel S. Smart, resident.

Patent Notice.—Notice is hereby given in regard to Canadian patents No. 102,830, Suspending and Hoisting Mechanism, granted January 1st, 1907, to O. Hetlesaeter, and No. 129,756, Steam Turbine, granted December 6th, 1910, to J. F. M. Patitz, that Allis-Chalmers-Bullock, Ltd., Montreal, is prepared to supply devices covered by these patents.

CRANE BRIDGE BARGAIN

Crane Bridge for sale at sacrifice, 5-ton capacity, 73 ft. 4 in. span, hand power operated, located at Sydney, Nova Scotia, used six (6) months, in A1 condition, cost $1,700.00. No reasonable offer refused. Send for sketch.

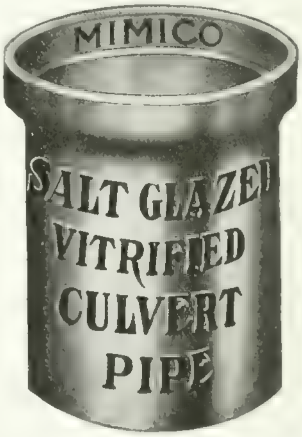
BOX 280,
The Canadian Engineer, Toronto.

When You Have Sewer Pipe to Buy CONSIDER THREE THINGS : : :

1st—Quality, 2nd—Delivery, 3rd—Price.

We don't aim to have a better price than anyone else, but we do claim **Higher Grade** and the **Promptest Delivery.**

BIG STOCK ALWAYS ON HAND.



4 inches to 24 inches. SINGLE AND DOUBLE STRENGTH

WRITE FOR CATALOGUE AND DISCOUNTS.

The Ontario Sewer Pipe Co.
LIMITED
MIMICO, ONTARIO

Telephones, Park 422; Evenings, Park 3888 & 3889, Toronto conn.

Volume 23. Toronto, Dec. 12, 1912

Contents of this issue on page 861

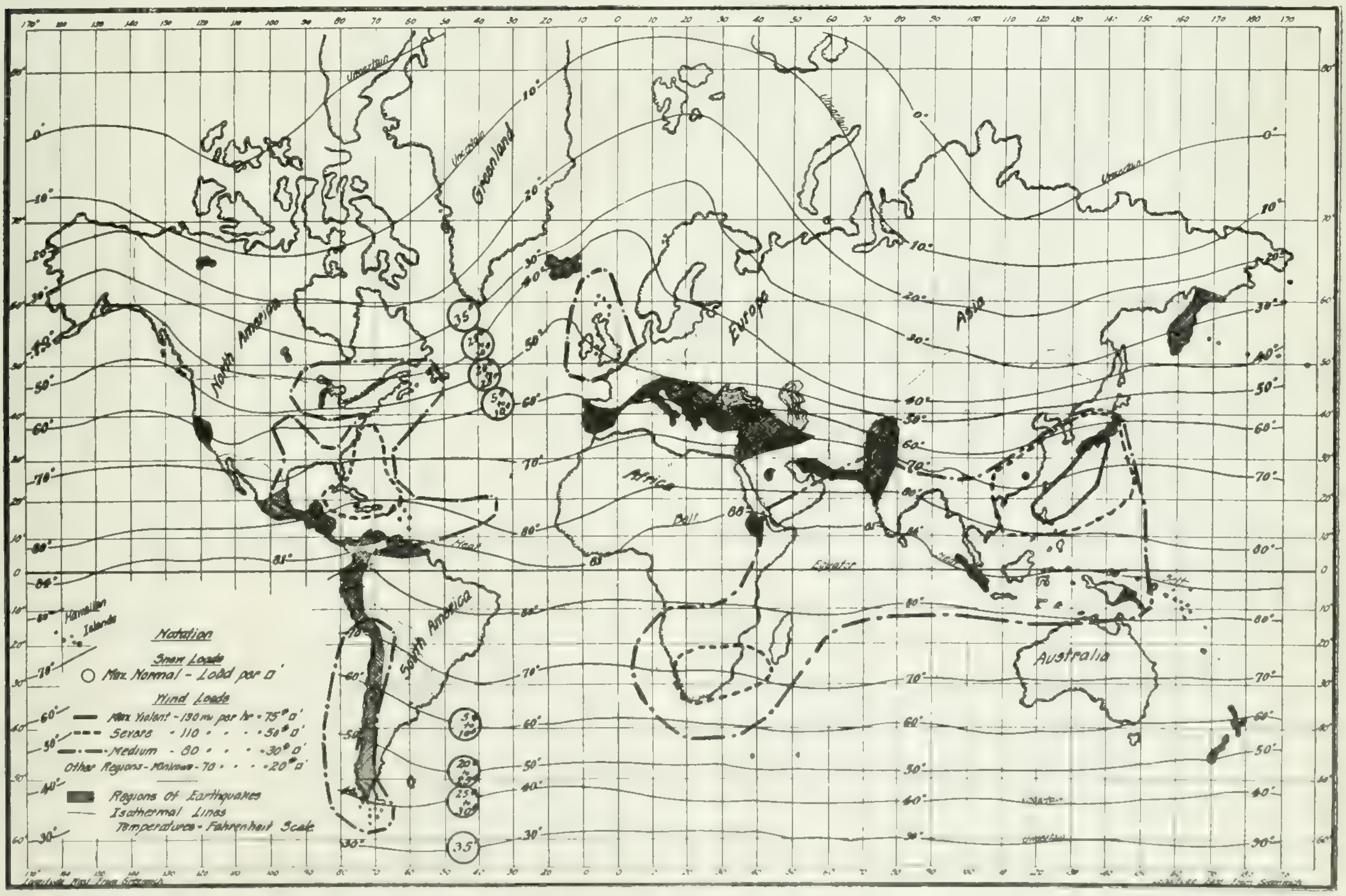
The Canadian Engineer

An Engineering Weekly

LOADING ASSUMPTIONS FOR STRUCTURAL DESIGN

By L. R. W. ALLISON.

Regional conditions of an extended period of time afford a basis for record which is vitally essential in computing loading assumptions for proposed structures. Variations in a specific locality covering many years would render a seasonable curve, if accurately plotted, comparatively uniform for the cycle average. Proper loadings for intelligent and comprehensive structural design, contingent with the elements, have been established for terms of latitude by practice.


North America
Greenland
Europe
Asia
Africa
South America
Australia
Hawaiian Islands
Notation
Snow Loads
○ Max. Normal - Load per □'
Wind Loads
Max Violent - 130 mi per hr - 75# □'
Severe - 110 - - - - 50# □'
Medium - 80 - - - - 30# □'
Other Regions - Minimum - 70 - - - - 20# □'
Regions Of Earthquakes
Isothermal Lines
Temperatures - Fahrenheit Scale
Longitude West From Greenwich

Such assumptions plotted upon regional lines are shown in the accompanying chart of the world. This offers in concise form, sufficiently accurate for all practical purposes, the fundamental considerations in design execution, especially for export work. The utility of the chart is evidenced for any section of the habitable world, and the method of composition permits of ready service. Additional loadings other than those dependent upon the elements are neglected, being, of course, features of construction that rest almost entirely upon the type of design and the particular purpose.

Snow Loads.—On the plotted temperature lines the normal horizontal snow load is given. This is maximum, and any reduction being proportional to the slope, the following formula is applicable:

Sn = normal snow load, pounds per sq. ft.

P = snow load for horizontal surface, pounds per sq. ft. (Obtained from chart).

a = angle of roof inclination with horizontal.

$$S_n = P\,(1 - \sin a). \qquad (1)$$

The curves obtained in Fig. 1, considering mean temperature from 30 to 60 degrees Fahrenheit, have been computed by this formula. This gives correct snow load assumptions for customary roof slopes from the horizontal to 60 degrees, or nearly 1 pitch, which is in excess of usual conditions. Any intermediate inclination is readily figured from the formula (1).

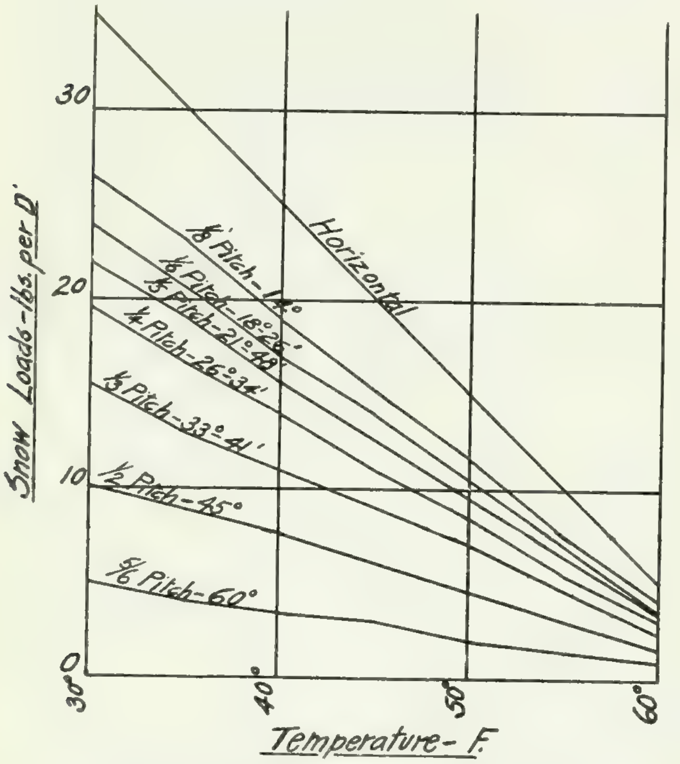


Fig. 1.—Snow Loads for Various Pitches.

Adjoining structures with roofs connected in series, as shown diagrammatically in Fig. 2, must be considered accordingly. Reduced loadings relative to pitch are computed for a, b, and c; full horizontal snow, as given on the map chart, is allowed for d, e, and f.

Correspondingly, when a high wind pressure is assumed the snow load should be reduced in proportion, in some cases practically neglected, as it is evident that such conditions would blow the snow from the roof.

Wind Loads.—Diverse conditions of winds and various allowances to be made for such are noted upon the chart. The pressure, dependent upon the velocity, is given as maximum. Such loadings, always considered as normal to the slope, are capable of reduction for customary roof pitches by using the following formula, and from which the curve (Fig. 3) is derived:

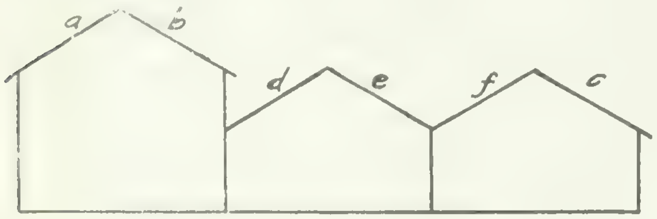


Fig. 2.

Wn = normal wind pressure, pounds per sq. ft.
Pl = maximum wind pressure on vertical surface, pounds per sq. ft. (Obtained from chart).
a = as in formula (1).

$$Wn = Pl\left(\frac{2a+5}{100}\right) \qquad (2)$$

For the various wind pressures given the formula (2) closely approximates the following:

$$\text{For 20 lbs. } Wn = \frac{4}{9}a$$

$$\text{For 30 lbs. } Wn = \frac{2}{3}a$$

$$\text{For 50 lbs. } Wn = \frac{9}{8}a$$

$$\text{For 75 lbs. } Wn = \frac{5}{3}a$$

These results are for "a" of 45 degrees or less; above this inclination the resulting normal and horizontal pressures are equal. The pressures given are in accord with modern practice, and for the United States and vicinity agree with tests made by the Signal Service Bureau.

Earthquake Regions.—The chart is serviceable in locating districts of seismal disturbances. As design in such localities embodies a thorough study of prevailing conditions, necessitating exceptional foundations and diagonal bracing for buildings in these regions, it is beyond the scope of intentions in presenting the map chart and explanation.

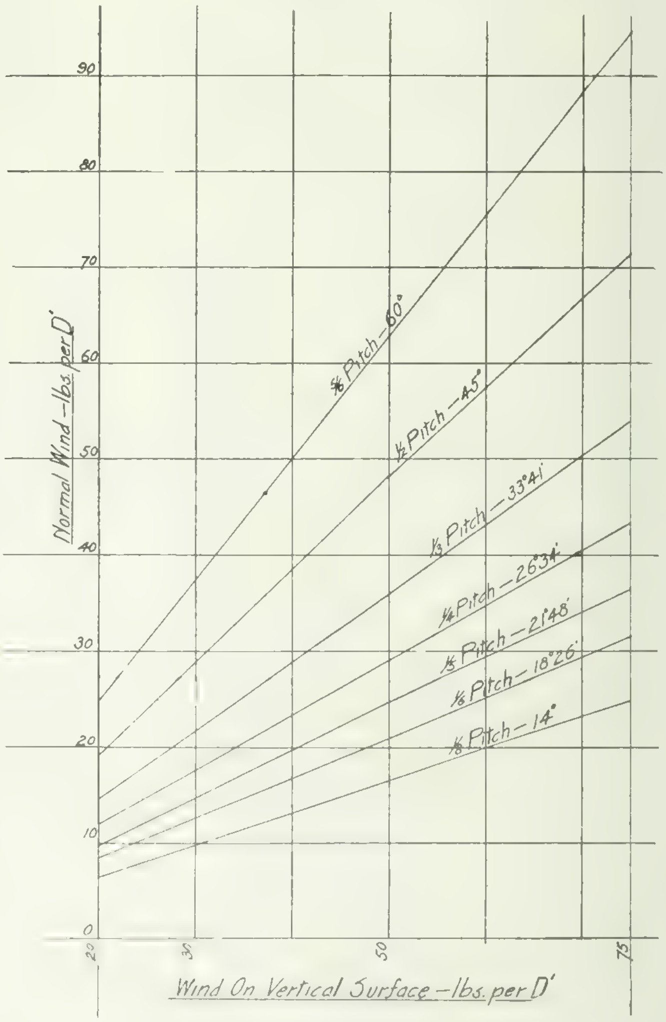


Fig. 3.—Wind Loads for Various Pitches.

The chart feature shown has been for some time employed in the engineering department of a large structural steel concern. The writer has embellished it where deemed essential, deriving the various curves shown from the formulas regularly used by this company.

THE PROTECTION OF THE FORESHORE AT DALLAS ROAD, VICTORIA, B.C.

The protection of the foreshore at Dallas Road, Victoria, B.C., has been the object of considerable work on the part of the Public Works Department of the province. Mr. G. M. Duncan, in a paper read before the Canadian Society of Civil Engineers, on November 7th, 1912, describes the work which has been done. The following abstracts are taken from the paper:

For several years the sea had been encroaching upon a part of this roadway, which runs along the coast overlooking the Strait of Fuca, with the consequence that the banks were gradually being eroded. In 1903 the city authorities commenced to build a low concrete wall to form some protection, and they continued building it in sections until it was about 1,500 feet in length in 1906. This wall, which had a height of 6 feet above high water, did not, however, prove of much service against the heavy seas which are prevalent during certain parts of the year. In 1910 the roadway was getting into a serious condition and the city authorities saw they would have to take immediate steps to form some permanent protection. A by-law was passed authorizing the expenditure of $75,000 which was augmented by the sum of $20,000 from the provincial government for the purpose of erecting more suitable protection works. The city authorities were in favor, and had the intention of building on top of the old wall, a proposal of which the public works engineer did not approve on account of the unstable condition of the foundations and general state of the wall.

After close investigation into the local conditions and a careful study of the various types of walls elsewhere constructed with similar objects, the conclusion was arrived at that protection could be most effectively and economically attained by a vertical wall carried down into solid ground below low water mark, except at its termination where it was anticipated the depth might be materially reduced. Trial sections of a solid and of a reinforced concrete wall were made and it was found that the cost of the former would considerably exceed that of the latter.

A comparison was then made between walls with counterforts 16 feet and 20 feet apart, respectively, and the balance in favor of economy proved to be for the latter. It was therefore decided that the wall should be vertical, carried up to the level of the roadway, of a reinforced concrete type without a base plate, with counterforts at 20 feet centres, and with a belt of granite in its face where the wash of the sea was greatest.

The calculations for the strains and areas of steel and concrete were then commenced and the following assumptions made:—

That all steel used would have an elastic limit of 32,000 lbs. per square inch.

That all rods should have a working stress of 12,000 lbs per square inch and be capable of being cold bent, 180 deg. flat on themselves.

These assumptions were subsequently required by specification.

The sketch shows typical sections of the wall and counterforts. The reinforcement in the wall consists of horizontal rods 1 foot apart commencing with ¾-inch diameter at 2 feet from top of wall and increasing in diameter with the depth of wall. These rods are link jointed and are kept in place between each counterfort by two face plates each ⅜ in. x 4 in. at 6 feet 8-inch centres. To the horizontal rods is wired expanded metal and No. 16, 1-inch mesh was at first used for this purpose but No. 10, 3-inch mesh was afterwards substituted on account of the former being found to be too light and the mesh too small.

The Dallas Road Sea Wall at Victoria, B.C.

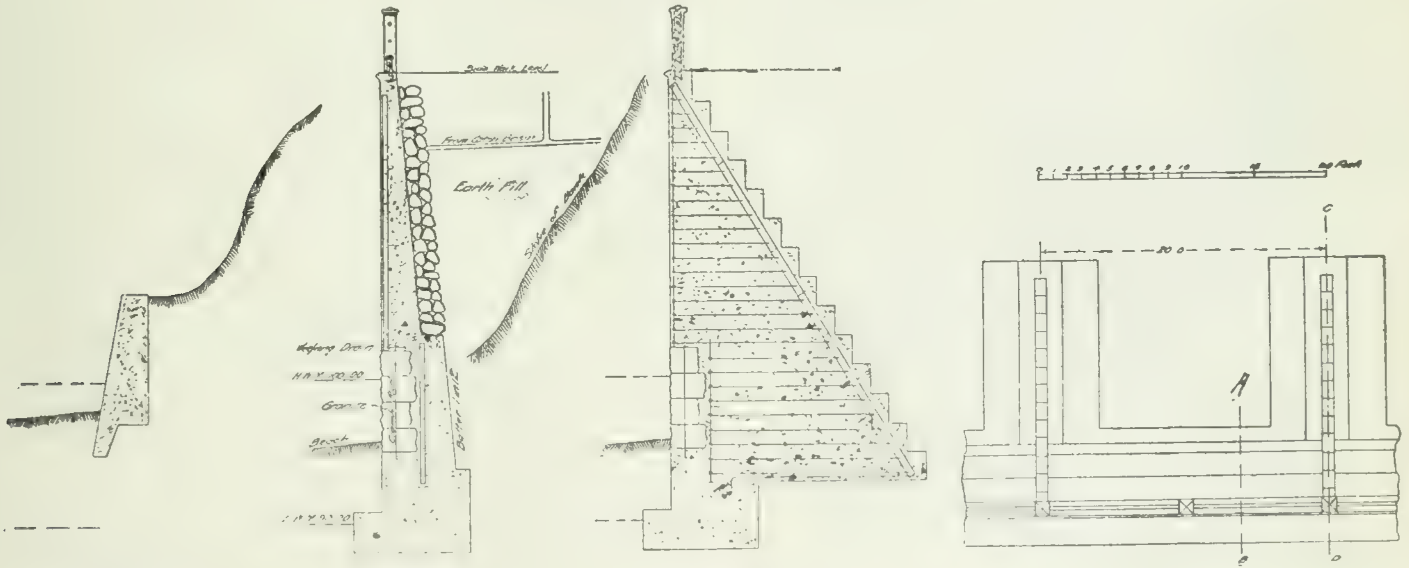


Fig. 1.
Section of Old Wall.

Fig. 2.
Section AB.

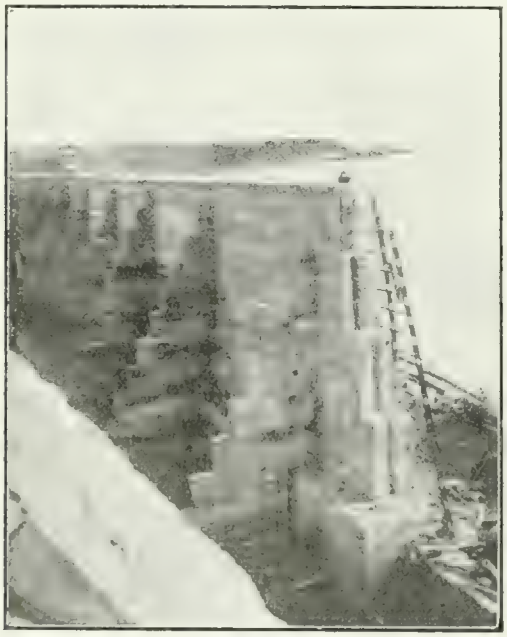
Fig. 3.
Section CD.

Plan.

The counterforts are reinforced in the same manner as the wall with horizontal tie rods hooked into face and back plates. It should be pointed out here that these tie rods and also the horizontal rods in the wall are subject to shearing stress at their connections with the face and back plates of the former and at the link joints of the latter, a point which is very easily overloaded. The back plates consist of 6-inch plates, ¼-inch and ½-inch riveted together.

At each counterfort the horizontal rods in the wall were at first placed between the face plate and the hooks of tie rods, but it was afterwards found that a more secure method was to place them at back of face plate and resting on tie rods of counterfort to which they were securely wired, and this method was adopted throughout the rest of the work. The bottom of all face plates are split and spread, and at the counterforts the face and back plates are held together by ⅝-inch bolts. The footings of the counterforts are reinforced with ¾-inch diameter rods at 4½-inch centres which are carried about 2 feet into wall and rods of same diameter at 7-inch centres and 7 feet long are placed between the bottom tie rods so as to thoroughly anchor the counterfort to footing.

To protect the wall from the wash of the sea and battering by drift logs, a belt of granite has been placed in the face of the wall as shown. Holes were drilled through the granite and ¾-inch diameter rods placed therein set with neat cement, thereby double clamping each stone. In the event of the cement mortar between the courses showing signs of disintegration the joints are to be raked out and caulked with lead wool. The lower part of the wall up to the shoulder, excluding the granite, is in the proportion of 1:3:6 concrete and all other concrete is in the proportion of 1:2:4. All concrete was of a "wet" mixture and the cement used was Portland. The exposed face of the concrete is of cement mortar in the proportion of 1 part Portland cement to 3 parts sand deposited at the same time as the concrete, and lifting plates were at first used to ensure the bond, but spading was afterwards adopted as being found more satisfactory.



View of Wall.

At the back of the wall a layer about 1 foot thick of broken rock is placed for facilitating drainage and a weeping drain of 3-inch drain tile placed in wall between each counterfort. The length of the wall is 1,680 feet, the greater part of which has an average height of 30 feet. It is finished on top with an iron pipe railing supported by reinforced concrete posts at 10 feet centres.

The work was done by contract and the total cost amounted to $119,020, divided up as follows: Wall, $112,130; convenience and steps to beach, $3,810; railing, $3,080.,

Work was commenced in January, 1911, and completed in February, 1912, but a great deal of delay occurred and time was wasted through disputes.

The plans were prepared in the Public Works Department by the author, acting under the instructions of Mr. Edward Mohun, M. Can. Soc. C.E., etc., who designed the work. Mr. A. E. Foreman, A. M. Can. Soc. C.E., was supervising engineer, and the contractor was the Pacific Coast Construction Company, Limited, Victoria.

PETROLEUM RESOURCES OF CANADA.

While the actual petroleum resources of Canada are comparatively small, nevertheless the potential resources are considerable.

In New Brunswick and Nova Scotia there are enormous deposits of oil shales which are valuable as a source of oil. On an average these shales will give a higher yield of crude oil than the oil shales worked so extensively in Scotland.

In the vicinity of Fort McMurray and Fort McKay on the Athabaska River, Alberta, there are enormous deposits of tar sands. The bitumen in the tar sand is the residue from evaporated petroleum and it has been estimated that there is 6½ cubic miles of solid bitumen in the tar sands exposed on this river.

Although enormous quantities of oil have evaporated from this district, nevertheless it is probable that accumulations of petroleum exist where the geological structure was such as to prevent its escape. This is also substantiated by the fact that natural gas occurs in quantity in districts where the tar sands are capped by overlying measures.

If large quantities of petroleum were discovered in Alberta, it would be a factor of great importance to the railway interests which operate in the Rocky Mountains and Jasper Parks and in forest areas in British Columbia and Alberta.

The Canadian Pacific Railway is now using oil-burning engines on its main line between Kamloops and Field in British Columbia. The Grand Trunk Pacific and some of the Canadian Pacific coast steamers also burn oil, and other boats are being changed from coal-burners to oil-burners. The oil is obtained from the California oil-fields. If supplies can be obtained at the prices now prevailing, its use will be very largely extended. Its cleanliness, the greatly decreased smoke, the decrease in the number of firemen required, the economy particularly in intermittent service, the increased efficiency—two boilers with oil, in steamship service, giving same steam as three with coal—and other considerations make it an almost ideal fuel.

◆

WESTERN WATER POWERS.

The Prairie Provinces' water powers upon which fairly definite information is available are mostly all confined to the southern portion of the provinces. This is a rather unfortunate coincidence and is likely to mislead the uninitiated regarding the total potentialities of these provinces, as the larger water-powers are situated in the north, on the Athabaska, Peace, Slave, Churchill, Nelson and other rivers. As even a preliminary survey of these rivers will be of great value, the Commission of Conservation has undertaken this work. During the last two summers, its Hydro-Electric Engineer, Mr. L. G. Denis, has been in the field making measurements of flow, height of falls, etc. Last year, the many rapids of the Athabaska River were investigated and the flow of the Peace and other rivers was measured. This year, the work included many long miles of travel, mostly by canoe, the western limit of the trip being the Peace River canyon in the north-eastern portion of British Columbia, while the northern limit was Fort Smith, on the Slave River. On the return trip the several rapids and falls in the Clearwater River and the upper waters of the Churchill were investigated. The general impression created by these large northern water-powers is that they will undoubtedly become of great value in connection with the wood-pulp industry. The raw material is close at hand, the only retarding factor, at present, being the lack of means of transportation and access. The details obtained by these investigations will be included in the Commission's forthcoming report on the "Water Powers of Western Canada."

MAINTENANCE AND REPAIR OF NEW YORK STATE HIGHWAYS IN 1911.

The following notes on the work done by the Bureau of Maintenance and Repair of the State Highway Commission of New York during the year ending December 31, 1911, have been taken from the last annual report of the State Commission of Highways:

Patrol System.—During the year there were 2,622 miles of improved state and country system of highways under the jurisdiction of the bureau. All of the minor repairs are cared for by the patrol system comprised of 594 patrolmen in charge of patrols of 5 miles average length. These patrolmen work under the supervision of highway inspectors in charge of sections of approximately 100 miles of roads each. These highway inspectors in charge of sections report in turn to superintendents of repairs in charge of the work in each division, the state having been subdivided into six divisions.

These patrolmen are required to furnish a horse and cart together with necessary small tools and to work upon his section between the hours of 8 a.m. and 5 p.m. In general the maintenance work done under the patrol system may be described as all work necessary to keep the surface of the paved roadway in as nearly perfect condition as possible, keeping the earth shoulders smooth and safe for traffic, the entire drainage system free from obstructions, noxious weeds and brush cut within the limits of the highway, small repairs to structures and guard-rail. In addition to these duties the patrolmen in numerous instances made surface applications of various dust layers upon the improved roads as granulated calcium chloride, glutrin and in some cases did surface oiling. Also they perform considerable work in unloading and delivering along the roads maintenance materials such as stone and oil. The number of miles to be patroled in 1912 is 3,151 and the number of patrolmen 698.

If the work of maintaining improved roadways is consistantly carried on the effective life of such roads will be greatly extended. It would appear as though it could be prolonged indefinitely, if year by year the material added to the road surface be equal or slightly in excess of the material which has been worn away during the same interval of time.

The experience during the years of 1909, 1910, 1911 has demonstrated that results of the patrol system has thoroughly justified its existence. The average cost for the entire state per mile for patrols for 1911 was $140.

For the season of 1912 it was proposed to subdivide the maintenance and repair work of the state into eight divisions instead of six, this change being necessary to give proper supervision to the rapidly increasing mileage of the improved state and county system of highways, also to have all the work in each county as far as possible under the direct supervision of one foreman or inspector, also to do most of the extensive surface piling and other repair work by contract. It is also proposed to do better and more permanent surface oiling treatment, substituting for the previous light oils applied cold with light cover costing about $500 per mile, a much heavier grade of bituminous oil applied hot covered with ¾-in. crushed stone and then rolled with steam roller costing about $1,000 per mile. This treatment in addition to being more durable avoids the criticism caused by the light cold application tending to soften up during continued wet weather, producing a sloppy condition which has been very much objected to by both vehicular and pedestrian traffic. While the first cost of this surface treatment is an increase over previous practice it is expected that in the long run it will result in a decrease of the total maintenance charge over a long period of time.

In 1911 there were resurfaced 48.23 miles at a total cost of $312,449, making the average cost per mile $6,509.

This resurfacing consisted of scarifying, placing stone and bituminous top dressing.

The total number of miles oiled in 1911 was 269. Total cost of oiling was $250,601; average cost per mile for oiling was $932.

The following is a summary of the result of the experiments:—

Oiled Surface Treatment Using Trinidad Liquid Asphalt "AA," Genesee County Road No. 586.—The summer season of 1911 was far advanced before the programme of surface oiling which had been laid out for the season's work was begun. It was determined to treat the surface of various roads with Trinidad Liquid Asphalt "AA" instead of the ordinary bituminous material C. O. and this was done upon Genesee county road No. 586 during September and October.

The usual methods for applying C. O. were followed, comprising sweeping the macadam clean of all mud, dust and loose material, followed by minor surface repairs to ruts, depressions, etc., with ¾-in. crushed limestone, the surface then being treated with Trinidad Liquid Asphalt "AA" which had been previously heated on account of the cold weather due to the lateness of the season so as to flow freely. Long stretches of one-half of the width of the road were treated and covered at a time so as to interfere with traffic as little as possible. The material used for covering the oil was rescreened or dustless limestone screenings. The oil was applied at the average rate of ⅓ gal. per square yard surface and the completed cost of the treatment, including all material and labor was $0.07½ per square yard. The oil cost in tank cars f.o.b. siding at delivery points $0.06¾ per gallon average. The stone for cover cost f.o.b. siding at delivery points $0.975 per net ton average. The total quantities of materials used were 988 net tons stone and 16,030 gals. oil. The width of the treated surface was 16 ft. and the length was approximately 5.2 miles. At the close of the year this surface was in excellent condition, there being no apparent tendency to mush up and become sloppy due to softening under continued wet weather. No roller was used during the prosecution of this work and the results were very satisfactory. The work was carried on under the patrol system the supervision of the Bureau of Maintenance.

Experimental Pavement Consisting of Limestone Top Course Macadam Bound with Glutrin.—Hudson Avenue, Sec. 1, Road No. 15, was originally improved during 1900, its length being 3,326 ft., or 0.65 mile at an expense of $7,242.67, or at the rate of $11,370 per mile, the surface being 16 ft. wide, the foundation course being of crushed limestone 4 ins. thick and the top course crushed trap rock 2 ins. thick, all water bound. The traffic carried by this road is exceedingly heavy, heavy loaded horse-drawn trucks of market produce, and sand and gravel from local pits predominating. The resulting wear required extensive repairs from time to time.

The cost of maintenance previous to 1907 was $6,376.40; expenditure in 1907, $277.81; in 1909, $2.25; in 1910, $542.27; in 1911 previous to this work, $46.55, making a total cost per mile per year for maintenance, $1,045.

During 1910 and 1911 the road was in a bad condition, depressions and ruts through the entire length of the roadway. This having been brought to the attention of the department during the latter part of September, 1911, it was decided to resurface the road with limestone bound with limestone dust and glutrin in solution, the general plan proposed being to fill up the depressions and ruts with coarse broken stone, restoring proper crown to the remaining old macadam and treating this as a foundation upon which to construct a macadam top course 3 ins. thick after rolling, this construction being adopted on account of amount of available funds preventing any more permanent construction. The work was carried on by County Superintendent J. Y. McClintock by the pay-roll system under the general supervision of the Maintenance and Repair Bureau.

The following points are taken from the specification for repair:

The upper course is to be composed of No. 3 limestone of an average thickness of 3 ins. After this is rolled and filled, spread over it ¾ lb. of pulverized feldspar per square yard of surface, and mix it in with the limestone by means of rakes. Roll with steam roller. Sprinkle with mixture composed of one part glutrin and three parts water, so as to get ⅜ gal. of glutrin into each square yard of the surface. Roll it until the stones are firm enough to walk over without any apparent movement.

For wearing course spread on limestone screenings. Put on enough to thoroughly fill the crevices between the stones. This will require thickness of about ¾ in. Now sprinkle with water and roll as usual until about one-half of the amount of water necessary has been applied. Then finish the sprinkling, and wet rolling with mixture of one part glutrin and three parts water. Now put sprinkling cart ahead of the roller and put on enough of the mixture to thoroughly flush the surface and wash the dust and small stones into the crevices. You cannot get the surface too wet, and you cannot roll too much. Keep on wetting and rolling until the surface puddles, which really means that it will not take in any more of the glutrin and water, the plan being to use about ¾ gal. of glutrin per square yard of completed road. Just before the surface dries, and this may be three or four days or a week later, the sprinkling cart should be filled with the mixture of one volume of glutrin to one of water, and the flow so regulated as to spread only 9 ft. wide. Sprinkle until ⅓ gal. of water or ⅔ gal. of mixture is applied to each square yard of the middle 9 ft. of the road.

This work was begun during the latter part of the month of September and progressed through October and November, when it was necessary to shut down for the season, due to the setting in of freezing weather. This necessitated building a portion of the road without glutrin in order to make it passable for the winter, with the idea of concluding the glutrin treatment in the spring.

The entire expense for this construction for the season's work, including all of the materials necessary to finish it up in the spring, is:

Use of steam roller	$ 392.23
Labor	873.12
Teaming	1,077.87
2,616 tons of stone	2,051.49
3,352 gals. of glutrin and crushed feldspar	403.58
Miscellaneous items	14.51
Total	$4,812.80

The number of square yards treated was 5,913, making an average expense of 81.4 cents per square yard of surface. It is fair to state that a portion of the labor, possibly one-quarter, should be charged to fixing the shoulders and ditches. A portion of this road, a few hundred feet upon which the glutrin was placed, was entirely constructed of No. 2 stone, and before winter set in, it showed signs of displacement because of being so small.

Glutrin was first used in Orange county in 1910 on roads Nos. 44, 93 and 160. The results were as follows:

On road No. 44, Goshen to Florida, the product worked especially well. About one mile of road on No. 44 is macadam. Before the application of glutrin this section of the road ravelled badly every year. The glutrin seemed to have a binding quality and the macadam section held tight the entire season of 1910. On the gravel section the product worked well as a dust layer. About the only fault one can find with it is that it is soluble in water and one or two days' rain causes it to move to the shoulders of the road. The results on road No. 93 were about the same as on road No. 44.

The department considered it satisfactory on roads Nos. 44 and 93 in 1910 and it was recommended for use on these roads for 1911. The residents seemed to like the glutrin and many citizens in the village of Florida ordered it in barrels for use in front of their dwellings.

On road No. 160 the results were not so good as on Nos 44 and 93.

The chief complaint from the public was that after rains it left the road in a soft and sticky condition. It is believed this was partly due to the poor material used in the construction of the road. The supervisor and several citizens requested that oil be used in the place of glutrin in 1911 and oil was recommended for No. 160 this year.

Glutrin was used again this year on roads Nos. 44 and 93 and is giving such good results that the first deputy in charge of maintenance has recommended its use next year. The people along the roads seem to be particularly well satisfied with it this season and many requested its use in 1912.

Details of various experimental pavements in Munroe county, among which are the Rocmac on road No. 83, the Mixing Method Asphalt, road No. 94, the Kentucky Rock Asphalt also Amiesite on road No. 5, and the Cube pavement on road No. 6 were given in Engineering and Contracting of November 15, 1911. The conditions of these various surfaces one year later, after they have been under traffic for over one season, are thus described in the report for 1911:

At the close of the season 1911 the Rocmac pavement on road No. 83 in the town of Gates was in perfect condition. It has not shown any indication of either ravelling or rutting. It is only slightly dusty. Continued wet weather does not produce any mud upon the surface. The surface being quite gritty gives excellent footing for horses and also reduces the liability to skidding of pneumatic-tired vehicles. Maintenance expense practically nothing.

The Mixing Method, Asphalt, laid on road No. 94 at the close of the season of 1911, was in perfect condition, there being little indications of wear, the surface being very smooth. The maintenance cost on this section during the season having been nothing except for work smoothing up the earth shoulders.

The Kentucky Rock Asphalt on road No. 5 at the close of the season of 1911 was, where laid during warm weather, in good condition. However, the end which was laid during colder weather was in rather poor condition and had necessitated considerable repairs. It is evident from the results on this road that it is absolutely necessary that this material be laid during the hot summer months in order to secure good results. The good portion was generally smooth, showing, however, occasional bare spots where the stone appeared through the asphalt on the surface.

The Amiesite on road No. 5 was partially laid during both seasons, 1909 and 1910, and at the close of the season of 1911 was in good condition. However, during 1910 an effort was made over a portion of this surface to roll on a thin sealing coat of the treated screenings size material. Where this was done there was a tendency for this thin surfacing to break off. However, the pavement underneath this surfacing was found in excellent condition. It would appear that if any sealing coat is used in connection with this construction that it it should be rolled in together with the balance of the road instead of attempt being made to roll it on afterwards.

At the end of the season of 1911 the vitrified shale cubes laid in 1909 on Road No. 6 were still in good condition and showed but little effect from wear. The Portland cement concrete cubes made with soft gravel and laid the same year showed the effect of wear but still preserved a good smooth surface, except for a short stretch of 100 ft., where they had broken up. The reason for this break seemed to be a weakness of a foundation. The concrete cubes made in moulds very wet, which were laid in 1910, were found to be soft in the spring of 1911, and did not hold up under traffic. The frost seemed to have disintegrated them. Of the ash clay cubes laid in 1909 the soft burned ones did not stand up well, but the ones made with small amount of Jersey clay mixed with local clay and ashes were in good condition.

This piece of road was subjected to very hard usage by the frequent passage of heavy agricultural engines with very sharp lugs on the wheels. It seems to be demonstrated that with cubes made tough enough to stand the wear of traffic, this form of pavement will be cheap and satisfactory.

◆

THE EFFECT OF SAFE WATER SUPPLIES ON THE TYPHOID FEVER RATE.*

Disasters have occurred from drinking sewage polluted water due to three distinct reasons:

One.—Failure to purify a surface supply exposed to pollution.

Two.—Inefficiency of the purification.

Three.—Failure to supply the purified water to all parts of the city.

Failure to Purify.—The failure to purify a supply which is polluted or exposed to sewage pollution may usually be attributed to an undue confidence in a supply which is safe "most of the time." It is difficult to impress upon municipal officials, without a severe lesson, that to avoid disaster it is necessary to have a water supply safe 365 days in the year. It is difficult to make them see the necessity for purification when the supply may be safe 350 or 360 days in the year.

They consider the expense almost unjustifiable when the menace only exists for four or five days in the year. But when disaster occurs they are willing then to spend the money after the damage is done. Erie, Pa., extended their intake pipe far out into the lake. It was nearly five miles from the nearest source of pollution. During 1909 and 1910 there was no evidence of serious pollution, but in December, 1910, such pollution occurred, and was followed in the early months of 1911 by 135 deaths and over 1,300 cases of typhoid fever.

There is too much confidence placed in unfiltered surface supplies from inhabited watersheds. Even where there is alleged control of the watershed and ample storage, pollution may occur. In regard to unfiltered surface supplies the need of bacteriologic control is very evident. Dangerous pollution may be present only for a few days or for a few hours. This is most likely to be disastrous in time of drought or low water. At such times the diluting effect of the inflow and the purifying effect of storage are both reduced to the minimum. The bacterial count per cubic centimeter is valuable, but the quantitative estimation of B. coli is of far greater importance. A low count does not necessarily imply a safe water, but a low count coupled with absence of B. coli may be considered an index of safety.

The typhoid epidemic in Baltimore in 1910 was coincident with prolonged drought. The run-off from the watershed of the Gunpowder River was reduced to the minimum. The sewage pollution was thus concentrated, and gross pollution was evident upon bacteriological examination. B. coli was frequently found in 0.1 of a cubic centimeter, and sometimes in 0.01 cubic centimeter samples. When the run-off increased, affording greater dilution and increased storage, the water returned to normal and the typhoid fever dropped to a minimum.

In Europe, surface supplies are almost invariably filtered, and eventually such supplies in America will be treated or filtered.

The factors affecting sewage pollution of a water supply and which determine the relative danger to be anticipated for such pollution are:

The amount of polluting material, the presence of pathogenic organisms, the time of transit from the source of pollution to the waterworks intake, and the amount of water available for dilution.

Provided the amount of polluting material is considerable, that typhoid fever is prevalent on the watershed, and at the time of transit is within the bounds of time deemed necessary for the natural death of bacteria, pollution of the intake will take place. The last factor, the amount of dilution, will determine the intensity of the pollution. If the polluting material is great in amount, and if a swift current cuts down the time of transit, prevents sedimentation and retards dilution, then gross pollution results.

With a dilute pollution one need not expect a great explosive outbreak, but many cases of typhoid may result, especially following floods and rains. Often in the absence of explosive outbreaks in the winter or spring months it will be demonstratable that too many deaths from typhoid fever occur in the first half of the year. On the other hand, it is reasonable to suppose that the dilute infection may be responsible for many scattered cases which can not be traced to water.

These cases may not appear in sufficient numbers in any particular month to be remarkable or they may be obscured by occurring in the months when typhoid fever is accepted as an inevitable visitation.

Water may be responsible for many cases of typhoid when it is impossible to prove the case against it. We are able to fix the guilt on the water supply only in massive outbreaks of explosive character, but smaller doses can be responsible for smaller outbreaks or many cases spaced over a long period without any hope of proving this causation.

It seems quite probable that a dilute pollution of a water supply with typhoid organisms may exert an influence indirectly through the agency of milk. The very few organisms in the water through multiplication in the milk may be enormously increased.

Inefficiency of the Purification.—There seems to be an impression that the installation of the filter plant means safe water. This is not necessarily true.

The filter plant must be properly constructed and intelligently and efficiently operated. I have seen filter plants that were structurally perfect, intricate mechanisms designed after plans by our best engineers, yet these plans are sometimes placed in the hands of an assassin, entirely innocent of knowledge of the proper bacteriologic control of his plant.

Poor filter efficiency is often responsible for disaster in the shape of typhoid outbreaks, and may be due to several causes. The slow sand type may give poor filter efficiency when sufficient extra units are lacking, necessitating excessive rates and placing of "green" filters in service. Excessive rates, too little coagulant, insufficient sedimentation capacity, and insufficient storage are common operating and structural faults of the mechanical type. Sometimes a properly constructed plant is struggling with a raw water which has a high bacterial content, and even with fair filter efficiency yields an unsafe effluent. Probably the greatest single cause of a poor effluent from filter plants is inefficient operation by unskilled men. It is absolutely essential for good results that bacteriologic examination, including B. coli estimation, be made at least once daily, and in slow sand plants from each unit separately.

---

*Abstract of address delivered by Dr. Allan J. McLaughlin, United States Public Health Service, Washington, D.C., at the Sixth Annual Meeting of the Association of Life Insurance Presidents in New York City, on December 5th, 1912.

The man in charge must be able to do this. In mechanical filter plants, or with hypochlorite plants, he must also have the necessary skill to adjust his chemicals with a nicety according to the changes in the raw water. With such a man in charge of a properly constructed plant a safe effluent is assured at all times. When struggling with a bad raw water, he will use hypochlorite as an adjuvant with good results. He will study the peculiarities and fluctuations of the constituents of the raw water and adjust his treatment accordingly.

In showing the relation between water and the prevalence of typhoid fever it is essential to have accurate vital statistics. Too often we find in making an investigation that no accurate statistics are available. Happily the registration area is growing larger each year, but the enormous territory still outside the pale, which furnishes no statistics, is a disgrace to our civilization and our much vaunted progressiveness.

The Federal Government can only request such statistics as a courtesy, but surely in this day and generation no authority should be necessary to compel the furnishing of statistics to the General Government for the general welfare.

Failure to Supply the Purified Water to All Parts of the City.—To secure the desired result, elimination of water-borne typhoid, it is essential to supply the safe water to all parts of the city. The high typhoid rate in Toledo, in spite of a safe public supply, was due to the fact that more than half the population depended upon shallow wells which were known to be contaminated in many instances. In Pittsburg during 1910 wards 1 to 20 were supplied with filtered water. The aggregate population of these 20 wards was 401,622. The typhoid-fever death rate per 100,000 in 1910 was 13.4. Wards 21 to 27 comprise the old city of Allegheny, and have a total population of 132,283. This section received unfiltered water. The typhoid-fever death rate per 100,000 in this section in 1910 was 46.9.

To summarize, the following facts are pertinent:

One.—In the prevention of typhoid fever there is a necessity for safe water supplies for 365 days in the year.

Two.—Unfiltered surface supplies may be exposed to a dangerous pollution for a few days or even for a few hours only.

Three.—Supplies derived by impounding surface waters, and which depend upon storage alone to nullify the pollution of an inhabited watershed may be very dangerous in periods of drought and low water. The proportion of pollution is relatively greater at such times and the time of storage is greatly reduced.

Four.—Purification, whether by storage, filtration, or chemical treatment, must be efficient at all times, and this cannot be assured without bacteriologic control.

Five.—It is essential that a daily quantitative estimation of B. coli be made, as a low bacterial count does not necessarily mean a safe water without absence of B Coli.

Six.—There is a necessity for close supervision of municipal plants by the State to correct structural and operative defects and insure a safe water at all times.

Seven.—Bacteriologic control and State supervision would insure cleaning when necessary, and should prevent the putting in service of slow sand filters before the "schmutzdecke" is ripe.

Eight.—In order to control typhoid fever and eliminate water-borne typhoid it is not sufficient alone to have a purification plant. In addition the purification must be efficient and the purified water must be available in all parts of the city.

It has been said that every death from typhoid fever was either a case of murder or suicide. An even stronger statement has been made that for every death from typhoid fever somebody should be hanged. These statements have a strong basis of truth, but exceed the truth somewhat. A more conservative statement, and one which is unassailable, is that every case of typhoid fever is due to somebody's ignorance or carelessness.

Now, in regard to carelessness or criminal negligence, the punishment should fit the crime, but for ignorance the remedy is not punishment but education.

It is precisely in this matter of education that this powerful and intelligent association can achieve the greatest good. The educational campaign must be directed against improper disposal of human excreta, impure milk supplies, flies, uncontrolled cases of typhoid, filthy personal habits of individuals, and, above all, against contaminated public water supplies. This paper is limited to water-borne typhoid, and therefore the other very important factors are not discussed. In the campaign for better water supplies we must direct our efforts toward securing the co-operation of the municipal authorities and the individual citizen.

Municipal authorities must be impressed that it is their plain duty to furnish a public water supply which is safe 365 days in the year and not on which is safe "most of the time"; that the absence of large explosive epidemics is not proof that the water supply is safe; that dangerous pollution due to a combination of weather and other conditions may occur only one day in the year, as at Erie, Pa., and that such disasters must be prevented; that a dilute pollution may be responsible for cases of typhoid fever scattered throughout the year, without giving an abnormally high typhoid rate; that a public water supply cannot be assumed to be safe, unless it is shown to be safe by a daily bacteriological examination.

In regard to the individual citizen, he must be awakened to the seriousness of the excessive typhoid fever rate in this country. In so far as water-borne typhoid is concerned the citizen should be taught that municipalities have an obligation to furnish a public water supply which is safe 365 days in the year, and that it is his inalienable right to demand and receive such a supply. The standard which should be expected in order to indicate safe water should be, less than 100 bacteria per cubic centimeter and an absence of the Colon Bacillus or other bacteria of sewage origin in one cubic centimeter samples.

◆

The following are the lines of the Canadian Northern Railway now under construction:—

Line.	Miles.
Sydenham Ottawa	86
Montreal Hawkesbury	60
Roberval Extension	30
Ottawa (Rideau Junction)-Capreol Junction	304
Ruel Port Arthur	543
	1,023

COMPRESSED AIR STORAGE IN ROCK.

In a recent issue of the Engineering and Mining Journal Mr. Frank Richards, of the Ingersoll-Rand Company, 111 Broadway, New York, gives some interesting data regarding compressed air storage in rock. We herewith reproduce the article and illustrations.

One of the most familiar annoyances or inconveniences in the use of compressed air is insufficiency of storage capacity. In most of the employments of compressed air, especially in mining operations, the air is used intermittently and the rate of air consumption varies over a wide range. At the same time the usual air receiver is so small as to have little effect in maintaining constant pressure.

It has often been proposed and also many times attempted to use old and abandoned workings of mines for air-storage purposes, but in many cases complete failure has resulted on account of the impossibility of making the rock air-tight. It is, therefore, a pleasure to call attention to at least one instance where this scheme has worked successfully. The storage capacity in this case is a hundred times that of the largest commercial air receiver usually furnished.

Fig. 1 shows the essential features of a crosscut and drift on the 700-ft. level of the Centre Star mine of the Consolidated Mining & Smelting Company, of Canada, Limited, Rossland, B.C., which has been fitted up to serve as an underground receiver. In this case the rock was so close grained and free from fissures that the leakage was inappreciable. Fig. 2 is a plan of the workings appropriated for the receiver, the dam being placed as indicated. At this point the rock was notched out so as to give a bearing at least two feet wide all around to take the thrust caused by the air pressure, which aggregated about 450 tons. The dam was made of concrete eight feet thick, reinforced as seen in Fig. 1, by nine horizontal arched rows of 30-lb. rails. A manhole, 14 x 18 in., was run through the middle of the dam and secured by a cover on the inner face.

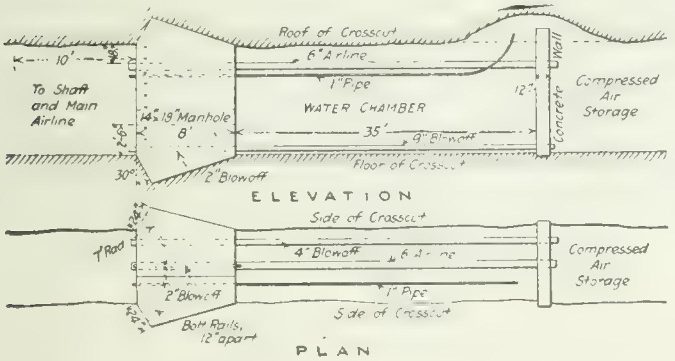


Fig. 1.

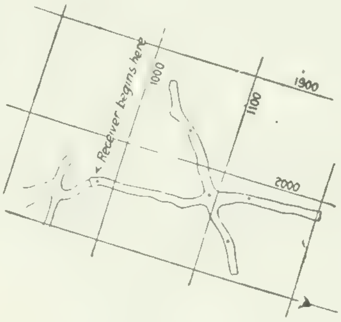


Fig. 2.

Compressed Air Storage in Abandoned Drift.

Inside the dam, with a space of 35 ft. between, was erected a concrete wall 12 in. thick to form a water chamber between it and the dam. It will be observed that this wall had to resist only the water pressure of four or five pounds at the most, the air pressure being effective equally on both sides, communication being free over the top of the wall.

The air communication between the main air line and the storage chamber was through the 6-in. pipe, this passing through the water chamber on the way. Any water which might accumulate in the bottom of the storage chamber could be drawn off through the 4-in. blow-off, while the 2-in. pipe would discharge the water from the water chamber when required. The function of the 1-in. pipe is not clear, but it could be used, like a try-cock on a steam boiler, to show whether or not the water was up to the turned-up head of the pipe.

How the water chamber was kept filled does not appear, but a pump must have been required for the purpose. It does not appear in fact how much the water scheme was used, Fig. 1 being from a blueprint made before the storage system was put into use. The air, so far as the storage function was concerned, was entirely independent of the water and we know that the storage is a permanent success. All necessary valves and gauges were, of course, provided outside to keep the engineers fully informed and in full control. For the information embodied in this article I am indebted to George A. Ohren, of the Canadian Ingersoll-Rand Company, Vancouver, British Columbia.

◆

LAYING NEW INTAKE PIPE AT MONTREAL.

The new intake for the water supply of the city of Montreal consists of double lines of 72-in. lock-bar steel pipe, laid on the bottom of the river from shore to the intake piers built in the St. Lawrence River just above the head of the Lachine Rapids where the water has a very swift current and is 32 ft. deep at high water. The work was described in a recent issue of the Engineering Record. Trenches from 7 to 10 ft. deep were excavated in the very hard, compact sand by a 2½-yd. dipper dredge moored by spuds and anchored by two 1-in. steel cables and one 1¼-in. cable.

The pipe, 9/16 in. thick, was manufactured in 28-ft. lengths by the Stewart & Lloyd Company, Glasgow, Scotland, and at the site was riveted up on shore to 140-ft. lengths and butt-strap joints. The ends were closed with temporary wooden bulkheads and the pipes were rolled from the wharf, dropping about 5 ft. into the water and were towed to position. They were lifted clear of the water by two floating derricks, the bulkheads removed, and were then lowered into the trench, where they were connected by divers who united them with gasketed flange joints. The joints were made up with bolts inserted by the divers who fitted the nuts to them and set ratchet wrenches on them operated by lines from the boats above.

Each of the double lines of pipe were connected to a 22 x 62-ft. concrete intake pier 30 ft. high which was built after the pipes were laid. Open caissons, with 12 x 12-in. timber walls, were floated to position, filled to a depth of 4 ft. with concrete, and sunk in pits dredged to solid rock. The caissons were pumped out and the concrete piers built in them in the usual way in forms, 8 ft. in diameter, with holes left opposite the ends of the intake pipes

Sections of 6-ft. steel pipe 12 ft. long were set in the pier openings, projecting into the interior walls, and the movable outer walls of the caissons were detached and floated away. Divers descended outside the intake piers and connected to the short pipes tackles which were operated by floating derricks to lift them and connect them up to the ends of the previously laid lock-bar pipes. The divers then sealed up the annular space around the pipes and both faces of the pier walls, after which the space around the pipe in the wall was grouted through holes left for that purpose in the concrete. The pipe in the trench was protected by a covering from 1 to 4 ft. deep, thus completing the work in about 4½ months with an average force of 50 men. Mr. George Janin is the city engineer, Mr. Thomas G. Lesage is the superintendent of waterworks and Laurin & Leitch, Montreal, were the contractors.

POWER SITUATION IN QUEBEC CITY

The large undertakings now under way, or in contemplation for Quebec city and surrounding district, have served to draw particular attention to the power situation at the ancient capital. At present, the Quebec Railway, Light, Heat and Power Company is obtaining about 5,000 horse-power at Montmorency and 1,500 horse-power from the Chaudiere. It had also been obtaining from 2,000 to 2,500 horse-power from the Jacques Cartier, but a short time ago the power plant of the Jacques Cartier Company was destroyed by fire and as yet the company has not proceeded with the reconstruction of the plant owing, undoubtedly, to arrangements that have been made for securing power elsewhere. This gives the Quebec Railway a combination of between 8,500 and 9,500 horse-power.

Recently, two new companies have come into the field, the Dorchester Electric, a small concern which, when connected, will have an output of about 1,500 horse-power, and the Stadacona Hydraulic Company, which will at the outset develop 10,000 horse-power from its powers at Seven Falls, and have so laid out their development that the output will be increased to 15,000 horse-power.

Owing to the large contract which the Stadacona Hydraulic has with the Quebec Railway, it was at first thought that there was some connection between the two companies. There is, however, no connection whatsoever, and while the Stadacona will sell a portion of its power to the Quebec Railway, it may indeed be a competitor against the Quebec Company for a portion of the balance of this power.

The development carried out by this new company brings about an entirely new condition in the city of Quebec and surroundings, as it will have an output in excess of all other companies combined and, in a measure, will be able to meet the requirements of a number of larger enterprises which will be established during the next few years. The Stadacona Hydraulic Company already has its output of 10,000 horse-power disposed of, 4,000 horse-power being under contract to the Quebec Railway, Light, Heat and Power, and 6,000 horse-power to the Bayliss Pulp and Paper Company. The Stadacona also has the right to enter the field in the city of Quebec, but the intention of the company at the present time is to be a wholesale concern only, turning over its output to large concerns, or to some of the existing power companies for distribution, thus occupying the same position as regards Quebec City as the Shawinigan Water and Power does in Montreal.

In view of the number of large undertakings now being provided for, it would seem as though the interests identified with the Stadacona Hydraulic had not carried out their plans for the new installation a moment too soon, and the new Harbor Commission of the city of Quebec is calling for tenders for the erection of a 2,000,000 bushel elevator which will take 3,000 horse-power to operate it. The Hon. Mr. Cochrane, Minister of Railways, has stated that the Grand Trunk Pacific intends to start in the spring of 1913 on the construction of a 5,000,000 bushel elevator which will require 8,000 horse-power. The Quebec Railway, Light, Heat and Power has closed a contract which comes into force in June, 1913, for 1,300 horse-power for the Quebec bridge, while the Transcontinental Railway shops now being erected are in the market at the present time for 3,000 horse-power.

The Stadacona Hydraulic Company will be supplying power about the middle of 1913. The large dam at Seven Falls, which is 70 feet high, has been completed, while the work has also been finished on the construction of the 8 feet penstock which extends a length of 3,200 feet. This leaves only the power-house to be constructed early next spring. The entire machinery for this plant has all been contracted for, assuring its delivery well within the time required. The power of the Stadacona Hydraulic has the greatest head of any in the world, amounting to 410 feet. The next in point of height is said to be located on the White River in California, which has a total head of 400 feet.

IRON ORE SUPPLY OF EMPIRE.

Some interesting evidence concerning the demand for and supply of iron ore was given before a meeting of the Dominion Royal Commission held on November 13th, by Mr. Wallace Thorneycroft.

It was stated that most of the ore imported into Great Britain was made into Bessemer hermatite pig-iron, which was used for steel making by the acid process. For that purpose the ore must contain very little phosphorus. Great Britain imported in the year 1909, 6,326,000 tons of iron ore, of which nearly 6,000,000 tons was Bessemer ore.

Nearly 5,000,000 tons of this Bessemer ore came from Spain, and the balance from Sweden, Norway, Greece, France, Algeria and Tunis. Except 62,000 tons from Newfoundland, no ore was imported during that period from the Dominions. Cumberland and North Lancashire supplied 1,558,000 tons of Bessemer ore. Therefore the Bessemer pig-iron industry depended upon foreign ore supplies.

The Wabana deposit in Newfoundland, from which the bulk of Canada's production of pig-iron was made, was said to contain over 3,000 million tons of ore. But as it contained .75 of phosphorus it was unsuitable for the manufacture of steel by the acid process. It was largely exported to Germany and Belgium, where steel was manufactured by the basic process, by which the phosphorus was extracted from the steel. Basic steel, it was stated, was not as reliable as steel manufactured by the acid process from Bessemer ore containing less than 0.5 of phosphorus. If the basic principle were adopted in this country there would be a greater demand for Newfoundland ore. The more rapid growth of the pig-iron industry in Germany and the United States was, it was said, entirely due to the invention of the basic process.

Except in Canada there was, so far as is known, no production of pig iron on a large scale in the Dominions. The governments of the Dominions, it was stated, might, with advantage, provide more money for the geological survey of the territory under their control. There could be no more profitable investment. They should publish the results of the surveys made as rapidly as possible, and communicate advance copies to the iron and steel associations of this country, or abstracts and references to such publications.

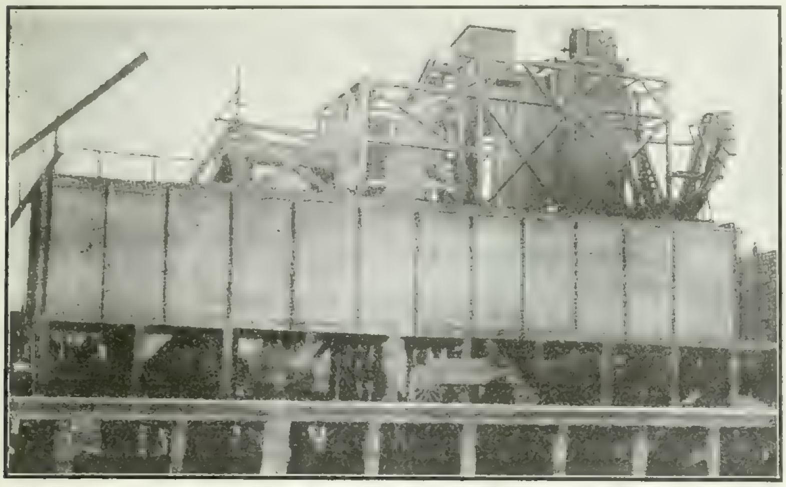
It was not suggested that the governments should undertake detailed prospecting work. The Geological Department of Canada was already very good, but with the vast area it had to cover, progress was necessarily slow.

The indication of large deposits, especially Bessemer ore, accessible for shipment anywhere in Eastern Canada or Newfoundland would promptly be investigated in detail by British makers of iron and steel and ample capital would soon be found if the deposits warranted development.

It would be right for the Dominion governments to encourage the report of iron ore. If the economic condition around the deposits were favorable, production of pig-iron and steel would naturally follow.

REPAIRING THE ASPINWALL FILTRATION PLANT.

As the only convenient source of water supply for the city of Pittsburg is the Allegheny River, the water must be thoroughly filtered before being delivered to the city mains. Accordingly, four years ago, the city spent over one million dollars in the construction of a filtration plant located at Aspinwall, Pennsylvania. This plant has been most effective in providing the city with safe and clean water. The entire plant covers 140 acres of ground and consists of a number of units called beds, covering ten acres each. Each bed in turn, comprises ten rooms, each covering one acre. These rooms are of concrete, having concrete floors and concrete roofs, these being supported by concrete columns, spaced 15 feet apart. The floor of each room is covered with several feet of sand and gravel, consisting of successive layers, varying from coarse gravel below to fine sand as the upper layer. Water, from the river, is pumped into these various rooms and allowed to slowly filter through the sand and is then pumped to the city's mains. The sand is frequently removed and washed by special machinery, which removes the sand from one room, delivers to a washer, and distributes over the floor of another room at the same time.



The Screening Plant of the John F. Casey Company.

Due to improper design and construction, considerable trouble was experienced with one of the beds of ten rooms from a seepage of water through the concrete floor. It was, therefore, necessary to remove all the sand and gravel from this bed, waterproof the floor, add several inches of concrete, wash and resize the gravel, and replace it over the floor.

The contract for this work, which involved the double handling of thousands of tons of gravel as well as the placing of a large amount of concrete, was given to the John F. Casey Company, which is one of the largest contracting concerns in Pittsburg. The method adopted by this company for handling the material, washing the gravel, and mixing and placing the concrete, allowed the work to be done in a remarkably short time and at a considerable economy.

The sand was siphoned direct from one room through the filtration plant sand washer into one of the repaired rooms by means of the sand scraping and spreading machines, which are part of the regular equipment of the plant. The sand, which could not be removed by the regular machine together with the gravel was loaded by hand into three-yard rocker bottom cars, which were hauled by gasoline locomotives to the washing and screening plant. In replacing this material in the repaired bins, it was withdrawn from the screening plant storage bins into industrial cars and hauled by electric locomotives over the top of the rooms. These cars dumped through manholes in the roof into the regular spreading cars, which deposited the material in even layers over the floor.

The washing and screening plant was located on the site of the filtration plant and was erected only as a temporary structure. The machinery equipment, however, although designed for this particular plant, was purchased with the idea of using it later on similar washing plants erected in connection with other contract work. On account of little available ground space the plant was made as compact as possible. The receiving hopper was located directly beside the bin structure and a belt and bucket elevator was placed to receive from the hopper and deliver to the screens above the bins. This elevator is equipped with 13 x 7 x 10-inch continuous buckets and the distance between head and tail pulleys is 50 feet. This elevator delivers into a chute feeding the first Gilbert screen from which it passes successively through three other screens and into a Stephens-Adamson automatic settling tank.

At this gravel had originally been washed and sized, the only object in rewashing was to remove the dust that had settled, and resizing was necessary as the various layers were necessarily confused in removing from the rooms. The city had very rigid specifications as to the maximum and minimum sizes in the various layers and the screens furnished were required to separate material according to these specifications. The size of the various bins was arranged according to the proportion of the different sizes which was definitely known.

Another part of the equipment, which assisted materially in reducing the labor cost and time on the job, was that for handling and mixing the concrete materials. A Haines concrete mixing plant was located on the site of the filtration plant, directly between the river and the railroad whereby the materials were brought to the plant. A derrick unloading rig and clamshell bucket was arranged to dig the gravel from barges and dump into a hopper above, from which it was drawn to the mixer as required. The cement was received in box cars in the usual manner and a belt conveyer was used for elevating the bags of cement to the top of the plant. The conveyer used for this was 24 inches wide by 86 feet centres using the unit ball bearing carriers.

This conveyer, as well as the complete screening plant, was designed by the Stephens-Adamson Manufacturing Company in their Pittsburg engineering office and this company also manufactured the entire machinery equipment for the plant.

◆

WELDING PIPE WITH THE OXY-ACETYLENE TORCH.

Welding with the oxy-Acetylene torch has been successfully accomplished in the large shops for several years, but the recent installation of an 8-inch high pressure gas line in San Francisco is unique in the adaption of this process to the welding of high pressure gas mains. This work was described by Leon B. Jones of the Pacific Gas and Electric Company, of San Francisco, in a recent number of the "American Gas Light Journal." The information here given is from Mr. Leon's description of the process and the cost of its application.

The recent installation of approximately 5,000 feet of 8-inch steel tubing in San Francisco, in which oxy-acetylene welding was used on every joint, was laid under the most difficult conditions. This afforded an excellent opportunity for practically testing the adaption of welding to high pressur gas mains. This line was laid in Geary Street, at the same time that the Municipal Railway was under construction; and this, necessarily, caused many obstructions and difficulties, but in every case, the oxy-acetylene welding proved itself equal to the occasion, and all difficulties were surmounted.

There are three separate methods in which pipe may be handled when welding with the oxy-acetylene torch. Bell holes may be dug as for any coupling, and the pipe welded in the ditch, or the pipe may be lowered into the ditch and turned while the welds are being made; thus, the welding of many of the joints is done on the top of the pipe, and the necessity for digging large bell holes at every joint is avoided.

The third method, which was found the most practicable, where conditions will allow, is to put short pieces of timber across the top of the ditch at intervals, rolling the pipe into places directly over the ditch. This method insures a good alinement of the joint, and requires the least labor. With it, two men can turn as much as 500 ft. of pipe, while the operator is welding the joints, and as a 500-ft. length is about as long as can be conveniently handled, it will thus only require a bell hole and a well in the ditch every 500 ft.

While it is possible to make a good weld without turning the pipe, a great deal more time and care are necessary than when the pipe is turned, and the welding is always done on top of the joint. In welding the under side of a joint in the ditch, it is not possible to pile up the metal, as it is when welding is done on top of the joint. A joint being welded in the ditch is also more often allowed to cool before the weld is completed, and this leaves a possibility of pinholes where the weld is commenced again.

To insure against the possibility of the mold not extending through the entire thickness of the pipe, the ends of the lengths to be welded were left about ⅛-in. apart, and the operator worked with a rod of 3/16-in. Norway iron in his left hand. This iron is melted into the joint to take care of the gap, and also to build up the metal around the joint. In this way the ends of the pipe are perfectly welded, and the metal at the joint is thicker than in the pipe; thus making the joint the strongest part of the line.

To prove this statement that the weld is as strong, if not stronger, than the rest of the pipe, sample welds were made, and the pipe was afterwards flattened and bent until it was broken. In every case the break occured back of the weld in the pipe and not across the joint.

A more practical test, which will appeal to gas men, was also made as follows: Two 40-ft. lengths were supported on timbers laid across the ditch, and the ends welded together. All the supports were then removed from under one of the lengths, and the entire weight of this 40-ft. length was suspended on the joint. The weld was in no way affected by this severe treatment.

After several hundred feet of pipe are welded into a section, the supports are removed, one at a time, and the pipe reeled into the ditch [illegible]. Careful handling is no longer necessary as a weld, if properly made, will stand the same treatment as the pipe, and any defect is better detected before the pipe is covered.

It may readily be seen that, when welding the pipe on top of the ditch, into sections several hundred feet long, it is possible to work several welding outfits at the same time, with the minimum of labor. If a little care is exercised in distributing the pipe along the ditch, two men can readily roll it into place, over the ditch, for welding. In many cases, after these sections were reeled into the ditch, the ends of the sections were several feet apart. To avoid using a short piece of pipe and making two welds, a block and tackle was used, and, with an automobile for motive power, these sections, in some cases 500 ft. long, were dragged several feet in the ditch to meet the end of the next section.

As the tubing which was used on this line was approximately 3/16-in. thick, and would not permit of threading, the question arose as to how valves or governors should be connected. This was solved in a very simple manner. A short piece of 8-in. standard pipe was threaded onto a standard flange. The standard pipe, which was 8-ins. inside diameter, was then slipped over the tubing, which was 8-ins. outside diameter. After the valve or governor was installed and the flanges bolted up, the end of the standard pipe was welded to the tubing. This installation, which represented about 180 joints, was welded throughout its entire length. At the end of each day's work the line was tested to 150 lbs. pressure and allowed to stand over night. As an extra precaution the joints were also gone over with soapsuds. After completion the entire line was tested to 150 lbs. pressure and the line stood at this pressure for three days without loss.

The oxy-acetylene torch develops a flame temperature which may conservatively be estimated at 6,000°F., and it may readily be seen that with this temperature concentrated in a small pencil flame under perfect control, all metals become amenable to the will of the operator. The torch used for oxy-acetylene welding is constructed upon the injector principle, in which the oxygen and acetylene are conveyed through separate tubes to within 1-in. of the point of combustion. The acetylene is usually conveyed direct from the generator, through hose connections to the torch, at a pressure between 3 and 5 lbs. per sq. in. The oxygen, stored in tanks, is used through a reducing valve and hose connections to the torch at between 15 and 20 lbs. per sq. in. On the handles of the torches are controlling valves whereby a nicer regulation is attained. For lighting the torch the acetylene is first turned on full and ignited. Oxygen is then added until the flame becomes a single cone. An excess of acetylene produces two cones and a white color, with an access of oxygen produces a violet tint.

The hourly consumption of the torch used for 8-in. steel tubing was 24 cu. ft. of acetylene and 30 cu. ft. of oxygen. Using acetylene direct from the generator, at a cost of 1 ct. per cu. ft., and oxygen from tanks at 6 cts. per cu. ft., at which price it is now available in San Francisco, the cost of operating the torch would be $2.04 per hour and, allowing 40 cts. per hour for the labor of an operator, the total cost of operation would be $2.44 per hour. As the average time necessary to weld a joint on top of the ditch, where the welding is done on top of the pipe, is 10 minutes, the cost of such welds would be slightly over 40 cts. per joint. The time necessary to weld a joint in the ditch, where the operator was forced to weld underneath the pipe, was 28 minutes per joint, making the cost of these joints $1.13 each; but if the pipe is welded into long sections on the ground it is only necessary to have a weld in the ditch to every 10 joints welded on the ground. This would make an average cost of 49 cts. per joint, which would be approximately 2 cts. per inch of circumference on steel tubing 3/16-in. thick, and from this can be estimated the cost of welding various sizes and thicknesses of pipe, as the time per weld, and consumption of oxygen and acetylene would increase in proportion to the size and weight of the pipe.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.

ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820 Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, DECEMBER 12, 1912. No. 24

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
The Water Powers of Canada 861
Toronto and Pure Water 861

Leading Articles:

Loading Assumptions for Structural Design...... 849
The Protection of the Foreshore at Dallas Road, Victoria, B.C. 851
Maintenance and Repair of New York State Highways in 1911 853
The Effect of Safe Water Supplies on the Typhoid Fever Rate 855
Compressed Air Storage in Rock 857
Repairing the Aspinwall Filtration Plant 859
Welding Pipe With the Oxy-Acetylene Torch...... 859
Toronto's Water Filtration Project 863
Reconstruction of an Old Retort House............ 867
The Windsor, Essex & Lake Shore Rapid Railway 870
The Effect of Traffic on Bituminous Pavements.. 872
Standard Method of Traffic Recording 873
Report on Water Supply and Fire-Fighting Appliances of Victoria, B.C. 874
The Development of Diesel Marine Oil Engines.. 875
Coast to Coast 876
Personals 877
Coming Meetings 878
Engineering Societies 878
Market Conditions 24-26
Construction News .... [illegible]
Railway Orders .... [illegible]

THE WATER POWERS OF CANADA.

Nearly a year has passed since the publication of "The Water Powers of Canada" by the Commission of Conservation. It was announced some time ago that another volume on "The Water Powers of Western Canada" was in process of compilation, and we understand that considerable work has already been done in the gathering of the necessary data.

We have had occasion at different times to refer to the volume already published; and, while a good deal of space has been given to it by the press in Canada, it is very doubtful whether the true value of the compilation is understood.

Probably the most valuable portion of "The Water Powers" is that dealing with the water powers of Ontario, and in particular that part which correlates the data respecting the legislation, public and private, connected with the great hydro-electric plants at Niagara Falls. This data is destined, in the future, to become more and more valuable as the work of the Hydro-Electric Commission of Ontario extends. Too much credit cannot be given to the author, Arthur V. White, C.E., for this section of the work. Perhaps no other man is as well qualified to handle it as he, and there can be only unqualified approval of the way the data has been compiled and presented. This section of the report has but to be read to appreciate the painstaking care and laborious research which he has, with an intimate knowledge of the local conditions, brought to bear on the work.

The importance of this work will be understood in the very near future. To-day at Niagara Falls 280,000 horse-power is being developed on the Canadian side by the hydro-electric companies. Of this amount 137,000 horse-power is being exported to the United States, or nearly one-half. At the present rate of increase in the use of electric power, due to the extension of the Hydro-Electric Commission system, it is a matter of a very few years until the demand will be greater than the available supply. The only complete record of agreements, franchises and legislation respecting these companies is that compiled by Mr. White, and to be found in "The Water Powers of Canada"; for that reason we feel sure it will be increasingly referred to as time goes on.

◆

TORONTO AND PURE WATER.

Toronto citizens are being asked to vote a large sum of money in January next for the duplicating of the filtration plant recently completed on the Island.

Ever since the inception of this plant there have been many, both through the press and otherwise, who have prophesied that the plant would not come up to the anticipations of its supporters.

This journal has always held that the choice of type of filter for Toronto was not based upon any reliable or ascertained data.

Ex-Controller Dr. Harrison, Dr. Sheard and others made a short visit to the States some few years ago, visited a few slow sand filter plants, came back and put a motion through Council that Mr. Allen Hazen, of New York (a slow sand filtration expert), be employed to make plans for such a filter for Toronto.

There were many, including this journal, who concluded that the proper course to have followed would have been to carry out a few simple experiments in order to ascertain first just what was the best type of filter to suit the local conditions. This was not done. No other system other than slow sand was considered. Advocates on municipal platforms were clear and impressive in practically guaranteeing that the system would remove at least 98 per cent. of the bacteria in the raw water, with the total elimination of all intestinal bacteria. Advocates appeared to have read Allen Hazen's book, entitled "Filtration of Public Water Supplies," a book which does not treat with or give examples of filtering similar water to that which forms Toronto's water supply. Advocates appeared not to have read or even heard of the high efficiencies which were being obtained by mechanical filters with similar waters to Toronto's water supply in England, the United States and elsewhere.

What is the result? Again history is repeating itself. Toronto is being asked to go blindly into spending a huge sum of money on a system of filtering its water which has not even under trial proved efficient. The question of the efficiency of the other method is not considered, apart from a general report by the engineer, who has practically completed his plans for a second slow sand plant, and who also was responsible for the first plant.

Apart from the question of this being business, is it engineering? Engineering is supposed to be a science built on the foundation of exact data. Its conclusions are supposed to be the natural outcome of experimental findings, either in the laboratory or in practice. Where are the experimental or any other data which should encourage the citizens of Toronto in voting a large sum of money for a duplication of a plant which has required a judiciary authority to stop up its one hundred and one leaks?

Manufacturer after manufacturer of mechanical plants have practically said: "We will put you in an experimental plant; if it does not work satisfactorily, then no pay." Every manufacturer of mechanical plants has been turned down. Why? Because the city's highly-paid advisor, prejudiced to a particular type, says it is the only type. Prejudiced because he has designed the first half, and any recommendation of another type for the second half would practically mean an admission that the first half was bad in type.

Commissioner Harris is not an engineer. Therein lies his strength as an arbitrator. He can afford to pass over the amenities and nice frills of engineering etiquette, which, unfortunately, do not always make for engineering efficiency. He can afford to choose the best, independent of the fact that Engineer Hazen was responsible for the first half, and just choose that the second half be based upon pure business and actual data. Let the one type be tried alongside the other, the results made apparent, and the best chosen. Thus only can the people of Toronto be sure that when voting for filtration in January next they are giving an intelligent vote for the proven system.

Toronto can afford to wait. With chlorine at the back of the water supply, risk of typhoid is eliminated. It is a question of clearing out turbidity either by mechanical or slow sand methods.

In the first instance, however, the excessive turbidity which interpenetrates the whole subject must be removed by evidence, so that the issue be clear and above board.

The subject is further referred to in detail on page [illegible] of this issue.

[The following letter Mr. T. Aird Murray, consulting engineer, who was one of the board of engineers that reported on the water supply of Toronto recently, has written in answer to certain questions we placed before him. The letter is self-explanatory.]—Editor.

(To the Editor of The Canadian Engineer).

Sir,—In reply to your enquiry re the recommendation in our report upon Toronto's waterworks, with reference to recommending mechanical filtration at Scarboro' and a duplication of the present plant on the Island. Of course I can only speak for myself. As far as my memory goes, the type or character of the duplication was not seriously considered as far as the Island plant was concerned. The question of type in connection with the Scarboro' scheme was thoroughly gone into, both with reference to probable efficiency and cost. Mr. Isham Randolph along with myself, went particularly into the question of cost, and we made it that a complete filter plant could be constructed at a cost a little over $10,000 per each 1,000,000 gallons of water treated.

Your point with reference to experimental data is good, and I certainly think the city would be in great error in spending any sum for absolute duplication of the present plant until it is made perfectly clear what the reasons are for the extraordinary variations in efficiency which have been peculiar to the Toronto plant ever since it has been operated. It also appears reasonable that the city should find out by experiment just what can be done by mechanical methods, especially as the area of land required by these latter types is very small compared to that required by slow sand. If mechanical filtration proved effectual, it would mean that an unlimited quantity of water could be treated on the Island, whereas, by slow sand methods, the quantity is, of course, limited to something like about two or three millions per acre. The successful treatment of Ontario Lake waters on the Island would probably justify the city in deferring the Scarboro' scheme to a much later date than at present appears.

I hold no brief for mechanical filtration as against slow sand. But it does appear now that the hypochlorite treatment is becoming universally an adjunct to either process, that the rapid methods may prove all that is required.

Further, there is no doubt but that mechanical methods have been greatly improved of late years, and that splendid results, comparable in every way with slow sand, are being obtained.

With reference to the question of operating cost, it may be taken that when the amount of coagulant required (if sulphate of alumina) is not more than one grain to the gallon that the total capitalized cost of mechanical filtration works out at a somewhat less figure than slow sand. For example, a ten million gallons per day capacity plant for each type would run about as follows:

Slow Sand Filtration.

Cost of installation, about	$200,000
Cost per annum for operating, sand washing and upkeep at $3.50 per 1,000,000 gallons per day capitalized at 5 per cent.	255,500
Total capitalized cost	$455,500

Mechanical Filtration.

Cost of installation	$100,000
Cost per annum of coagulants at 1 grain per gallon, labor, washing, etc., $4 per 1,000,000 gallons per day, capitalized at 5 per cent.	292,000
Total capitalized cost	$392,000

Balance in favor of mechanical filtration on above basis is, therefore, $63,500.

I may say it is very difficult to compare costs of either type, as one almost requires that both types be working alongside one another, dealing with the same class of water under the same conditions.

I think you are about the mark when you mention the requirement of half a grain to the gallon of coagulant for Toronto water. Of course, this would make the total capitalized cost even more favorable for mechanical. A half grain to the gallon would cost in Toronto about $1.25 per each 1,000,000 gallons of water treated.

Yours faithfully,
T. AIRD MURRAY.

TORONTO'S WATER FILTRATION PROJECT.

The problem of whether the slow sand filtration or rapid mechanical filtration provides the most efficient system for Toronto's water supply is before that city.

Under the advice of Mr. Allen Hazen, supported by Dr. Amyot, of the Provincial Board of Health, Toronto has completed a slow sand filter plant which evidently requires expansion. Further, under the advice of Mr. Allen Hazen and, we believe, again supported by the Provincial Board of Health, the city Works Commissioner advises the city to duplicate the slow sand filter plant already constructed.

Ald. Yeomans, of the Toronto city council, has taken up with no little enthusiasm the cause of the rapid mechanical system as against the proposed duplication of the present slow sand method.

Mr. Allen Hazen, as a sort of reply to Ald. Yeomans, again reiterates his conviction that conditions at Toronto are more favorable to the slow sand methods than to the rapid methods.

The Canadian Engineer has felt that it is due to its readers that some expression of opinion in this matter be made. We have looked into the matter for ourselves, with the result that we are forced to the conclusion that there is evidence that slow sand filtration is not suited to Toronto water supply, and that there is no evidence before the city that rapid mechanical filtration is unsuitable.

On page 13 of the Report of the Board of Commissioners, Toronto Water Works, 1912, the following paragraph occurs: "This board has concluded that a mechanical filtration plant will meet the requirements at Scarboro', and will cost less than a slow sand filtration plant similar to that on the Island." On page 15 the estimate of cost is given at $653,400 for a 60-million gallon per day plant. What we wish to know is: If such a plant is considered suitable at Scarboro', then why not suitable at the Island?

Capacity of Present Slow Sand Plant, Toronto Island.

Twelve filters, each having a filtering area of about four-fifths of an acre, with a rated capacity of 32,000,000 Imperial gallons per 24 hours, is a rate of 3.3 million gallons to the acre when all are in commission.

As one filter at least should be out of commission for cleaning and only eleven filters in use, the capacity is increased to 3.6 million gallons to the acre.

The maximum capacity is stated as being 48,000,000 gallons per 24 hours, or at the rate of 5 million gallons to the acre when twelve beds are in commission, or 5.4 million gallons to the acre when eleven beds are in operation.

Capacities Elsewhere.

	Average (acres.)	Average daily consumption.
United States	17.13	26.87
British Columbia	.82	1.80
Holland	22.75	31.48
Great Britain	161.80	362.73
Germany	106.22	117.13
Other European countries	34.74	88.84
Total	343.64	648.85

Average per acre 1.8 million gallons.

From this it would seem that the maximum capacity should not exceed 3.6 million gallons per acre by allowing double the capacity of the average rate as practised throughout the world.

Most of these results are with clear waters which have been impounded and settled before filtration, so that the clear water of Lake Ontario comes under the same classification.

Efficiency of Present Plant.

To analyze the efficiency of the present filtration plant let us review its results from June to October (without the use of chlorine), This should be a fair trial, as the filters started up in the early part of January last.

The following chart prepared by Alderman Yeomans is made up from bacteria counts supplied to him by the medical officer of health, and shows graphically the efficiencies.

In the first run we find an average bacterial efficiency of 86.1 per cent. in 26 days, while in the latter the actual efficiency for 10 days out of a 35-day period there is an average of 204.10 per cent. worse than the raw water.

All authorities are unanimous in their statements that well operated filters should give an efficiency of about 98 per cent. where the raw water count is not too low, but at all times should give continuity of results from day to day.

Clearly viewed in the light of these efficiencies, Toronto's plant is a failure. Why? Briefly the causes may be put down as follows:

(1) Type of filter unsuitable.
(2) Design of filter faulty.
(3) Faulty construction.
(4) Faulty operation.
(5) Too high rate relative to capacity.

Type of Filter.—Before considering the type of filter the quality of the raw water must be considered, and its relation to the principles of filtration.

Dr. Frankland, one of the greatest authorities on the action of filters, gives the results of the investigations of Piefke, the resident engineer at Berlin waterworks, in which he fully concurs, which determine that the slimy coating on the surface of the filter sand is the main cause of high efficiency rates.

"In a small experimental filter constructed by Piefke with **sterilized waterworks sand,** and set to work in the usual way, it was found that the power of retaining microbes was nil, that in fact more organisms were often found in the filtrate than in the unfiltered water, multiplication having taken place during passage through the filter. These experiments with sterilized sand **demonstrate that it is the slime deposit on the sand which constitutes the real filtering material in the waterworks filter.**"

Bearing this principle in mind, we must consider all forms of filtration. For large waterworks systems these can be resolved into:

Slow sand filters.
Gravity mechanical filters.
Pressure mechanical filters.

In the first the slime is formed naturally, while in the two latter it is formed artificially by the precipitation of alum in various forms with the action of the lime in the water.

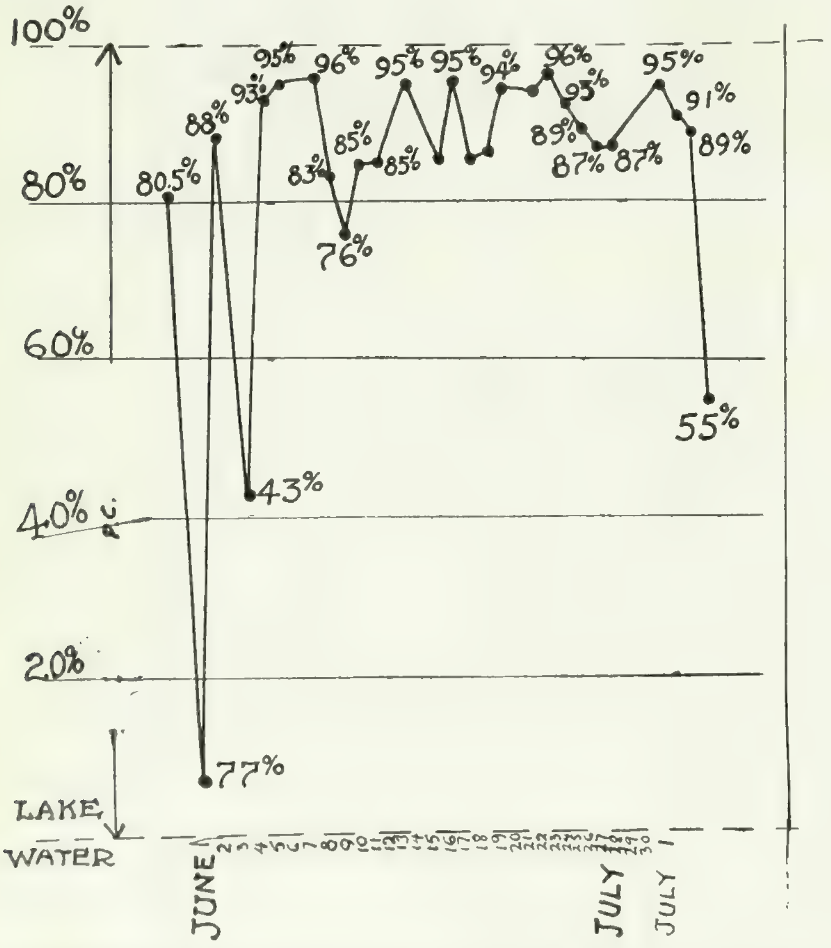
The first depends on the natural power of the water to form the film, while under the latter it is controlled.

If Lake Ontario water is so clear as to allow of the high rate of filtration which is being used, then it is too clear to form an efficient and strong film deposit, so that **probably the mechanical filter in this respect will be found more efficient.**

Of the two forms of mechanical filters the gravity filter is most successful in America, while in Britain the pressure filter holds first place. Both are found to give high percentages of efficiency, and to give them continuously.

Design of Filter Faulty.—In this respect an investigation was held, in which Judge Winchester presided. His summing up after all evidence was taken was that the design was all that could be desired, and this must be accepted with the mention that all filters should be designed so that they are absolutely watertight, according to the findings of the leading specialists and commissions. That there are leaks in Toronto's filtration plant has been established, and admitted by Engineer Hazen and his superintendent, Mr. Longley.

Faulty Construction.—In this respect Judge Winchester has decided that contractors have fulfilled the requirements of the specifications drawn up by Engineer Hazen, therefore, the question of leakages should rest with the question of design.



Graphic Diagram Showing Efficiency of the Toronto Slow Sand Filters from June 1st to July 5th, 1912.

Faulty Operation.—The filters having been operated to the satisfaction of Engineer Hazen's representative, under his supervision, any inefficiency due to their operation should rest with Mr. Hazen, who, according to the statements made from time to time in the daily press, authorized by him, is fully satisfied.

Too High Rate Being Used.—Commissioner Harris, Engineer Hazen, and Mr. Longley have repeatedly stated that the filters are being operated at too high a rate, so that they cannot be expected to give efficiency.

The responsibility for this rests with Mr. Hazen for designing and having constructed a filtration plant which will not give the efficiency required, even if such were done at the request of the council.

Surely an engineer should not hand over any plant to a municipality which he knows will not do the work required of it.

Present Position.—The present position, therefore, appears to be that either the design of the filter is faulty or its capacity is too small, both of which faults the designer has been paid a large sum of money to prevent. **In view of this, we do not think Mr. Hazen ought to be entrusted with the design of another filter until the efficiency of the present plant is placed beyond question, or mechanical filtration experimented with.**

It appears to us that what is required now for an extension of the present waterworks system is a filtration plant which we know will give efficient results. One that can be erected speedily to bring the present plant up to the capacity required, and one which will rectify the deficiency in filming due to the character of Lake Ontario water, by the addition of mechanical means under engineering control, not subject to the vagaries of the raw water.

From this review it appears that mechanical filters are worthy of independent investigation, and the reasons why they have not been so considered lead to the conclusion that Mr. Hazen's advice has been solely relied on.

Mechanical Filters Have Not Been Fully Considered.

Commissioner Harris is a good business man, but not an engineer, and as such has strictly relied on the advice of Mr. Hazen. Surely it is up to Commissioner Harris to have this advice from some other person than the engineer responsible for the first plant.

Mr. Hazen has been building slow sand filters for a great many years, and may be prejudiced in their favor, and may be loath to consider other methods which have arisen in more modern practice. He has reported that operating costs of mechanical filters are too high and they are not suitable for Lake Ontario waters.

A comparison of the two systems is therefore advisable, the principal points of which are as follows:

(1) Suitability.
(2) Efficiency.
(3) Operating costs.
(4) Methods of washing.
(5) Capital investment.
(6) Time for construction.
(7) Space required.
(8) Need for disinfectant.
(9) Taste, color, hardness.
(10) Operating supervision.
(11) Chances of pollution.

Suitability.—The question of suitability is chiefly determined by the raw water, and it is very doubtful if Lake Ontario water has the qualities necessary for the formation of the film which is the chief medium in obtaining efficiency, it would appear that an artificial means would remedy this defect to advantage, provided no trace of the reagent employed is left in the water after passing through the filter. Mechanical filter manufacturers have stated that they are prepared to give a guarantee that this can be effected.

Efficiency.—The efficiencies of mechanical filters (without chlorine) are invariably as high as need be desired, a few of them may be given as under:

United States, Atlanta	98.4%
England, Shrewsbury	98.8%

United States, Loraine	98 %
United States, Harrisburg	99.1
England, Buxton	99.6%
United States, Louisville	96.7%
England, Banbury	99.4

Numerous other results give in every case high efficiencies, as high as slow sand filters are showing in similar circumstances.

Operating Costs.—The chief cost of operation is the coagulant or reagent in the case of mechanical filters, and of cleaning in slow sand filters. For Lake Ontario waters an average of ½ grain of alum is required or 71 lbs. per million gallons treated, which at current market prices amounts to $1.06.

The average amount of sand to be washed on the American continent is 3.8 cubic yards per million gallons at 32 cents a cubic yard or $1.21 per million gallons. This does not include the cost of scraping, which might very well be balanced by the cost of washing sand by mechanical methods. It would seem, therefore, that there is a slight advantage on the side of mechanical filters in regard to operating cost.

Methods of Washing.—With slow sand filters the sand is scraped off by human agency, taken out and washed. With mechanical means all sand is washed mechanically in enclosed vessels which avoid any chance of contamination by those working on the plant.

Capital Investment.—Slow sand filters are a permanent investment and cannot be removed. The true mechanical filter is made up in units which can be moved to any desired location, according to the changes which make it necessary. In rapidly growing cities where the requirements and the policy of the future cannot be determined, this is a very desirable feature. The cost of the present Toronto plant is at the rate of $23,400 per million gallons treated, while rapid filtration is about $10,000 per million gallons. (See commissioners' report).

Time for Construction.—A duplication of the present slow sand filter will take about three years to complete. With mechanical filters the present shortage can be made good in eight months at the most, and other units can be added as they are required at short notice, so that shortages can be made up in a few months at most.

Space Required.—The space required for slow sand filters for a duplicate plant in Toronto will be above eleven acres. With purely mechanical filters less than one acre is required.

Need for Disinfectant.—With the present slow sand filtration plant it is absolutely necessary to have a disinfectant to prevent danger. With mechanical filters a purification of 97 per cent. can be obtained without the use of disinfectants, but a small amount would render the water practically sterile.

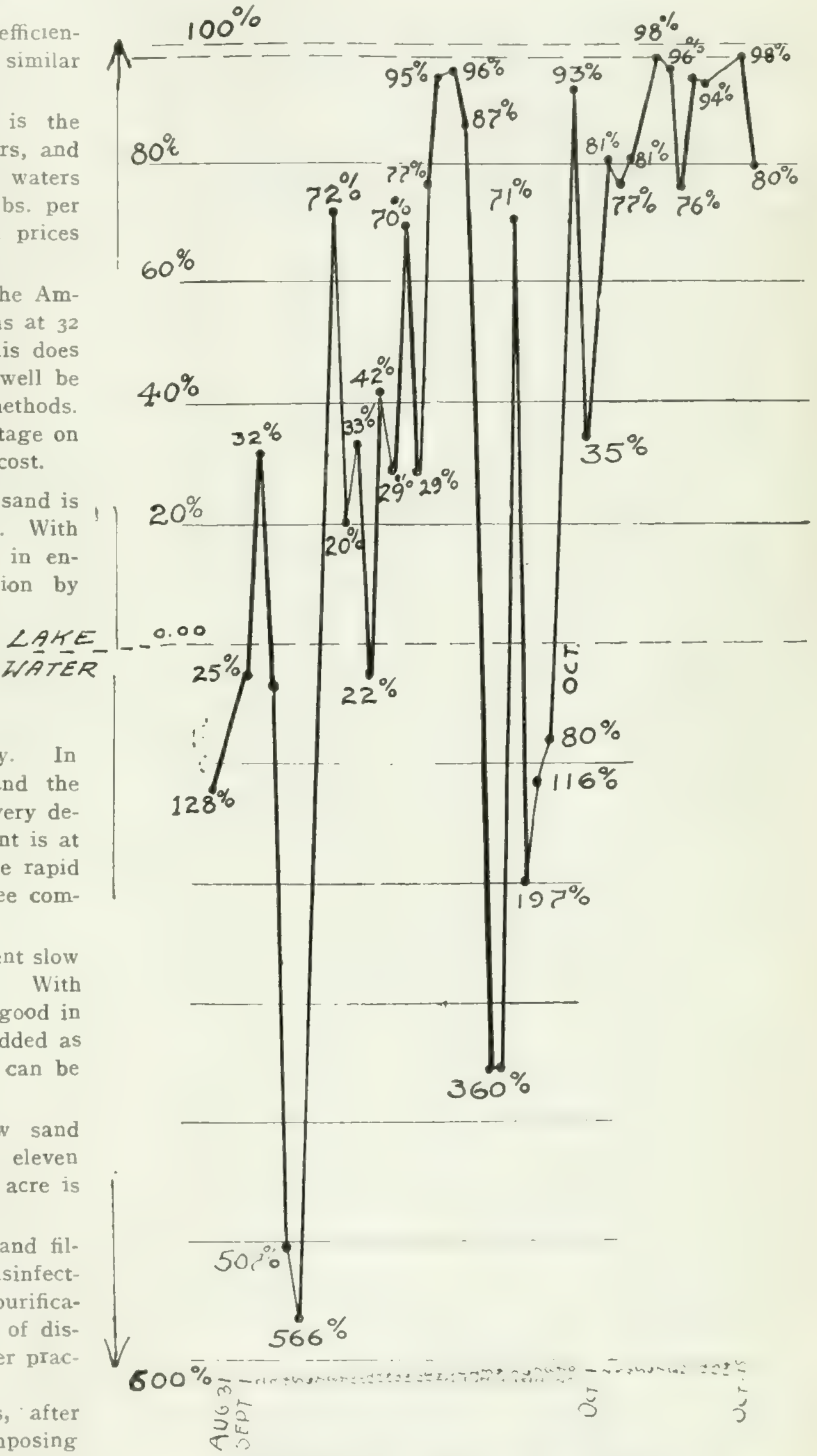
Taste, Color, Hardness.—With slow sand filters, after the filters have been idle there is a chance of decomposing vegetation giving a taste to the water. About 10 per cent. of color is removed, and there is no alteration to the hardness of the water.

With mechanical filters there is no taste, 90 per cent. of color being removed, while the water is increased about 1 degree in hardness.

Operating Supervision.—With slow sand filters skilled operators are required to see that the head is regulated to the flow, and to regulate supply to the filters to prevent their becoming inefficient by allowing too high a rate of filtration to pass.

With mechanical filters the engineers at the pumping station can secure the desired results.

Chance of Pollution.—Slow sand filters, being submerged, should there be any leakage from outside sources, there is serious danger which is not detected till after the water has been examined.



Efficiencies from August 31st to October 15th.

(Percentages for charts obtained from figures supplied by the Medical Officer of Health)

With mechanical filters every joint, pipe and filter is above ground, where any leak can be detected at once, and there is no chance of the outside water leaking in.

The former occupies a large area of foundation and runs considerable risk of settling, which makes the danger from cracking on insecure foundations very great, while the latter is not subject to this without immediate remedy.

There only remains, then, the fact of the pumping to the filters which would be greater in the case of mechanical filters, owing to their requiring a greater head of water to operate with, but this does not amount to more than fifty cents per million gallons, as per Mr. Hazen.

We have gone carefully into these facts and think that recommendation of the board of water experts for mechanical filters at Scarborough should be carefully considered in relation to the proposed extensions at the Island plant.

Alderman Yeomans has evidently undertaken a vast amount of research work in this question, and his case, as presented to the council, should have every consideration.

The urgency of the question, and the need for impartial consideration leads us to think that Commissioner Harris will do well to look further into the merits of mechanical treatment, and the employment of an expert who is well well versed in modern mechanical plants.

LETTERS TO THE EDITOR.

25-CYCLE CURRENT FOR LIGHTING.

Sir,—Your correspondent on this subject in last week's issue would seem to be puzzled as to the reasons for the choice of 25 cycles per second for current supplied by the Hydro-Electric System, and questions whether the effect of such lighting would be approved by an expert oculist. It is quite obvious that the technical exigencies governing the choice of this low periodicity did not include consideration for the eye sight of the lighting consumer. The advent of the small candle-power metal filament incandescent lamp has much accentuated the flickering effect of a low period current, owing to the extreme attenuation of the filament, as it is noticeable that with carbon filament lamps, possessing as they do a much slower temperature rise, this effect is much less noticeable. The same remarks apply to metal filament lamps of higher candle-power and consequently thicker filaments.

Carrying the matter further, anyone who has tried arc lighting on such a low periodicity as 25 cycles per second, knows that it is, for practical purposes, impossible.

HENRY COLES, E.E.

2 Toronto Street, Toronto, Nov. 30th, 1912.

CANADIAN ENGINEERS AND DRAUGHTSMEN.

Sir,—In reply to my friendly critic, Mr. Thomas, I would like to suggest to him that he has, to quite a large extent, proved my statements, although they were somewhat amazing to him.

First of all, I quite agree with him now, and if he will read my article again he will see that I recognized the fact at the time it was written that exceptions always occurred to the general principle I laid down with regard to the making of engineers from farmers.

These men were truly exceptions though, and would have made their mark probably in any branch of science and art. It was not, however, the exceptions that I referred to, but the great rank and file which is necessary to make up a mighty army.

I would ask Mr. Thomas, however, what is the natural tendency with, say, perhaps nineteen sons out of twenty? Is it not to follow in the steps of their fathers?

For myself, I am an exception to this, in a way, as my father was connected with the clerical staff of a railway system in the Old Country. Both my grandfathers, however, were workers in iron. Unfortunately, I cannot trace my pedigree back any farther than this, so that it is impossible for me to say how long the iron was in the blood. Now, I originally followed my father's footsteps when I started work, but found the work so uncongenial that at the end of about three years I gave it up and entered into my present profession. So, perhaps, in face of this evidence, it was a case of an exception in my father and not myself.

I am afraid I do not agree with the second paragraph of Mr. Thomas' letter.

Competition is keen everywhere, even in Canada, for the man who is looking up to the top of the tree. Also the statement that no one without shop experience could get a job as draughtsman in England is incorrect, as most of the offices I worked in it was the exception rather than the rule to find men with practical training.

Mr. Thomas must certainly have had rather an unlucky experience with his employers, I am afraid. I grant that the hours are longer, but I believe the province of Quebec stands alone in this from what I have heard.

Otherwise, I must confess that since I have been over here I have been treated more like a human being than I was in the Old Country, and as for the mutual trust and confidence, I think one has to merit that before you get it. It would not be reasonable for a boss, having sunk a good many thousands of dollars into his business, to let any man come along and do as he likes until he has satisfied himself his confidence is not misplaced.

The men in England who earn 35 shillings a week at mechanical engineering designing are the very sort of men who do not worry about theoretical considerations, and therefore are paid according to the service they give.

Mr. Thomas was certainly preparing for a storm, and I think every draughtsman would simply shout himself hoarse with opposition to his amazing statement.

Thanking Mr. Thomas for the opportunity he has given me of enlarging on this subject.

F. TISSINGTON.

Sherbrooke, Que., December 1st, 1912.

THE WORK OF RATS.

For many weeks the private telephone system installed in one of the largest and best-equipped printing offices in Canada has not been giving the service called for by the contract, and the electrical contractors, in accordance with the agreement, have searched for many days without even a clue. Outside of the fact that there was a short circuit on the line from the battery case, nothing could be secured, but first one instrument and then another would fail to respond or cross with another, or would work with complete satisfaction for a day or two, then drop off.

The cable was of the standard construction, wherein all the wires, insulated with cotton, wax-covered, are enclosed in a cotton covering, also waxed; this covering was, in the estimation of rodents, entirely suitable for use in home construction, and they removed the covering from every wire for a distance of about fourteen inches, and the bronze wire bears many indentations of their teeth. In their effort to remove the covering many of the wires were twisted around each other, and this, of course, was responsible for the ineffective operation of the system.

This illustration at once suggests the question, "Are many of the fires now laid to the cause of "defective electric lighting" due to these rodents removing the insulation from electric light wires in the same manner?"

Application will be made to the Dominion parliament for the incorporation of a company to carry on the business of fire insurance in all its branches, under the name of the Great West Fire Insurance Company. Messrs. Elwood, Embury, Scott and Graham, Regina, are solicitors for the applicants.

RECONSTRUCTION OF AN OLD RETORT HOUSE.*

By Mr. Howard E. Mann.

Prior to the year 1909 coal gas was manufactured in three retort houses at the Elm Station of the "Montreal Light, Heat and Power Company." These retort houses were referred to as No. 1, No. 2, and No. 3. No. 1 retort house was built in 1871. The building was of stone, 225 feet 6 inches long by 65 feet 7 inches wide, and 27 feet to eaves of roof. There were originally 19 direct fired benches containing seven 15 inches by 21 inches by 20 feet, through oval retorts. Recuperators were later added, and a pit excavated extending the full length of house on furnace side of benches. This pit was for clinkering purposes and the inspecting of recuperators. The recuperators were shallow, and would not be considered more than quarter-depth. The mouthpieces were old type with luted lids. Ascension pipes were 6 feet in diameter. The hydraulic mains were of cast-iron, with tar seal and overflow.

When first operated all the work of the recharging of coal and the discharging of coke was done by hand.

In 1895 "Bronder" charging and discharging machines were installed; also, an inclined cable system, with side-dumping cars, for the handling of coke from retorts to coke dump.

This installation was superseded in 1905 by DeBrouwer projector and ram. The house was also equipped with DeBrouwer coke conveyer, which extended the full length of retort house and up an incline to an outside radial coke conveyer. This radial coke conveyer was intended to cover a large area for stocking purposes. Owing, however, to design of tower, which supported far end of conveyer, it was impossible to radiate same without first moving 2,000 or 3,000 tons of coke which had fallen around tower, completely burying same from ground level to conveyer support.

No. 2 retort house was built in 1888. The building was of stone, 225 feet 5 inches long, 69 feet 6 inches wide and 26 feet 5 inches to eaves of roof. The original bench installation consisted of 17 half-depth benches of eights, with oval retorts 15 by 24 by 20-foot, through. As with No. 1 retort house, the transition from hand labor to machine operation was the same. Mouthpieces were of the self-sealing type. Stand pipes, 6 inches diameter, hydraulic mains of steel. Tar overflows and tar seals were originally used in this house, when a change later on was made to liquor seals. A clinkering pit, the same as in No. 1 retort house, was used for access to furnaces and recuperators. A DeBrouwer coke conveyer delivered coke into an inclined conveyer adjoining No. 3 retort house. A wooden coal storage bin was erected between No. 1 and No. 2 retort houses, and delivered coal to hoppers of DeBrouwer projectors.

No. 3 retort house was built in 1907. The building was 173 feet 9 inches long by 68 feet 4 inches wide, and 40 feet 6 inches to eaves of roof. This building was of first-class construction, being of steel, brick and concrete. The steel roof had a covering of cinder concrete, water-proofed with plastic asphalt.

The bench installation consisted of 9 full-depth, recuperative benches, of elevens, with D retorts, 15 inches by 25 inches by 20 feet, through. The mouthpiece, hydraulic mains, tar and gas mains were of English design. The coal bunkers were continuous and extended the full length of setting. Two 50-ton per hour bucket-elevators delivered coal from ground floor to 20-inch coal conveyer-belt, located over top of bunkers. A DeBrouwer projector and ram were installed for charging and discharging retorts, and a DeBrouwer coke conveyer delivered coke into an incline conveyer, which, in turn, delivered coke to rotary screen and small storage bin.

This type of retort house had been decided upon as the unit for future extensions, arrangements having been made to extend building and install 9, and possibly 18 more, benches of elevens.

These three retort houses, with the equipment of DeBrouwer charging and discharging machinery and coke conveyers, would be considered an extensive installation. The combined length of retort houses was 624 feet 8 inches; the number of benches was 47; the total number of 20-foot through retorts was 368. For comparison I will state that this installation was equal considering retorts alone, to 92 stop-back benches of 8's.

The daily gas production from all three houses, on 6-hour work, during the winter of 1908, was 3,000,000 cubic feet. In justice to this low production I will state that coal carbonized was not from the Pittsburg district, but was Canadian mined coal.

Owing to the increased yearly gas production, made possible by the expansion and growth of the city of Montreal, it became apparent to the officials of the company that the problem of gas manufacture with the existing retort house installation was becoming serious. The reconstruction of No. 1 and No. 2 retort houses was considered; also an extension of No. 3 retort house by an additional block of 9 benches of 11's. The condition of bench ironwork in No. 1 retort house would not permit of same being used in reconstruction, mouthpieces, standpipes and hydraulic mains being held together more by good luck than by bolts and rivets. The furnaces being small, it was impossible to obtain sufficient heat to carbonize a full retort of coal. The recuperators were practically useless, the secondary air ports in some benches entering the furnace below the furnace arch. In justice to the management I will state that this arrangement of secondary air under furnace arch was an American idea.

All of the retorts in the 19 benches were so badly cracked and punctured with holes that it was impossible to patch same further. In fact, everything pertaining to these 19 benches was practically worn out. When you consider that the greater part of the material, outside of retorts, had been in service for 38 years, we realize that what was left could only be considered as nothing more than junk.

After considering the capital outlay required to reconstruct No. 1 retort house, using the same arches, small furnaces and recuperators, and at the same time considering the tonnage carbonized, with small make of gas per man, it was decided that no reduction in cost of gas could be made, or increase in gas production obtained, unless full-depth benches and larger retorts were installed.

The condition of benches in No. 2 retort house was practically the same as benches in No. 1 house. Hydraulic mains were not only warped and twisted out of shape, but were also spattered full of holes. The bench ironwork was in a similar condition to that existing in No. 1 retort house. Retorts, furnace linings, and recuperators would require resetting inside of 12 months. Owing to condition of hydraulic mains a heavy seal was required to insure against air being drawn in when charging. No arrangement for lowering of seal after charging was used with result that make of gas per ton of coal was affected.

The clinkering pits in No. 1 and No. 2 retort houses were places that will always live in the memory of the men who worked there. With no ventilation, except from the inclined entrance at one end of the house, with the heat from furnaces reinforced by the burning of ½-inch gas pipe torches in front of every other furnace, with occasional backing up of sewers and flooding of pits, the clinkering of furnaces and wheeling out of ashes during winter months constituted a job that polite language is totally inadequate to describe.

---

* Paper read before joint meeting, Canada-Michigan Gas Association, Toronto, September, 1912.

The reconstruction of No. 2 retort house, using a modern design of half-depth benches, and utilizing all bench ironwork that could be recovered, was seriously considered. As No. 3 retort house adjoined No. 2 retort house we would have one house operating from the ground floor and one house operating from a stage floor. Additional coal-handling equipment would be required, and future coke storage (which we had in view) would not be available. The enlarging of clinkering pits would be expensive and as costly as a steel and concrete stage floor. There were too many factors against the reconstruction of No. 2 retort house with half-depth benches. Increased production of gas was absolutely necessary, the make of gas per man would have to be greatly increased, and the cost of gas reduced to warrant the capital outlay. We could not see wherein the perpetuation of half-depth benches would meet above requirements. We, therefore, decided upon another scheme of reconstruction, which has worked out to our entire satisfaction, re-production of gas, make per man, and reduction in cost of manufacture. Before dealing with the reconstruction of No. 2 retort house, a description of No. 3 retort house and a statement as to condition of benches in May, 1909, I believe would be interesting.

As previously stated, No. 3 retort house was adapted as the unit for future extensions. The benches were guaranteed for 2,000,000 cubic feet of gas per 24 hours, on 6-hour work. Each bench contained 11 D-retorts, set vertically in 3 tiers, 4 on each side and 3 in the centre. The centre, bottom retort, or bull's eye directly over furnace, was left out, and one furnace on discharging side of bench heated the setting.

This house was completed, and benches charged, July 15th, 1908. After operating a short time settlement was noticed in retorts over furnace, and this settlement became so great that charges could not be pushed out by ram. It was, therefore, decided to let down the collapsed benches and reconstruct the settings. A change in design was adopted with a view to overcoming this settlement and rupture of retorts. This reconstruction was not satisfactory. The retorts again collapsed, and, in some cases, closed up so completely that it was impossible to get a clinker bar into a retort. Gas could not be produced in this house without further reconstruction of settings.

As it had been decided not to rebuild benches in No. 1 retort house, we were left with only No. 2 retort house for the production of coal gas. With an increased gas consumption of over 10 per cent., the problem of supplying the consumers was becoming serious. Fortunately, the company had a water gas reserve of 2½ million cubic feet per day; but this production was not equal to the combined make of Nos. 1 and 3 retort houses. It was apparent that our only recourse was to increase the capacity of the water gas machines. Altering the time of blow-and-run, increasing steam openings and measuring steam and air used, increased the capacity of water gas machines 100 per cent. Mr. Haug's paper at last year's Quebec meeting dealt with this problem. The increased capacity of the water gas machines permitted us to put No. 1 retort house out of commission.

The reconstruction of No. 3 retort house was, then, our first problem. The two failures of the bench contractor convinced the management of the company that radical changes were required to insure stability of setting. We, therefore, decided to make up our own design and reconstruct with our gas works' staff. A bench of 11's is not a standard design, and careful perusal of gas literature failed to give us a design we considered suitable. A block setting would require too much time in waiting for material. Fortunately, we had in stores several hundred thousand Scotch firebrick, Welsh silica brick, 12-inch brick soaps, splits and arch bricks. It was decided to use these bricks in resetting the benches, as a block setting was out of the question when time was considered.

A design that we believed would overcome collapse and settlement in block setting was adopted. The furnace arch was torn out, carried higher up into combustion chamber, and rebuilt of silica brick. Furnace was widened from arch to grate bars, and relined. The combustion chamber was built of silica brick. The supporting walls for retorts were made of a 9-inch silica brick, and Scotch firebrick. The firebricks were used between side retorts and division walls of benches. The centre of supporting walls, from combustion chamber to main arch, was silica brick. These supporting walls were 9 inches apart, and carried up to main arch where provision was made for expansion. Retorts over combustion chamber were protected with silica brick in a similar way as shield tile are used in block settings. The recuperators, having given no serious trouble, were not disturbed. We have since redesigned and rebuilt recuperators, for we found, after a year's operation, tiles so badly ruptured, due to structural weakness, that short-circuiting of air seriously affected the heat of bench.

After the resetting of benches was completed we had, with the exception of retorts and recuperators, a bench built entirely of 9-inch bricks. This design was a departure from standard block construction, and we were told by bench builders that all manneer of trouble would be experienced.

No. 3 retort house was charged September, 1909, and, with the exception of time consumed in renewing recuperators, has been in continuous operation for 3 years. All of the benches will have a life of 4 years, and we expect to continue some benches on to the fifth year. Up to date we have experienced no settlement of retorts or settings. The retorts are level and true, the division walls and combustion chamber are as sound as when first constructed, and, with the exception of minor patching and repairs, we have had no further trouble or expense with this stack of elevens.

After operating the brick setting for a few months we were so well pleased with the condition of retorts, combustion chamber, supporting walls, etc., that we decided to adopt this type of construction for all future extensions. In the spring of 1910, the benches in No. 2 retort house were in condition for resetting. Having decided against the reconstruction of this house with half-depth benches, our only alternative was extension of No. 3 house as originally contemplated, or complete reconstruction of No. 2 house. The capital outlay required for the extension of No. 3 house we considered too high for a 2,000,000 coal gas unit. The walls and roof of No. 2 retort house were sound, but height of walls to eaves would not permit installation of stage floor benches. Floor space was ample for 18 benches of 8's, which would produce 2,500,000 cubic feet of gas per day on 8-hour work, or 3,000,000 cubic feet on 6-hour work.

As No. 2 retort house adjoined No. 3 house the reconstruction of same to make one continuous building was cheaper than proposed extension to No. 3 house. Yard space for present storage of coke and future storage of coal, would be reduced if extension to No. 3 house was adopted. We, therefore, decided upon the reconstruction of No. 2 house and the installation of 18 full-depth benches of eights.

The walls of building were 26 feet 5 inches to eaves of roof. As roofs to both houses were to be continuous, it was necessary to increase height of walls 14 feet 1 inch. The old roof was first cut in three sections; one section at a time was raised by chain-blocks attached to gin poles.

Brick walls were built up on old stone walls to a height level with wall plate of No. 3 house. As walls were completed, roof sections were lowered into position, riveted together and connection made to roof over No. 3 house. The roof covering was made of a thin layer of concrete, waterproofed with plastic asphalt.

The bench installation for new house consisted of two stacks, each stack containing 9 benches of 8's.

The brick setting in No. 3 house having worked out satisfactorily, we decided to adopt brick construction entirely in the settings of eights. The material used in furnace arch, combustion chamber and supporting walls of retorts was the same as used in the setting of elevens, but a change in design of combustion chamber was necessary, owing to the centre row of retorts being left out. The retorts were of Glenboig material, D-shape, 16 inches by 26 inches by 20 feet, through, set in two vertical tiers of four. The combustion chamber was built directly over furnace arch, and extended the full length of setting. The secondary air entered combustion chamber through flues opposite each nostril hole in furnace arch. Silica shield tile protected sides and bottom of retorts next combustion chamber. The furnace, located on discharging sides of bench, was of ample size to evenly heat the setting. Special attention was given to design of recuperators to minimize short circuiting of secondary air. The flue gas was led from recuperators into a main flue 4 feet wide by 4 feet 6 inches high, which extended the full length of setting and connected to chimneys at each end of house. The 4½-inch firebrick bottom of flue was laid directly on top of foundation. A 4-inch wall or mid-feather was built in centre of flue and extended the full length of same.

The stage floor was level with floor in No. 3 house, the charging side being made up of steel beams with checkered steel and cast-iron floor plates. The discharging side floor was made up of steel beams filled in with reinforced concrete. Mouthpieces on charging side of bench were 20 inches deep, and 7 inches on discharging side. Tar aprons were attached to mouthpieces with the exception of bottom row. The 8-inch ascension pipes and hydraulic mains were on charging side only. The discharging side was free from ascension pipes, hydraulic mains, etc. As gas was taken from retorts on charging side, the mouthpieces on discharging side were at all times free from tar. We were, therefore, not troubled with tarry and spongy coke, which is generally formed in and around the mouthpieces. Another advantage gained was reduction in cost of hydraulic main equipment and saving in pipe men on discharging side of house. Stopper men were dispensed with by allowing spongy coke pushed over into discharging mouthpiece to remain as a stopper for the charge from projector. This spongy coke was converted into dry coke during the next period of carbonization.

The coke was delivered into a DeBrouwer conveyer, which, in turn, delivered coke into incline conveyer connected with No. 3 retort house. Each bench had an individual hydraulic main. To each hydraulic main was attached a 10 by 10 weir valve for outlet of gas and regulating depth of seal. This weir valve was connected to 24-inch foul gas main, which extended the full length of setting and joined a header main connecting to 30-inch foul gas main on wall of building. At junction of header main two 16-inch retort house goverenors with by-passes were installed, and two clean-out pockets for removal of heavy tar were attached to each hydraulic main. A 4-inch tar outlet at bottom of hydraulic main connected with 10-inch tar main, which extended the full length of setting, and delivered tar and liquor into tar tower. A weir valve at tar tower was also used to regulate depth of seal in hydraulic mains. The liquor overflowing from tower passed into tar and liquor separator in cellar of retort house. Liquor was pumped from receiving tank connected to separator back into hydraulic mains. The accumulated tar in tower was drawn off every hour and flowed into tar well. Continuous coal bunkers, of 24 hours' capacity, extended the full length of stack on the charging side of benches.

The results obtained from 8-hour work in No. 3 retort house were so satisfactory that we decided to adopt 8 hours as the time of carbonization for all charges of both houses.

With the DeBrouwer projector we were able to charge the retorts full, thereby reducing the area of retort exposed to the gas. The time contact of gas with crown of retort was reduced to a minimum, which resulted in eliminating stoppages of ascension pipes and pitched hydraulic mains.

The coke (produced from Westmoreland slack coal) was very large and hard, closely resembling oven coke. This was due to increasing time of carbonization and full charges in retorts. Coke handling equipment, consisting of crusher, screens, bins, skip hoist and belt conveyers, now being installed in No. 1 retort house building, will give us an overhead inclosed coke storage of 4,000 tons capacity.

The total cost of reconstructing No. 2 retort house, including alterations to building and complete retort installation, was approximately $140,000. The production of coal gas was increased from 3,000,000 cubic feet per day to 4,000,000 cubic feet per day on 8-hour work, or 5,000,000 cubic feet per day on 6-hour work. The work of reconstruction and the dismantling and abandonment of No. 1 retort house at the cost indicated, were amply justified by the resultant increased production of gas and reduction in cost per 1,000.

◆

MERGER OF BRIDGE COMPANIES IN MONTREAL.

The latest merger spoken of here is that of the Dominion Bridge Company and the National Bridge Company. The expectation is that the Dominion Bridge Company will buy the National out, and that following this there may be an issue of the stock of the Dominion Company and that this may be listed on the local stock exchange where the public may buy and sell it as in the case of other stocks. There can be no doubt that Dominion Bridge would be one of the popular trading stocks as the company has been so well known for many years past and has been unusually progressive and successful.

The National Bridge Company has a capital of $1,000,000 common stock and a bond issue of $560,000 of 6% first mortgage, 40-year sinking fund bonds. The plant has only been in operation since July 1st, 1911, and a year after it had begun was turning out a total of 1,300 to 1,400 tons per month.

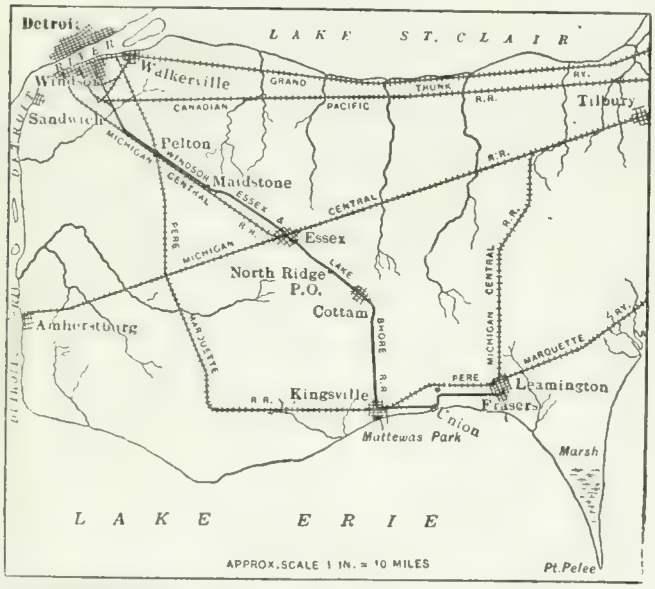
It is the owner of 350,000 feet of land and a plant at Longue Point, near the city, and although its plant is operating to full capacity it is quite unable to keep up with the orders which are coming in from all quarters. There are now orders in hand, it is claimed, to keep the plant going until well into next year.

Not the least remunerative of the assets of the company must be an option possessed on a block of 560,000 feet of land adjoining its own property. This option has till next April to run and land has been increasing at a very rapid rate in value in the vicinity mentioned.

It is stated that the Dominion Bridge Company will guarantee the interest on the National Company bonds and give one of its shares for four of the National shares. The directors of the National are Messrs. J. N. Greenshields, K.C., president; William Lyall, W. G. M. Shepherd, Hon. R. Mackay and H. W. Beauclerc.

THE WINDSOR, ESSEX AND LAKE SHORE RAPID RAILWAY.

The Windsor, Essex & Lake Shore Rapid Railway is a single-track line extending from Windsor to Leamington in the province of Ontario, with a total trackage of 40 miles. The line has been operated since 1908 and has the distinction of being the first and only single-phase railway in Canada. A very full description of the line was given in a recent issue of the Electric Railway Journal; this abstract is prepared from that article. The operating conditions are simple, as may be judged from the fact that the country is of level character with the exception of a 5 per cent. grade near Kingsville. Twenty-six miles out of the 37 miles of route are on private right-of-way, but in spite of this there are few curves. The following paragraphs will present some figures on the maintenance cost of the electrical features of this road and also a description of the freight and passenger business development.



Routes of Windsor, Essex & Lake Shore Railway and Nearby Steam Railroads.

The line construction is of the catenary type with cross-span suspension in towns. The poles are 120 ft. apart on tangents and as close as 80 ft. on curves. The material is of Westinghouse standard type, consisting of a steel messenger wire with hangers spaced 10 ft. apart, No. 000 grooved trolley wire, wooden-arm steady strains at curves, etc. In general the line is anchored at every thirty poles. This catenary carries current from the power house to the substation at Madisone, 18 miles distant, at 6,600 volts, which voltage is also used for the trolley service throughout.

The maintenance records for 1908 and 1909 do not show the charges made specifically for the upkeep of the line and bonding, but for the following fiscal years ended June 30 the amounts spent were as follows: $2,084.26 for the year 1910; $1,650.79 for 1911; $1,808.58 for 1912, a total of $5,543.63, or an average of $46.19 per mile per annum. Other figures by months were as follows: July, 1911, $174.66; July, 1912, $[illegible]; August, 1911, $179.5[illegible] and August, 1912, $145.53. These figures are not chargeable entirely to line and bonding account because the three linemen have plenty of time available for other work. The excellent behavior of the catenary construction will be best appreciated from the fact that in nearly five years of service only one or two wire breaks have occurred and it has been unnecessary to replace any material whatsoever. Most of the expenses charged were due to the installation of additional material such as strains at curves, hangers, switches, etc. Pantograph current collectors are used, and it is figured that the trolley wire is good for three to five years more. It is probable that the replaced line construction will consist of a copper catenary and a steel trolley wire. The snow-fighting equipment consists of an ordinary flat car which was fitted with nose plows at each end.

It has not been found necessary to make any track replacements or the like, but the roadway has been greatly improved by being reballasted with spoil from the company's gravel pits.

The generating equipment of the power house at Kingsville consists of two Goldie-Corliss cross-compound engines, operated at 125 r.p.m. and direct-connected to 500-kw., 25-cycle, 13,000-volt single-phase generators, which are furnished with 6,600-volt taps for the trolley line. These engines have required so few repairs that the total expense for five years' operation has been less than $50. The repair expense to the generators would be covered by about $100, the cost of four or five coil burn-outs.

Perhaps the most interesting feature of the station is the use of natural gas for the four 360-h.p. Canada water-tube boilers. Each boiler has seven Gwynne burners which have three cocks whereby the amount of fuel supplied to the boiler is regulated as easily as with a domestic gas stove. A slide valve at the end of each burner tube is manipulated to change the air mixture until a perfect blue flame is secured. The gas is obtained from the wells at 500-lb. pressure and is reduced to 8-oz. pressure at the boilers. Its fuel value is 11,000 b.t.u. per cubic foot. The boilers are operated at 140 lb. to 150 lb. steam pressure. The amount of attendance which these boilers need is so little that only one night man and one day man are required except for the occasional help of a cleaner from the engine room. In fact, the entire staff of the boiler station consists of but three day men and two night men. The use of natural gas as fuel has also proved an excellent thing from the maintenance standpoint because so far no replacement material has been required except a few bricks for the settings.

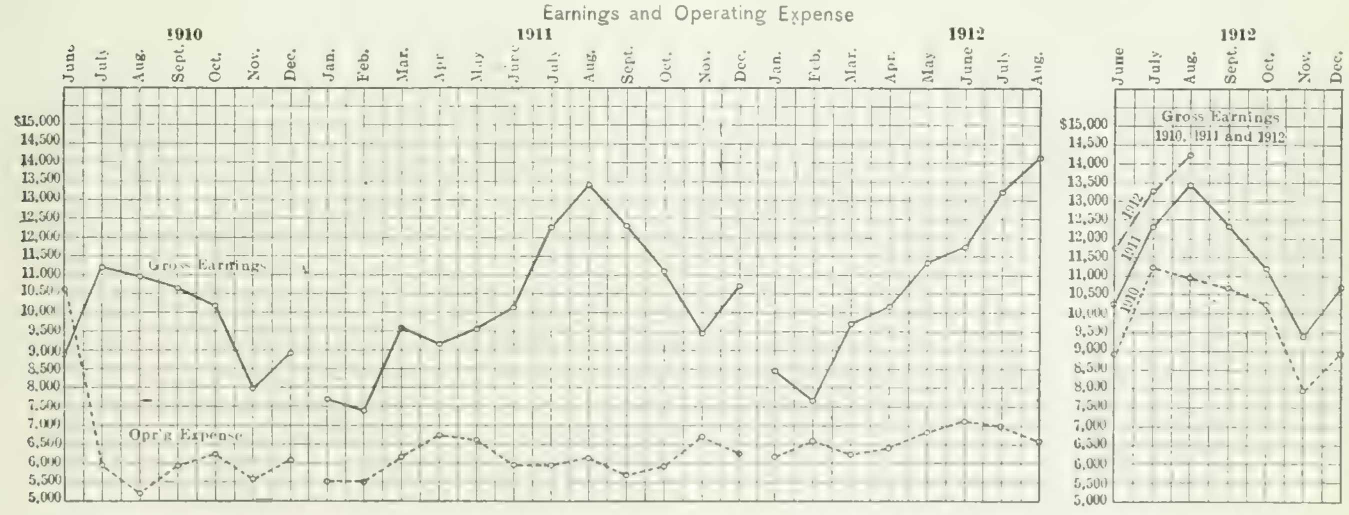
The original rolling stock consisted of five 55-ft. interurban type motor cars, four passenger trailers formerly used in elevated railway service, two baggage trailers and one electric locomotive. The passenger cars are each equipped with two 100-h.p. Westinghouse-132 straight single-phase motors, and the electric locomotive has four 100-h.p. motors of the same type. A similar equipment of four 100-h.p. motors has been furnished for the new combination express and locomotive car. The company also keeps four spare motors on hand. In general, the motors have always proved capable of meeting the conditions for which they were designed except that under excessive overloads they do not accelerate so quickly at a d.c. motor. The only trouble given by the original type was due to the breaking off of the thin leads at the commutator. The original coils were therefore replaced with coils with thicker tips, and no further trouble has been experienced. The company does all its coil winding and baking and also slots all commutators. The pantograph shoes are home made.

For the year ended June 30, 1911, the cost of maintaining the electrical equipment of the cars was $6,793.47 and for the following fiscal year $4,899.88. During the fiscal year ended June 30, 1911, the company operated 266,063 passenger miles and 80,903 freight and miscellaneous miles, making a total of 346,966 miles, and for the following year 273,380 passenger miles and 85,223 freight and miscellaneous miles, making a total of 358,603 miles. Approximately 2 per cent. of the passenger mileage included trailer service. In accordance with these figures the maintenance cost of electrical equipment of cars was $19.57 per 1,000 miles for the year ended June 30, 1911, and $13.66 per 1,000 miles for the year ended June 30, 1912. It is believed that the cost will be appreciably less during the next few years, owing to the change in armature coils and because the cars have been thoroughly overhauled during the past few months. The company feels that it has every reason to be satisfied with the behavior of the car apparatus.

The company operates nine passenger trains a day each way between Windsor and Leamington, a distance of 36.6 miles, and one extra passenger train each way between Kingsville and Leamington, a distance of 8.7 miles. Two of these trains are limiteds except on Sundays, when all trains are locals. The local trains make the run from Windsor to Leamington in one hour and forty-five minutes and the limited trains in one hour and twenty-five minutes. The institution of limited train service increased the company's passenger business about 20 per cent.

In addition the company operates each weekday two express and freight trains each way. These are scheduled to make the trip between Windsor and Leamington in two hours and ten minutes in one direction and one hour and fifty-five minutes in the opposite direction. Before December, 1911, less-than-carload express and freight service was run with passenger cars to form an accommodation train. This service hindered the passenger business to a great degree, and the running time between Leamington and Windsor was two hours and fifteen minutes. This train was therefore replaced by the limited service mentioned, and arrangements were made to handle the less-than-carload business by the new combination express and freight car, which also hauls standard freight cars twice a day on regular schedule. The latter arrangement saves a great deal of mileage as compared with the former method of having a locomotive make a special trip for individual freight cars. The old locomotive formerly used for freight service is now employed for general utility service, including the hauling of passenger trailers, as shown in one of the accompanying illustrations.

Locomotive Car with Four Trailers.



Curves Showing Ratio Between Gross Earnings and Operating Expenses, and Increase in Gross Earnings.

As noted from the mileage figures previously quoted, the company does considerable freight business, most of which consist of local products like tobacco, grain, hay and live stock. Besides handling local business the company has through billing arrangements and physical connections with the Canadian Pacific and Père Marquette Railroads, with which it prorates in accordance with the regular steam railroad classification. Where there is competition with the steam railroads the electric railway usually gets the business because it gives two deliveries a day compared with one delivery by the steam railroads. The freight business has been built up by personal solicitation among the local men, who are asked to specify the electric railway for all through routing.

The company has a large freight terminal at Windsor, a transfer station at the junction with the Canadian Pacific Railroad, a freight house at Leamington and a yard for live stock at Cottam. It has recently completed at Essex a handsome combination passenger and freight station. The station building, 32 ft. x 27 ft. 4 in. in area and constructed chiefly of brick, contains a waiting room and offices. It is adjacent to a corrugated-iron freight shed, which is 52 ft. long at the wagon delivery side and 41 ft. long at the track platform side.

On this line the growth of the freight business is merely a question of facilities. Thus the new express car has already secured a great deal of new business, and it is believed that the new depot at Essex will increase the earnings from this branch by about 50 per cent. It is likely, therefore, that additional sidings and freight houses will be built in the near future.

The improving financial condition of this property is indicated by the fact that the operating expenses for the fiscal year ended June 30, 1911, were 63.27 per cent., and for the fiscal year ended June 30, 1912, 59.52 per cent. of the gross earnings, in spite of the large amount of rehabilitation. The curves show by months how the gross earnings have increased and the proportion of operating expenses has decreased since June, 1910. The improvements have been made under the direction of Albert Eastman, general manager, who created and built up the freight and express business of the Utica (N.Y.) & Mohawk Valley Railway before assuming the management of this property.

EFFECT OF TRAFFIC ON BITUMINOUS PAVEMENTS.*

By Isaac Van Trump, Engineering Chemist, Chicago.

A new problem has arisen within the past year or two which the paving engineer must solve, and that is the deep ruts formed in bituminous roadways under exceedingly heavy motor traffic. The writer has in mind two boulevards, paved about 12 years ago with sheet asphalt. Until less than two years ago these thoroughfares were, after 11 years of constant traffic, still in perfect condition. During the summer of 1911 slight ruts appeared in the pavement, gradually becoming deeper until during the past hot season it became almost dangerous for a fast moving vehicle to use that portion of the street. In the writer's opinion this pavement, which had for 11 years been perfectly hard and stable, gradually became softened and displaced under the tremendously increasing automobile traffic and the minute oil drippings. It has been estimated that 17,000 vehicles, principally automobiles, pass over these pavements each day, a large percentage of which are homeward bound between the hours of 4 and 7 p.m., when the pavement, especially during the summer, is still warm and yielding from the hot sun.

It is, of course, well known that asphalt pavements become harder with age, but on the two boulevards above mentioned the condition of the pavement after years of service is reversed and it is now the problem of the paving engineer to prepare and lay a bituminous pavement which will not be seriously affected by the minute but constant dripping of oil and gasoline from automobiles. Neither is the above condition confined to sheet asphalt alone, as a similar condition existed on another portion of one of these same boulevards, paved in 1907 with bituminous concrete containing a coal-tar binder. Deep ruts appeared in this pavement within two years after laying, making it necessary to resurface the entire roadway.

Some few municipalities are advocating the elimination of the binder course. In many instances to economize in this manner is a serious mistake. A dense binder not only acts as an anchor for the wearing surface by giving added rigidity and stability to it, but it also protects the upper surface to a considerable degree from the deleterious action of water and illuminating gas from beneath. Many concrete foundations exude moisture under certain atmospheric conditions. The opportunity for street liquids to get beneath pavements from along car tracks, gutters and headers, and around manholes and catchbasins is great. Where no binder is employed, these liquids have easy access to the under side of the wearing surface.

To prevent the wearing surface from creeping under traffic some municipalities substitute a paint coat in place

---

* Abstract of paper read before American Society of Municipal Improvements, Dallas, Texas, Nov. 12-15.

DIMENSIONS OF PIPE					SAFE LOAD IN POUNDS STANDARD WROUGHT PIPE COLUMNS Quiescent Loads — 40,000 Ultimate — Factor of Safety of 7												
Inches			Square Inches	Pounds	LENGTH OF PIPE — FEET												
Nominal I. D.	Actual O. D.	Thickness of Metal	Area of Metal	Weight per Foot	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.315	.134	.495	1.67	......	......	......	......	......	......	......	......	......	......	......	......	......
1¼	1.66	.14	.668	2.24	......	......	......	......	......	......	......	......	......	......	......	......	......
1½	1.90	.145	.797	2.68	......	......	......	......	......	......	......	......	......	......	......	......	......
2	2.375	.154	1.074	3.61	5,085	4,785	......	......	......	......	......	......	......	......	......	......	......
2½	2.875	.204	1.708	5.74	8,520	8,120	7,720	7,350	......	......	......	......	......	......	......	......	......
3	3.5	.217	2.243	7.54	11,700	11,300	10,940	10,520	10,100	9,670	......	......	......	......	......	......	......
3½	4.00	.226	2.679	9.00	14,280	13,940	13,600	13,150	12,650	12,280	11,880	......	......	......	......	......	......
4	4.50	.237	3.174	10.66	17,140	16,850	16,450	16,050	15,650	15,200	14,720	14,280	13,820	......	......	......	......
4½	5.00	.246	3.674	12.49	20,000	19,710	19,430	19,030	18,630	18,170	17,720	17,250	16,790	16,330	......	......	......
5	5.563	.259	4.316	14.50	23,780	23,480	23,150	22,740	22,400	22,000	21,540	21,030	20,570	20,050	19,550	19,030	......
6	6.625	.28	5.584	18.76	31,030	30,740	30,450	30,100	29,720	29,310	28,900	28,450	28,000	27,550	27,020	26,500	25,910
7	7.625	.301	6.926	23.27	38,800	38,500	38,200	37,900	37,500	37,100	36,680	36,280	35,760	35,250	34,740	34,230	33,720
8	8.625	.322	8.386	28.18	47,200	46,900	46,630	46,280	45,900	45,630	45,200	44,700	44,230	43,760	43,250	42,750	42,180
9	9.625	.344	10.03	33.70	56,570	56,290	56,000	55,700	55,400	55,100	54,650	54,250	53,750	53,250	52,750	52,230	51,750
10	10.75	.366	11.924	40.06	67,500	67,200	66,900	66,600	66,300	66,000	65,600	65,200	64,750	64,250	63,750	63,200	62,600
12	12.75	.375	14.579	48.98	82,750	82,500	82,280	82,000	81,720	81,450	81,060	80,680	80,280	79,880	79,480	79,000	78,570

From the Valor World, October, 1912.

of a binder course between the concrete base and the surface mixture. Theoretically a paint coat forms a perfect bond between the two courses, but at best it is difficult and inconvenient to prepare and apply, and unless the conditions on the street are ideal the practical results are frequently entirely different from those obtained in theory.

Also for the purpose of overcoming the tendency of the wearing surface to shove under traffic, several cities have recently adopted what is known as "anchor concrete," a form of construction patented by W. B. Brady, of Chicago. Anchor concrete is merely a slush coat of cement mortar spread ⅜ in. deep upon the freshly laid concrete foundation. Before this slush coat has received its initial set, clean, hard, broken stone about 1½ to 2 in. in diameter is spread evenly over it and imbedded into the slush coat by light tamping. When dry, this produces a very rough but rigid surface and acts as an anchor for the topping which is laid directly upon it. This form of construction is especially effective on steep grades.

Where the traffic is light, such as on suburban or residential streets, it may be possible to eliminate all forms of intermediate courses and lay the wearing surface directly on the concrete base, but to do away with the binder course generally, as a few municipalities have recently done, regardless of traffic or other conditions, is a serious error.

STANDARD METHOD OF TRAFFIC RECORDING.*

The object of this report is to suggest a uniform method of recording, analyzing and standardizing quantity and weight of traffic on streets and roads, and for reducing it to unit bases of quantity and of tons per yard of used traffic width of roadway per day, or per square yard of used roadway surface, which it the same thing. It is wise to recall the two legitimate causes of wear and destruction of pavements; they are traffic and weather, separately and combined. Many records of traffic have failed to state the width of the road and are defective in other respects. Many cannot be reduced to any unit basis for comparison with one another. Many have unnecessarily subdivided the vehicles into too many kinds, sizes, etc., by methods which are complicated and unnecessary for practical, general use. Traffic records should be based on a simple, accurate method of counting and recording traffic and reducing it to standard units of quantity and tonnage. The method should be such as to be quickly understood and applied.

The period during which traffic should be counted is for 12 consecutive hours from 7 a.m. to 7 p.m. and during six consecutive or other different week-days. If average weather and what is known to be average traffic conditions are selected, then a record for only three consecutive week-days gives valuable information. No traffic should be counted in abnormal seasons of snow and ice, nor during continuous rainy, very cold or excessively hot days. The traffic should be counted at or near the centre of a block and not at an intersection of two streets. The traffic is that which passes both ways along the street or road.

The general classification of vehicle traffic for practical results, is as follows: First, horse vehicles, subdivided for vehicles drawn by one, two and three or more horses; second, auto vehicles. The vehicles and horses must both be considered in computing the weights of traffic from the quantities counted and recorded. For general traffic counting and the reduction of the quantities of vehicles to tonnage of traffic, the average weight of all vehicles, empty and loaded, drawn by one horse can be taken as 1 ton of 2,000 lb.; by two horses as 2 tons; by three or more horses as 4 tons. In like manner the average of all auto-vehicles, loaded and empty, for transportation of persons and goods can be taken as 1¾ tons. All bicycles and ridden horses, because light and very few, are best omitted from street traffic recording.

For recording traffic, sets of four cardboard slips, about 9 x 2 in., fastened together at the end, may be used; twelve sets are needed. One set is used for each hour. Each set is marked for location where traffic is counted, name of observer, date, the hour represented by the set (as 7 a.m. to 8 a.m., etc.). There must be at least two observers for each location, to relieve each other at the end of each hour or two hours, because one recorder cannot work accurately for a longer period. An ordinary conductor's punch is needed and a hole is punched in a slip for each vehicle passing in either direction along the street in front of the recorder. One-horse vehicles are punched on white cardboard; two-horse on yellow; three and more horse vehicles on red; all auto vehicles are punched on blue slips.

A blank form for one-day traffic record consists of a consolidated record of the quantity of traffic during each of the twelve hours from 7 a.m. to 7 p.m., with totals and reductions to unit bases. It gives details of name of city, width of roadway, effective width used by traffic, which averages ½ yd. less on each side or 1 yd. less than the full width between curbs or edges of the street, the kind and quality of pavements, the weather and other needed facts are shown. This form reduces the one day's traffic to standard units which are the total vehicles and total tons of traffic on the whole street; also per yard of effective width of the street. This is the equivalent of number of vehicles and tons per square yard of used roadway surface.

From the forms for the one-day traffic records a consolidated traffic record is compiled. It consists of a condensed statement covering the six or other number of days' traffic. It shows the data day by day, together with the final totals and the average per day. These totals are reduced in quantity and tons to the standard units of yard of effective width (square yard) of roadway surface subjected to the traffic. These are the true bases for comparing the traffic of one street with another and for establishing the relation of different amounts of traffic to wear on pavements, cost of maintenance and for many other useful purposes.

Traffic records are seldom needed annually; but at longer intervals up to once in five years or according to local conditions.

NOVEL METHODS OF HAULAGE.

During the operation of excavating for the foundations of large buildings it is a familiar sight to see an additional team whose duty it is to assist the haulage of the earth wagon to the road level, but this method has been superseded by a donkey engine at the corner of Simcoe and Richmond Streets in the city of Toronto.

The donkey engine is located on the roadway at the top of the incline, which is exceptionally steep, and uses the curbing as a brace. When a wagon has been filled and moved by the horses to the bottom of the incline, a cable is let down and secured to the tongue of the wagon by a hook; the horses are started on the upward path as the throttle is opened and it is interesting to see mechanical horse-power pitted against the more fleshy nature. If any conclusions are to be drawn from the action of the horses a by-stander would take it that the horses imagine they are on an elevator.

---

* Committee report of J. W. Howard, consulting engineer, New York, chairman, presented before American Society of Municipal Improvements, Dallas, Texas, Nov. 12-15.

REPORT ON WATER SUPPLY AND FIRE-FIGHTING APPLIANCES OF VICTORIA, B.C.

An exhaustive report on the water supply and fire fighting appliances of the city of Victoria and district has been prepared by Mr. H. R. Page, secretary-treasurer of the Vancouver Island Fire Underwriters' Association.

The report expresses the opinion that a conflagration hazard exists in Victoria owing to the narrowness of the streets in some instances, and the congested condition of a number of the mercantile blocks, which are solidly built up and lack lanes or other modes of access to the rear of the buildings.

The report considers there is no conflagration hazard in Oak Bay, but the abandoned shacks at Wharf Street, Esquimalt, are a danger.

The fire losses, the report says, have been rather severe during the past few years, the losses paid by insurance companies being as follows:—

1909	$ 74,435 00
1910	582,975 00
1911	128,377 00
1912 (to end of October)	128,584 00
Total	$914,471 00

or roughly calculated, slightly more than 60 per cent. of premiums received during the same period.

The Victoria city council decided to refer the report to the fire wardens, fire chief and water commissioner.

The mayor remarked that they would search in vain for any reference to the reduction of premiums. They had doubled in the last 18 years, steadily advancing from time to time as the city improved the fire brigade equipment.

The following findings of the report contain the observations of Mr. Page on the application of the city's apparatus to cope with an emergency:—

"The consumption has outgrown both the supply and capacities of the supply mains and pumps; at the present moment, with the Beaver Lake and North Dairy pumping stations in operation to the limit of their output, which equals approximately 4½ million gallons per 24 hours, there is a gradual drop of the water stored in Smith's Hill reservoir.

"This during a season when the consumption is probably at its minimum, promises a serious condition of affairs during the coming summer unless some provision is immediately made for increasing the supply.

"Further, the supply mains mentioned in this report are single lines, and have been laid for a period of 20 years or more, also the pumping units are not in duplicate, and should the larger pump at the North Dairy station, which has been steadily in commission for the past year, become inoperative through any cause, the city, or a large portion of it, would be without water for domestic purposes.

"The attention of the civic authorities has been drawn to these matters at different times during the past three years, and beyond repairing of the reservoir no material improvements have been made towards insuring an adequate domestic supply.

"It is proposed, and the work is at present under way, to bring water from Sooke Lake, some 27 miles distant; but this work, at the present rate of progress, will not be completed before 1914. It therefore becomes necessary to make some temporary provision, the two most feasible propositions being to lay a new supply main from Elk Lake to Smith's Hill reservoir and install additional pumping machinery at the North Dairy station, or connect the 36-inch main now laid on Gorge road with the Esquimalt Water Works Company's main. Should the latter course, which would appear the most simple, be adopted, the actual work of connection could be completed within two months, but under their charter the Esquimalt Water Works Company are privileged to demand 15 months' notice before such connection can be made, and also that a minimum of 500,000 gallons of water per day, at the rate of 6c per thousand gallons, be accepted for a period of not less than five years. Taking it for granted that the period of notice be waived by the company, and that the joint trouble in their supply main has been remedied, and considering that the head is sufficient to supply Smith's Hill reservoir without recourse to pumping, and the quality of the water unquestionably superior to that of Elk Lake, the latter proposition should be preferable.

"A large percentage of 4-inch pipe has been laid in James Bay district, and the section between Hillside, Tolmie, Victoria and Sidney Railway and Cook Street being particularly bad in this respect.

"The hydrants in some dwelling sections are widely scattered, while in the outlying business area the distances between hydrants runs as high as 500 feet. In such blocks intervening hydrants should be installed.

"When taking pressure tests, a number of hydrants were found in poor condition, three within the business area being entirely out of commission. A thorough inspection is recommended of all hydrants and also that all faulty ones be replaced by an approved pattern of hydrant having a steamer connection, and also that where the main permits, the branch connections be not less than 6-inch.

"Service mains running parallel on Wharf, Government, Douglas and Blanchard Streets would be materially assisted if cross connected, say, at Discovery, Cormorant and View Streets, also more gate valves should be provided; under present conditions a break in any one of these pipes during fire service would cause serious delay owing to the distance apart of the salt water hydrants in an easterly and westerly direction.

"As before stated, the salt water mains, when not in commission, are kept filled with fresh water and connected to the domestic system. In order not to waste the 65,000 gallons required to fill the system after service, the high pressure pumps are not started until a second alarm is sent in. As the steamers frequently connect to the high pressure hydrants for suction, there would appear to be a possibility of serious consequences in the event of a fire getting out of hand during the interval between releasing the steamer and changing the hose lines to the salt water hydrants. However, this is a matter that will be remedied when the scarcity of fresh water ceases to be a factor for consideration.

"The wires carrying the current from the British Columbia Electric sub-station to the salt water pumping plant should be in duplicate and underground in conduit, and kept live at all times, thus doing away with the manual agency at the sub-station. These wires should also enter the pump room direct, without passing through workshop and room in which the distributing tower is located.

"At time of inspection the North Dairy pumping station was practically without fire protection, one fifty-foot length of hose without a nozzle being the only equipment on hand. The two adjacent fire plugs should have hose and nozzles permanently attached.

"This department has kept pace with the growth of the city, the equipment being fully modern and organization good. The strength of the brigade has doubled in the past three years.

"The headquarters station is located in a poor class of building, originally constructed for a market. This constitutes a serious hazard to the alarm system, the central station of which is located at this building. Should a new fire hall not be contemplated within reasonable time, it would be as well to have the alarm equipment housed in a separate fireproof building.

"The city by-law re electric wiring is incomplete and elastic, the system of inspection inefficient; on the whole, however, the new work is comparatively good, but a large amount of old wiring should be condemned.

"The building by-law recently adopted covers the ground fairly well, but makes no provision for mandatory protection of exposed openings in district B. This is an important feature, especially in blocks having no lanes, and where buildings on either street are built back to within a few feet of one another.

"The building inspector's department is apparently understaffed, and during the busy season unable to carry on the necessary supervision, but I have at all times received most courteous attention when reporting any defects."

◆

THE DEVELOPMENT OF DIESEL MARINE OIL-ENGINES.

Among sundry notices that have recently appeared in the press about new engine works for the development of Diesel oil engines for ocean-going ships, little notice has been taken hitherto of progress made in this direction on the River Tyne. Messrs. Swan, Hunter & Wigman Richardson, Limited, at their Neptune Engine Works, Walker, Newcastle-on-Tyne, have for some years been actively engaged in studying and developing Diesel oil engines.

Diesel-engined Ships.—Two years ago they completed a twin-screw cargo ship called the "Toiler" which has the distinction of being the first oil-engined vessel to cross the Atlantic. She is owned by Mr. James Playfair, of Midland, Ontario, and trades in the Great Lakes of North America. Her builders at once followed up the "Toiler" with another similar twin-screw cargo steamer for the same owner. The vessel is called the "Calgary," and has greater engine power than the "Toiler." She has been safely delivered at her destination in Canada, and trades on the Great Lakes. Messrs. Swan, Hunter & Wigham Richardson, Limited, are now engaged in the construction of two much larger cargo boats for British owners, and carrying about twice the deadweight of the "Toiler" and "Calgary."

Electric Transmission.—In addition to these ships the same builders have in hand another interesting ship being built for the Montreal Transportation Company, of Montreal. This will be the first large vessel designed for propulsion by power transmitted electrically from the engine to the propeller. The designs of the engines have been executed by Mr. Henry A. Mavor, of Messrs. Mavor & Coulson, of Glasgow, who have already tried this system on a small experimental vessel called the "Electrical Arc." The deadweight cargo capacity will be about 2,500 tons. The machinery will consist of two 300-h.p. high-speed Diesel engines, each with its own alternating current generator and exciter. Just ahead of the thrust block there will be a specially designed motor operating a single propeller, and reducing the 400 revolutions per minute of the Diesel engines to about 80 revolutions per minute. Among the advantages claimed for Messrs. Mavor & Coulson's system of electrical transmission it may be noticed that the total power of the propelling engine required in a single unit for direct drive can be split up into several sub-units, each with its own generator, all connected to a single propelling motor. Furthermore, all reversing and speed changes can be done by switches, and the electrical control station can be placed in any convenient spot in the ship, e.g., on the navigating bridge, in the engine-room, or elsewhere.

The "Neptune-Diesel" Engine.—Messrs. Swan, Hunter & Wigham Richardson, Limited, have for some little time been developing two-stroke cycle Diesel engines. Various well-known designs of this type of engine have been critically examined and the details exhaustively analyzed. The outcome of all this study has resulted in the "Neptune-Diesel" engine, which for marine purposes is claimed to be second to none. The resign is substantial in its strength, no undue risks being taken by imprudently cutting down weights. Another leading feature is much greater simplicity than is found in many Diesel engines. This means a smaller prime cost and less expense in running and maintaining the engine. The builders have also aimed at easy accessibility to all parts of the engine, which is of the highest value, if ever repairs are necessary. Several radical improvements have also been introduced in the valve gear, pistons and cooling arrangements, all of which are distinctive features in the "Neptune-Diesel" engine.

New Engine Works.—The Neptune Engine Works, which have been established since 1879, have been frequently enlarged and improved, and the best of modern machines have from time to time been installed to replace older tools. Partly in order to develop the "Neptune-Diesel" engine more successfully, and also owing to the general expansion of business, Messrs. Swan, Hunter & Wigham Richardson, Limited, have now embarked upon a complete reorganization of their engine works. This department is to be moved to another site within the Neptune shipyard, and entirely new shops are being erected. The present buildings of the engine works will be used for the shipyard blacksmiths, plumbers and angle-smiths. For some months Messrs. Swan, Hunter & Wigham Richardson, Limited, have been busy clearing a plot of ground of about three acres in extent, with a splendid river frontage. The old Anglesey Cooper Works of Messrs. Henry Hills & Sons formerly stood on this spot. These buildings have been entirely pulled down, chimney stacks demolished, and fresh foundations laid for the new engine works. These new buildings will touch the existing boiler shop of the firm, which is a lofty building 220 feet long by 120 feet wide. The whole of this department for building both engines and boilers will then be at the north end of the Neptune shipyard and will be adjacent to the dry dock department of the firm, giving further splendid facilities for executing repairs to ships and engines with rapidity and economy. Mr. David Purdie, of Shields Road, Newcastle-on-Tyne, has the main contract for piling and excavating.

The new engine buildings are being built of brick and galvanized iron, with glass roofs, most of the work being undertaken by the Clyde Structural Iron Company, Limited, of Scotstoun, Glasgow. Apart from smaller erections the main building will measure about 300 ft. by 200 ft, divided into six bays, and comprising a combined machine and erecting shop. A considerable amount of modern machinery of the latest and best designs will be installed. A new railway siding is being made and the lines from the North Eastern Railway Company will be led right into the shop so as to facilitate the discharge of material coming from distant parts. The river front is being furnished with a completely new jetty making a deep water berth for ships lying alongside. This new wharf will be extended along the front of the Neptune north yard and will be joined to the older portion, making in effect a fitting out berth 1,800 feet long. The existing 80-ton sheer legs at the old Neptune Engine Works quay will be used to help the completion of ships after they are launched. The 150-ton floating crane "Titan," belonging to Messrs. Swan, Hunter & Wigham Richardson, Limited, will be mainly used to lift sets of engines entire from the new engine works quay into ships. This, of course, means a very great economy, saving a great deal of labor in dismantling and re-erecting an engine. This is another example of the splendid and powerful modern plant possessed by these builders. The utility of their floating crane "Titan" has been much appreciated by other firms, for it is frequently hired for lifting heavy weights on board warships and merchant vessels, and it has also been sent to neighboring ports for harbor work, such as lifting and laying concrete blocks, drawing piles, etc.

COAST TO COAST.

Kingston, Ont.—The building permits of this city for the month of November last show an increase of 675% as compared with the same month in 1911.

London, Ont.—The report of Prof. Angus, Toronto, on the cost of lighting the streets of London, is now in the hands of City Clerk Baker. Mr. Angus in this report states that the sum of $19,000 is adequate for the service rendered the city. This is about $1,000 larger than the cost as estimated by Ald. Richter, and just $11,000 less than the amount charged by the water commissioners at the present time. Mr. Angus, in his statement, includes profits, which he figures at $2,000. This is a trifle more than 10 per cent., which is not a bad profit for hydro-electric, all things considered.

Merriton, Ont.—The Riordon Paper and Pulp Co., will undertake the erection of a large new plant at Merriton, Ont. A site has been selected near the present mills and the outlay will amount to about a million and half dollars. The company is capitalized at $6,000,000 and recently $1,500,000 bonds were issued for improvements and extensions to the various plants of the company. At Hawkesbury, Ont., extensive enlargement is now under way, and the daily output of 100 tons of dry sulphite pulp will be increased by 40 per cent. Two new digesters, each of 12½ tons capacity, are being installed. A new digester, house, a new boiler house three new acid towers, and additions to the wood room and shipping room are being rushed to completion. The sulphite mill at Merriton has a capacity of twenty-five tons of moist sulphite pulp per day; twenty-one tons of ground wood-pulp and about the same amount of wallpaper and building paper.

Gaspe, P.Q.—H. Hilyard, of Dalhousie, N.B., acting on behalf of the St. Maurice Lumber Company, has acquired all the properties of A. W. Carpenter, of London, England, formerly carrying on business at Gaspe Basin, under the title of the Gaspe Lumber and Trading Co. The purchase price is understood to be in the neighborhood of $250,000, for all the holdings. The trustees, the Charing Cross Bank of London, took over the property after the failure of Mr. Carpenter. Mr. Hilyard will immediately proceed to develop the property at Gaspe, and it is understood that the construction of a large sulphite mill will be commenced. Included in the property acquired are the wharves of the Gaspe Lumber and Trading Company which command the best situation in Gaspe harbor. The Atlantic Quebec and Western Railway which Mr. Carpenter started is now running into Gaspe Basin and in a short time the Matane Railway will also reach the town.

Dryden, Ont.—The Dryden Timber and Power Company, of Dryden, Ont., which is completing a sulphate plant and a paper mill for producing building and heavy wrapping papers, received a heavy setback recently when the power house and sluice gates were destroyed by fire, as stated in our contemporary paper. In the power house there were two turbine units of 950 hp. each connected direct to two, 750 kva generators. It was the intention to generate the current at 600 volts and distribute it through the various motors in the buildings. The concrete dam across the Wabigoon river is 140 feet long and 20 feet high, giving an available head of 45 feet. The location of the power house was at the foot of the lower falls, and the hydro-electric equipment had been installed. The loss by fire will reach $100,000 and it is said that it will fall on Harris & Harris, contractors, who had the work on the concrete dam and power house nearly completed. J. B. Beveridge is the manager of the Dryden Timber and Power Company. It was calculated that the work under construction at Dryden including the paper and pulp plant and the hydro-electrical development would involve an expenditure of nearly three-quarters of a million dollars.

THE ROAD EXHIBITION.

An exhibition of road materials, appliances, and machinery used for the construction, maintenance and improvements of roads, will be held at the Royal Horticultural Hall, Vincent Square, Victoria Street, London, S.W., in connection with the International Road Congress to be held in London in June, 1913.

It will be opened on Monday, June 23rd, by the Right Hon. Earl Beauchamp, first commissioner of H.M. office of works, president of the exhibition committee, and closed on Saturday, June 28th.

The exhibition is to be international and is open to all classes of machinery, apparatus, materials, models, drawings, plans and maps illustrative of road construction.

A piece of ground adjoining the Royal Horticultural Hall, will be completely roofed and walled in, and paved with wooden sleepers to form an exterior section of the exhibition, for the exhibiting of heavy machinery.

A room fitted up as a writing room will be available for the use of members of the congress and exhibitors, and at a marquee in the ground, tea will be served to all members and exhibitors on production of their membership cards.

All the leading firms engaged in the industry have decided to exhibit. They are representative of all branches of the industry, and include:

Tar-Macadams, Etc.—Messrs. Tarmac, Limited; Gas Light and Coke Co., Limited; Canadian Rubber Co., Limited; Roadamant, Limited; F. E. Bristowe & Co.; Anglo-American Petrol Products Co., Limited; Taroads, Limited; Rocmac, Limited; Roadite, Limited; Limmer Asphalt Co., Limited; Neuchatel Asphalt Co., Limited; Dussek Bitumen Co., Limited.

Machinery.—Messrs. J. & P. Hill, Limited; Barford & Perkins; T. Green & Sons; Aveling & Porter.

Quarries.—Messrs. Ellis & Everard; Enderby & Stoney; Stanton Granite Co., Limited; London Granite Co., Limited.

Publishers.—Messrs. Illiffe & Sons, Limited; John Hutchinson; Roads Improvement Association; Good Roads; Crompton & Co.

Mr. Maybury, county surveyor, of Kent, is honorary secretary of the exhibition committee.

It is expected that representatives from between two thousand and three thousand highway authorities from all parts of the world will attend the exhibition.

◆

HEAT AND POWER FROM SAWDUST.

An application has been made to the city of Vancouver by ten prominent saw-mill owners for a franchise to sell steam heat and electric light and power generated by burning saw-mill refuse. The application came immediately after the report of a committee of the City Council dealing with the smoke and saw-dust nuisance due to burning mill refuse in the city.

It is proposed to install plants for burning the refuse at each of the various mills, thus permitting a wide zone of distribution and enabling steam heat to be furnished at much lower pressure than from one central plant. The intention is to establish an auxiliary oil-burning apparatus at each mill for use in case of accident to the main plant and also whenever the supply of refuse runs low.

The problem of disposing of refuse without a loss has confronted mill owners for years and with coal selling at $7.50 a ton retail in Vancouver, it is thought that this scheme for utilizing it will prove successful. It is estimated that these mills have 114,000 cords of refuse and sawdust to burn each year. The approximate cost of installing each burner is placed at $30,000, and the annual operating cost at $5,000.

PERSONAL.

MR. C. B. HANDCOCK, construction engineer of the Manitoba Government Telephone Department, has resigned his position. It is reported that he will enter private business.

Capt. R. W. Hunt.

ROBERT W. HUNT, of Chicago, widely known as the head of the firm of Robert W. Hunt & Co., Limited, has been awarded the John Fritz medal for this year. This medal was founded in 1902 in honor of the veteran iron master whose name it bears "to commemorate notable scientific and industrial progress." Capt. Hunt was one of "John Fritz's boys." When about 20 years old he began work in the iron industry at Pottsville, Penn. Later he studied chemistry and became the chemist of the Cambria Co. He was at various times superintendent of steel works in Wyandotte, Mich., Johnstown, Penn., and Troy, N.Y. In 1888 he founded the firm of R. W. Hunt & Co., consulting engineers, inspectors, etc. He served in the Civil War from 1861 to 1865, rising from private to captain. The previous awards of this medal, besides the initial presentation to Mr. Fritz, have been to Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas A. Edison, Charles T. Porter, Alfred Noble and Sir William White.

JOSEPH OWEN, late of the engineer's department, London County Council, England, was recently appointed assistant city engineer of Fort William, Ont. Mr. Owen was articled to Mr. T. Aird Murray, consulting engineer, Sheffield (now in practice at Toronto), for four years, and remained in the capacity of assistant for a further period of eighteen months. During this time he was engaged on extensive water supply, sewerage, and sewage disposal works for various municipalities, chiefly in the capacity of resident engineer. He then held for four years the position of assistant district engineer in the city engineer's department, Sheffield, where he left to take up the position of resident engineer on street railway and sewerage works for the Colchester Corporation, in which capacity he remained two and one-half years. Six and one-half years ago Mr. Owen joined the staff of the London County Council as assistant engineer, and obtained extensive experience on street and bridge improvements, and street railways on the conduit and overhead systems. Mr. Owen received his technical education at the Sheffield University, and is by examination an Associate Member of the Institution of Civil Engineers, a member of the Royal Sanitary Institute, and an Associate Member of the Institution of Municipal and County Engineers. Shortly prior to leaving England, Mr. Owen was elected to the Executive Committee of the latter institution, and about the same time was appointed lecturer in road construction, drainage, and sanitation at the Holloway Polytechnic Institute to prepare students for the Surveyor's Institute final examinations.

◆

RALIROAD EARNINGS.

The following are the railroad earnings for the week ended November 7th:—

	1911.	1912.	Increase or Decrease.
Canadian Pacific	$2,493,000	$2,938,000	+$445,000
Grand Trunk	956,818	1,061,984	+ 105,166
Canadian Northern	526,000	590,300	+ 64,300
Temiskaming & N. Ontario...	38,693	32,011	— 6,682

The following are the railroad earnings for the week ended November 14th:—

	1911.	1912.	Increase or Decrease.
Canadian Pacific	$2,486,000	$2,916,000	+$430,000
Grand Trunk	959,980	1,064,317	+ 104,337
Canadian Northern	504,000	609,500	+ 105,500
Temiskaming & N. Ontario...	35,794	28,864	— 6,930

For the quarter ending September 30th the receipts of the Guelph Junction Railway amounted to $12,072.70. The receipts for the other three quarters were $8,794.93, $6,510.36, and $8,840.30, making a grand total of $36,227.29 for the year.

The statement of earnings of the Canadian Northern Railway for October shows a gross increase of $322,300; net increase is $24,900. The four months' figures of the company, from the beginning of the new fiscal year on July 1st last to October 31st, make a more favorable showing in this respect, a gain of $1,096,400 in gross being accompanied by a gain of $218,100 in net.

The statement for the month follows:—

	1912.	1911.	Increase.
Gross earnings.............	$2,351,200	$2,028,900	$322,300
Expenses	1,645,900	1,348,500	297,400
Net earnings	705,300	680,400	24,900
Mileage in operation.......	4,297	3,731	566
	July 1 to date.	July 1 to date.	Increase.
Gross earnings	$7,598,200	$6,501,800	$1,096,400
Expenses	5,604,000	4,725,700	878,300
Net earnings	1,994,200	1,776,100	218,100
Mileage in operation........	4,297	3,717	580

◆

VICTORIA'S BUILDERS ARE BUSY.

When the building permit was issued for Victoria's new high school, costing $416,750, the permits for structures aggregated $7,217,000 to date since the beginning of the current year.

The total building permits for 1911 amounted to $4,025,000.

With the permits for Oaklands and Quadra Street schools, costing nearly $100,000, to be issued next month, and the many private residences and stores now being planned, the grand total will be over eight millions, or twice the total of permits for last year. Oak Bay, Victoria's important residential suburb, has constructed over one million dollars' worth of building this year.

Greater Victoria's permits, including Oak Bay, Esquimalt and South Saanich, amount to nearly ten million dollars.

◆

MEETINGS.

The annual meeting and dinner of the Manitoba branch of the Canadian Society of Civil Engineers were held Thursday evening, December 5th, at the Royal Alexandra, Winnipeg. At the business meeting, over which Col. Ruttan presided, J. T. Legrand, bridge engineer of the G.T.P., was elected chairman; E. Brydone Jack, secretary-treasurer, and W. A. Duff, D. A. Ross, W. L. Mackenzie and Frank Lee, executive committee. At the banquet, Prof. Featherstonhaugh presided in the absence of Mr. Hesketh. This branch has now about 70 members.

The ninth annual convention of the American Association of Manufacturers of Sand-lime Products was held in the King Edward Hotel, Toronto, on December 4th. The convention is held for the first time in Canada, and was largely attended by the foremost manufacturers from the United States and the Dominion. The meetings were presided over by President S. O. Goho, of Harrisburg, and Secretary W. E. Plummer, jr., of Buffalo.

A meeting of the mechanical section of the Canadian Society of Civil Engineers was held in the rooms of the Montreal Club of this society on December 5th last. Mr. Russel S. Smart, A. M. Can. Soc. C.E., entertained those attending by an address on "Patent Law from an Engineer's Standpoint."

COMING MEETINGS.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago Jan. 21-23. 1913. Secy-Treasurer, F. J. Angier. Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson 911 Rogers Building, Vancouver, B.C. Headquarters: McG University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P. O. Box 1290

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose. Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. B. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr, G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bioor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Kamloops, B.C., power house equipment	Dec. 19.	Dec. 5.	65
Monteith, Ont., frame schoolhouse	Dec. 14.	Nov. 28.	65
Montreal, P.Q., railway ties	Dec. 20.	Nov. 14.	65
Ottawa, Ont., conveyance of H.M. mails	Dec. 13.	Nov. 7.	76
Ottawa, Ont., machinery for dredge	Dec. 30.	Dec. 5.	65
Quebec, P.Q., alterations to post office	Dec. 23.	Dec. 5.	65
Regina, Sask., power house, laundry and refrigerating plant	Dec. 14.	Nov. 28.	65
Rocky Island Park, Alta., timber purchases	Dec. 12.	Nov. 28.	65
St. Joseph, N.B., extension of college	Dec. 31.	Nov. 28.	65
Toronto, Ont., four steel bridges	Dec. 20.	Nov. 28.	65
Toronto, Ont., erection of school	Jan. 7.	Nov. 28.	65
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Winnipeg, Man., turbines and governors	Dec. 16.	Nov. 28.	66

TENDERS.

Aylmer, Ont.—Sealed tenders addressed to R. C. Desrochers, Secretary Department of Public Works, Ottawa and endorsed "Tender for public building, Aylmer, Ontario," will be received at the above office until 4 p.m., on Monday, December 30th, 1912, for the construction of a public building at the place mentioned. Plans, specifications and form of contract can be seen and forms of tender obtained at the post office, Lonodon, Ont., at the Post Office, Aylmer, Ontario, and at the Department of Public Works, Ottawa. Ontario.

Fort William, Ontario.—A. L. Farquharson, construction superintendent, is open to receive tenders for the following street railway material:—Steel, angle bars, spikes, bolts, cedar poles, ties, trolley wire, overhead material. Form of tender and particulars can be had at the office of the above.

Hamilton, Ont.—R. C. Desrochers, Secretary Department of Public Works, Ottawa, will receive sealed tenders marketd "Tenders for Hamilton Harbor Improvements," up to 4 p.m. Monday, December 30th, 1912. (See ad. in The Canadian Engineer.)

Halifax, N.S.—C. W. West, Architectural Engineer, 44 Granville Street, Halifax, and 133 Waterloo Street, St. John, also 42 Maywood Street, Boston, Mass., is the designer of a new building to be erected for the Halifax Herald. Tenders are invited, to be received by Monday, December 23rd, for plumbing, engine and direct connected dynamo, steam boiler and steam heating. Plans and specifications may be seen at any of the above addresses, or at the office of the general contractors, Messrs. Thompson and Theakston at the work in Halifax.

Kelowna, B.C.—Sealed tenders will be received by G. H. Dunn, Secretary, Kelowna Board of School Trustees, up to 5 p.m. of the third day of January, 1913, for the erection of a ten-room school at Kelowna, B.C., building to be of brick and to be completed not later than August 1st, 1913.

The plans, specifications, and all necessary information may be had from the Secretary of the School Board, Kelowna, B.C., or G. E. Nobles, architect, Lethbridge, Alta.

Orillia, Ont.—Sealed tenders, marked on envelope "Tender for construction of new drill hall, Orillia, Ont.," and addressed to the Director of Contracts, Department of Militia and Defence, Ottawa, will be received until noon, December 19th, 1912, for the construction of a new drill hall at Orillia, Ontario. Specifications may be seen and full particulars obtained at the office of the General Officer Commanding 2nd Division, Toronto, Ontario, the Town Clerk, Orillia, Ont., and the Director of Engineer Services, Headquarters, Ottawa.

Ottawa, Ont.—J. D. McLean, Asst. Deputy and Secretary Department of Indian Affairs, Ottawa, will receive sealed tenders endorsed "Tenders for Indian Supplies," up to noon, Tuesday, January 7th, 1913, for the delivery of Indian supplies during the fiscal year ending March 31st, 1914. Forms of tenders and all particulars may be obtained from the above at Ottawa.

Ottawa, Ont.—Sealed tenders addressed to R. C. Desrochers, Secretary, Department Public Works, Ottawa, and endorsed "Tender for Re-Erection and Completion of a Lobnitz Rock Breaker," will be received at this office until 4.00 p.m. on Monday, December 23, 1912, for the re-erection and completion of a Lobnitz rock breaker.

Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of T. H. Schwitzer, Esq., mech. superintendent, Birks Building, Ottawa, Ont., and C. E. W. Dodwell, Esq., district engineer, Halifax, N.S.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. of the amount of the tender.

Point Grey, B.C.—Separate sealed tenders for valves, special castings, and hydrants, will be received by C. H. Heighway, Clerk of the Municipal Council of Point Grey, B.C., will be received up to January 6th, 1913. (See ad. in The Canadian Engineer.)

Sarcee Indian Reserve.—J. D. McLean, Asst. Deputy and Secretary, Department of Indian Affairs, Ottawa, will receive sealed tenders up to January 3rd, 1913, for the erection of two school buildings at this point.

Plans and specifications may be seen at the Dominion Land Offices at Edmonton, Calgary, Medicine Hat, and Lethbridge, at the Indian Office, Winnipeg, and at the office of the Indian agent on the Sarcee Reserve.

Each tender must be for both buildings complete and must be accompanied by an accepted cheque on a chartered bank for ten per cent. of the amount of the tender, made payable to the order of the above.

St. John, N.B.—Sealed tenders addressed to R. C. Desrochers, Secretary Department of Public Works, Ottawa, and endorsed "Tender for post office building, St. John, N.B.," will be received at the above office until 4 p.m. on Monday, December 30th, 1912, for the erection of a post office building at St. John, N.B. Plans, specifications and form of contract can be seen and forms of tender obtained at this Department, on application to Mr. G. B. Fairweather, Archt., 84 German Street, St. John, N.B., and at the office of Mr. R. L. Deschamps, 103 St. Francois Xavier Street, Montreal.

Toronto, Ont.—Tenders will be received by registered post by the Chairman of the Board of Control, City Hall, Toronto, for the construction of sewers as per details in the ad. in The Canadian Engineer. The closing date for the above is December 17th, 1912.

Vancouver, B.C.—Sealed tenders addressed to the Secretary of the Y.M.C.A., Cambie Street, Vancouver, will be received up to noon of December 23rd next for the erection of a new association building on Georgia Street. Separate and bulk tenders are invited for the following trades,—

1. Excavation and concrete.
2. Structural steel.
3. Brick work and terra cotta setting.
4. Terra cotta.
5. Carpentering.
6. Plumbing.
7. Plastering.
8. Marble and tile work.
9. Roofing and sheet metal work.
10. Elevators.
11. Ornamental iron.
12. Painting and glazing.
13. Linoleum.

Plans and specifications may be had upon application to the architect. H. S. Griffith, Dominion Trust Building, Vancouver.

Ville-Marie, P.Q.—R. C. Desrochers, Secretary Department of Public Works, Ottawa, will receive sealed tenders endorsed "Tenders for Wharf at Ville-Marie, Que.," up to 4 p.m., January 7th, 1913, for the construction of a wharf at this point.

Plans, specifications and form of contract can be seen and forms of tender obtained at this Department, and at the offices of J. L. Michaud, Esq., District Engineer, Merchants Bank Building, Montreal; and on application to the Postmasters at Ville-Marie, Que.; Haileybury, Ont., and at North Bay, Ont.

Each tender must be accompanied by an accepted cheque on a chartered bank payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender.

Victoria, B.C.—Sealed tenders, superscribed "Tender for Motor Launches," will be received by the Honorable the Minister of Public Works up to and including 23rd day of December, 1912, for the construction of two 55-foot and four 36-foot motor launches.

Plans, specifications, contract, and forms of tender may be seen at the offices of the Government agents at Vancouver and New Westminster, and the Department of Public Works, Victoria.

Victoria, B.C.—Sealed tenders, superscribed "Tender for Motor Launches," will be received by the Honorable the Minister of Public Works up to 12 o'clock noon of Monday, 23rd day of December, 1912, for the construction of two 25-foot motor launches.

Intending bidders will give full description of the hull, engine, etc.

Delivery. One launch at Arrowhead; the other at Nelson.

Each proposal must be accompanied by an accepted bank cheque, payable to the Honorable the Minister of Public Works, for a sum equivalent to ten per cent. of the amount of the tender.

Forms of tender can be obtained from the Government agents at Vancouver, New Westminster, Revelstoke, and Nelson, and the Department of Public Works, Victoria.

Winnipeg, Man.—Tenders will be received by The Elm Park Company, Limited, for the construction of the steel superstructure of a bridge across the Red River from a point near Jubilee Avenue to Riverdale Avenue, in Elm Park. Plans, specifications and conditions may be seen at the office of Prof. E. Brydone-Jack, 53 Canada Life Building, corner of Portage and Main, Winnipeg, on and after Monday, December 9th. All tenders must be delivered to the company on or before Tuesday, December 17th, accompanied by marked cheque for 10 per cent. of the amount of the tender.

CONTRACTS AWARDED

Brantford, Ont.—It is reported that Messrs. P. H. Seward and Sons have received the contract for all concrete work on the Lake Erie and Northern Railway. The price is reported to be $150,000.

Esquimalt, B.C.—The Esquimalt council has awarded its contract for the lighting of a section of the municipality [illegible] B.C.E.R. and work upon this important civic work will be started at once.

Edmonton, Alta.—The contract for a fourth bridge across the Saskatchewan, to cross at the foot of Fifth Street, has been awarded by the city to the Lyall-Mitchell Company for $97,898.

Fredericton, N.B.—The contract for the sub-structure of the new bridge over the reversible falls at St. John has been awarded to Joseph McVay and Son. The work is to be completed by December 1st, 1913 and the cost will be approximately $50,000.

Grand Forks, B.C.—Contracts to be awarded in the near future by the Hidden Creek Mine management will aggregate about $400,000. About twelve machinery firms will share the order.

Vancouver, B.C.—The tenders submitted for the erection of a police headquarters are so much higher than anticipated that the cheques have been returned to the senders and the matter dropped for the present.

Victoria, B.C.—The Canadian General Electric Company have been awarded a contract for the supply of $3,218 worth of electric cable as required by the fire department.

Victoria, B.C.—The Gamewall Fire Alarm Company have been awarded a contract to supply four large fire gongs and seven relay boxes to the municipal fire department at a cost of $450.

RAILWAYS—STEAM AND ELECTRIC.

Ottawa, Ont.—The Canadian Northern Railway will apply to the Federal Parliament for a time extension on the date for the completion of the following lines:—

Washago to Kincardine.
Arnprior to Gananoque.
Pembroke to Cobourg or Port Hope.
Frenchman's Bay, northwesterly to Owen Sound.
Niagara River to Goderich.
Hawkesbury to a point in the County of Leeds or Lanark.
Parry Sound to North Bay.

Province of New Brunswick.—The Provincial Government will extend the time for the completion of Gibson and Minto Railway for about seven months; it is not likely that much construction work on the line will be done during the coming winter.

Ottawa, Ont.—The Canadian Northern Railway will apply to the Federal Parliament for an act authorizing the construction of the following lines:—

An extension of the Berlin, line, through Guelph, Acton and Brampton to Toronto, southwesterly to Stratford and St. Marys, with a branch to Woodstock.
Sarnia to Chatham.
Orillia to Goderich via Owen Sound, or with a branch to Owen Sound.

Northern Canada.—There is some publicity being given to a scheme called the Porcupine Rand Belt Electric Railway Company, with Mr. C. H. Fullerton as engineer of construction. The first seventy miles of the line are to be surveyed during the coming winter, but the entire plan calls for an electric railroad, with lines stretching from Winnipeg to Quebec and with seven points of contact with the great steam roads of the country. Mr. F. Adalia, Toronto, is first vice-president of the company.

Vancouver, B.C.—The Board of Railway Commissioners, following the hearing of complaints regarding inadequacy of depot facilities, has ordered the British Columbia Electric Railway Company to file statements regarding the intention of that corporation in the erection of terminal for the Lulu Island Line.

Western Canada.—One or two prominent Western Canada railway men have stated that winter work on the Grand Trunk Pacific lines will not be practical.

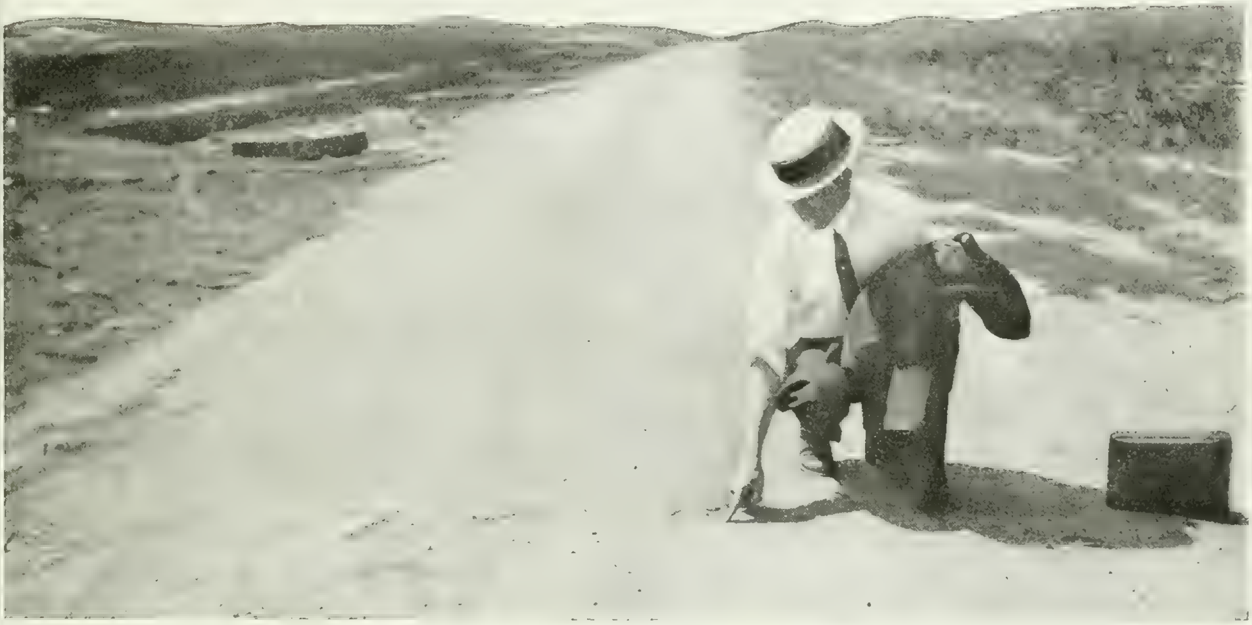
LIGHT, HEAT AND POWER

Clinton, Ont.—Clinton town council have decided to submit a by-law at the municipal election to raise $33,000 to purchase the Clinton electric light plant, erect a transformer station, and accept power from the Hydro-Electric Commission at $39 per horse-power.

New Westminster, B.C.—The British Columbia Electric Railway Company are planning to remodel their electrical distribution system on all existing lines in the Fraser Valley

Tarvia

Preserves Roads
Prevents Dust~



Country Club Road, Greenville, S.C. Built with Tarvia X.

What the Government Found Out About Tarvia

THE Office of Good Roads, U.S. Department of Agriculture, built an experimental road at the country club at Greenville, S.C., in 1909, following very closely our specifications for two-coat penetration work, using "Tarvia X."

After two years the above photograph of the road was taken at a point where it adjoins a stretch of plain macadam. The intention of the Department was to find out just how much difference the Tarvia treatment made.

The picture tells the story. The plain macadam in the foreground is *worn out*. The tarviated surface is in *perfect condition*, and the difference is so great that a clear division line is seen in the above photograph.

This is a typical instance of the success of Tarvia as a road binder. A tarviated road is automobile proof, waterproof, dustless and mudless. It is so much cheaper to maintain that the cost of using Tarvia in the construction is more than compensated for.

Tarvia is made in three grades:

"Tarvia X" for use in constructing roads and pavements.

"Tarvia A" for hot surface applications.

"Tarvia B" (applied cold) for dust prevention and road preservation.

Tarvia Booklet mailed free to anyone interested. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

and the lower mainland. If these plans are put into action it will involve the expenditure of vast sums of money.

Victoria, B.C.—The Pacific Great Eastern Development Company, which is a subsidiary corporation controlled by the Pacific Great Eastern Railway, is applying to the government for a license to take and use for power purposes 2,000 cubic feet of water per second out of Cheakamus River, a tributary of the Squamish River, in the Howe Sound district. The water will be diverted at a point two miles below North Creek fork.

Winnipeg, Man.—The operation of the civic electrical plant, as shown by a recent report, gives ample ground for hope that 3 cent rate may be established in this city during the next few months. The profit for November was $10,000.

Winnipeg, Man.—Prof. L. A. Herdt has submitted to the board of control his recommendation for the erection of a second transmission line to Point du Bois, adding two units to the plant there and enlarging the facilities at the McPhillips Street sub-station. The whole project would cost $700,000 and would protect the city against all trouble that might occur.

◆

GARBAGE, SEWAGE AND WATER.

Edmunds Burnaby, B.C.—Engineer MacDonald, of the waterworks department of this municipality, has submitted a report to the council wherein he states that $250,000 is the sum required to put the waterworks in satisfactory operating conditions. Pipe, hydrants and an additional pumping unit are the chief items in the report.

Lethbridge, Alta.—The recently installed sewage disposal plant was placed in operation a few days ago.

◆

BUILDINGS AND INDUSTRIAL WORKS

Brandon, Man.—The Canadian Northern Railway will erect a $10,000 freight shed at this point during the coming spring.

Brantford, Ont.—The plans of a new government building to be erected here have been made public; they show a structure of stone, with a clock tower in one corner, 3 stories in height. Mr. W. F. Cockshutt, M.P., is interested in the matter.

Bridgeburg, Ont.—The ratepayers and council are seriously considering the erection of a new town hall.

Fredericton, N.B.—Messrs. D. Fraser and Sons, will have the Victoria Mills rebuilt and enlarged, Mr. W. H. Montague, of Hartford, Conn., U.S.A., will prepare plans for this work.

Galt, Ont.—Mr. W. R. Osborne, Ainslie Street, is considering the matter of erecting a business block; the design that he contemplates calls for red brick construction two stories in height.

Halifax, N.S.—The council of this municipality have selected a plan for a new market prepared by Sydney P. Dumaresq.

Hamilton, Ont.—Messrs. Dixon Bros. have commenced construction work on a new warehouse to be of brick and concrete. It will cost about $20,000. Mr. W. A. Edwards is the architect.

Lethbridge, Alta.—Mr. P. J. McInenly is interesting a number of local business men in a proposition calling for the erection of a covered rink to be used for exhibition hockey games.

Lloydminster, Alta.—The ratepayers of this municipality will erect a new town hall to replace the one recently destroyed by fire. The building is to cost $5,000 or $6,000.

Medicine Hat, Alta.—Mr. E. C. Metzner has purchased a block of property on Toronto Street, and a report states that a six story hotel will be erected.

Niagara Falls, Ont.—The congregation of the First Baptist Church will erect a new church on Simcoe Street. Rev. O. C. Gray, Pastor.

New Westminster, B.C.—Publicity Commissioner C. H. W. Stuart states that there is a probability of a $10,000,000 steel plant locating in this city.

Ottawa, Ont.—A number of Roman Catholic residents in the section of the city known as the Glebe are working for the erection of a new church.

Port Arthur, Ontario.—The Canadian Northern Railway, according to report will erect a new cement dock and a coal shed, together with other improvements. It is planned to have this work well under way by the summer of 1913.

Port Arthur, Ont.—The management of the Soo Falls Brewing Company will erect a brewing plant in the south end of the city.

Sault Ste. Marie, Ont.—The Canadian Northern Railway have placed an order with the steel mills at this point for 15,000 tons of rails to be delivered at Kamloops early in January.

South Saanich, B.C.—The education officials of this municipality will erect two school buildings in the immediate future at a cost of $12,000 and will take steps for the erection of a third building at an early date. This place is not far from Victoria. Captain H. J. Rous-Cullin is architect to the school board.

Vancouver, B.C.—Messrs. A. Grossman and Son have purchased a site and, according to report, will erect a ten-story block.

Vancouver, B.C.—The municipal Park Commissioners will consult an architect on the matter of providing better quarters for bathers at the various civic bathing beaches.

Vancouver, B.C.—Officials of the American Can Company are considering the erection of a branch plant in this city. Mr. F. P. Kendall, of Portland, Or., is western manager of this company.

Victoria, B.C.—The new observatory, to be erected by the federal authorities, will be located on Gonzales Hill, 210 feet above the sea level. This structure is to cost about $20,000.

Winnipeg, Man.—The management of the Dominion Trust Company have recently purchased a site and propose the erection of a large office building.

◆

BRIDGES, ROADS AND PAVEMENTS.

Assiniboine River, Man.—The large wooden trestle bridge of the Canadian Northern Railroad collapsed and fell into the river below. The accident happened on the morning of December 3rd and it is thought that the cause of the collapse may be traced to a Grand Trunk Pacific car that became derailed while crossing and that the vibrations arising from this caused the bridge to loosen some important brace. The car was one of a freight train.

Ottawa, Ont.—The board of railway commissioners has authorized the C.P.R. to construct a bridge to carry its proposed tracks across the Ottawa waterworks aqueduct.

Sault Ste. Marie, Ont.—The bridge over the Michipicoten River, on the Algoma Central Railway system, was completed recently by Geo. Fitzgerald, of Ottawa, just one month ahead of the time called for in the contract. The bridge has cost $100,000, and is 300 feet long.

Vancouver, B.C.—Among the list of by-laws to be submitted to the ratepayers is an item of $100,000 for proposed alterations to the Georgia-Harris bridge.

Vancouver, B.C.—The Board of Railway Commissioners have ordered that the Canadian Pacific Railway construct electrically operated gates at the Columbia Avenue crossing of their tracks. These gates will automatically close when a train approaches and will shut off the passage of vehicles and pedestrians until danger has passed.

Victoria, B.C.—According to an announcement in a recent issue of the British Columbia Gazette, the provincial parliament will construct a highway to be known as the Victoria-Campbell River Trunk Road, this road is to have a width of forty feet and will be about nineteen and a half miles in length. It will commence on the left bank of a branch of the Cowichan River, in the centre of the Clem-Clem-a-letz bridge and runs to a point on the district line between the districts of Oyster and Chemainus.

Victoria, B.C.—The management of the Worswick Paving Company are about to make several improvements to their plant which will cost about $20,000 and enable this company to carry out street paving contracts to a better advantage. The improvements consist of a rock crushing plant and an enlargement to the premises that will give a capacity of 100 tons per day of street paving material.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

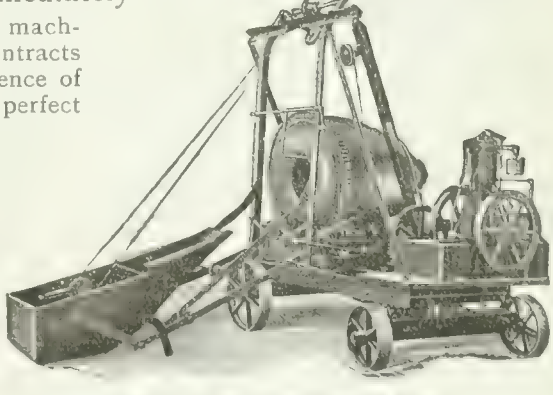
WETTLAUFER MIXERS

are carried in stock in all sizes; if you need a mixer quickly to finish that work before the really cold weather, telephone or telegraph us, and we will place it on your work immediately.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased the Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

If you expect ever to purchase a concrete mixer, write now for our catalogue. Compare the simplicity of our mixer with other makes. The main points in favor of our mixer are its thoroughness, simplicity and durability. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing, also the saving of power

Ask for our catalogue.



Wettlaufer No. 1 Heart-shaped Mixer.

NAYSMITH & LOWE,
545 Bastion Street, Victoria, B.C.

HOOTON & MOORE,
613 Ashdown Block, Winnipeg, Man.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

WETTLAUFER BROS.
Head Office and Ware-rooms
178 SPADINA AVENUE
TORONTO

LAVALLE-ROSS, LIMITED.
Alexander Block, Edmonton, Alta.

A. R. WILLIAMS MACH'Y CO.,
15 Dock Street, St. John, N.B.

FACTORIES:
Mitchell, Ont. Buffalo, N.Y.
Detroit, Mich.

HENRY HOPE AND SONS FACTORY FOR CANADA

Attracted by the number of factories and other buildings being erected in Canada for which metal sash could be used advantageously, Henry Hope & Sons, Limited, of Birmingham, England, have decided to build a Canadian factory. Peterboro, Ontario, has offered a free site and exemption from taxes, excepting educational and local improvement taxes, and if the by-law making this grant is approved of by the electors of Peterboro next January 1st, a factory will be established there.

The site is bounded by Park, Romaine and Monaghan Streets, and is about 2,000 feet by 220 feet. It will be served by both the Grand Trunk and C.P.R. The first building will be a machine shop about 100 feet by 200 feet. It is intended to erect a model plant, with employees' lunch and rest rooms, recreation grounds, etc. About fifty men will be employed at the beginning. The plant will be constructed with the Hope sash and with saw tooth roof construction, with Hope's patent roof glazing. It is intended that the plant be a model daylight factory. Sproatt & Rolph, of Toronto, will be the architects. One of their staff will visit the English factory, of which the Canadian factory will be a duplicate, to get data for preparing plans.

The capital for the Canadian company, which will be called Henry Hope & Sons, Limited, of Canada, has been all subscribed. H. D. Hope, President of the English company, is also President of the Canadian company. A. L. Young, of Toronto, is Vice-President, Secretary-Treasurer and Manager; and David McGill, of Montreal, is a director.

Mr. A. L. Young.

Henry Hope & Sons, Limited, was established in 1818. They ship all over the world, but have been interested in Canada for only about five years. The business in Canada has grown to such proportions, and also that in the United States, which territory they started to invade about three years ago, that it was deemed necessary to have a factory on this side of the water.

In June, 1911, Mr. A. L. Young, who had been for twenty-seven years connected with The Aikenhead Hardware Limited, of Toronto, and who is still Vice-President of that concern, decided to give his entire attention to pushing the sale of Hope sash in Canada, and opened an office at 45 King Street West. Among the more important contracts executed in Canada have been The Bank of Toronto new head office building; McGill University; Union Bank Building, Toronto; Burwash Hall and the library of Victoria University; Saskatchewan University; four buildings for the Consumers' Gas Company; Copp, Clark Co.'s new warehouse; Gage's warehouse; Samuel Benjamin's new warehouse; Rolph & Clark's new factory; B.C. Sugar Refinery; B.C. power house; [illegible] pumping station and power house; power house and transformer station for the Sydney Electric Power Company of Trenton, Ontario, etc.

It is intended, at the start, to manufacture only the steel sash and patent roof glazing at the Peterboro plant, but the firm of Henry Hope & Sons, Limited, also manufacture a very high grade of gun metal sash. This sash is actually manufactured of the same metal that is used for the English battleship guns, and is extremely tough and durable.

Steel sash for factory and mill buildings, power houses, pumping stations, or wherever light, ventilation or fireproof construction is valued, will give 25 to 30% more light to the same size openings than wood sash and is very little more expensive.

◆

FIRES.

Bobcaygeon, Ont.—The power plant of the Bobcaygeon municipality was destroyed by fire with a loss of $5,000. The hydro-electric engineers have been requested to furnish a solution to the problem of temporary lighting.

◆

CURRENT NEWS.

Berlin, Ont.—The Berlin water commission has just completed the erection of the largest water tower in America, which they will use for the first time about Christmas. It is capable of holding 2,500 tons of water. It has a capacity of a half million imperial gallons and cost $23,000.

Fredericton, N.B.—The trustees of the Victoria Public Hospital are considering the purchase of an x-ray machine and if they decide on such a move, will expend $1,500 on such an instrument.

Medicine Hat, Alta.—December 27th next is the date set apart for the vote of the ratepayers on eight by-laws. The money by-laws consist of the following: $65,000 for purchase of land for park purposes; $15,000 for purchase of land for widening streets; $68,000 for the purchase of land for industrial purposes.

Montreal, Que.—Judge Lafontaine recently awarded a workman a pension of $100 per year for loss of a foot that was amputated through being frost bitten while at work for the company with which he was employed.

New Westminster, B.C.—Out of eighteen firms who applied for specifications for work on New Westminster's harbor scheme, but one tender was received. The Westminster Dredging and Construction Company put in a bid of about $600,000 for the work. This was the extreme limit placed for the work. The tenders were called for chiefly for the purpose of ascertaining the advisability of doing the work by day labor.

St. Thomas, Ont.—The ratepayers endorsed a by-law giving certain inducements to the Wright Shoe Company to locate a branch plant at this point.

Welland, Ont.—The total of the building permits issued in this municipality for the past ten months, amount to $458,571.

◆

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

18153—November 20—Postponing to and including December 31st, 1912, the effective date of the Wabash R.R. Co.'s Supplement No. 1 C.R.C. No. 635, and Item No. 10 in C.R.C. No. 654.

18154—November 2[illegible]—Authorizing C.L.O. and W. (C.P.R.) to construct road diversion to connect with road allowance between Cons. 1 and 2, Tp. Hope, Co. Durham, Ont.; and construct road diversion at mileage 130.21 from Glen Tay.

18155—November 28—Authorizing C.P.R. to construct spur for the Stewart Sheaf Loader Company, Limited, Winnipeg, Man.

18156—November 28—Recommending the Indenture of Lease, dated October 2nd, 1912, made between the Quebec Central Railway and the C.P.R. to the Governor in Council for sanction.

18157—November 29—Authorizing C.P.R. to open for traffic its Lauder Extension from Tilson, mileage 28.7 to Alida, mileage 54.72.

18158—November 29—Authorizing C.P.R. to open for traffic the following portions of new second track:—Crete to Sudbury, mileages 75.7 to 78.9, Cartier Subdivision; Devon, mileage [illegible], Chapleau Subdivision, to Fisher, mileage 6.9, White River Subdivision; Depew to White River, mileages [illegible], White River Subdivision; Heron Bay, to Peninsula, mileages 55.5 to 64.2, Schreiber Subdivision; Fire Hill to Ruby, mileages 55.0 to 59.4, [illegible] to [illegible], mileages [illegible] to [illegible], Nipigon Subdivision.

18159—November 28—Authorizing C.P.R. to construct bridge to carry proposed additional tracks across Ottawa Waterworks Aqueduct, Ottawa, Ontario.

18160—November 29—Authorizing C.P.R. to construct spur for L.A.F. and F. G. Crepeau, on Lot Cadastral No. [illegible], Parish of St. Henri, de Mascouche, Co. L'Assomption, Que.

18161—November 29—Approving revised location C.P.R. from mileage [illegible], Sec. [illegible], Tp. [illegible], R. [illegible], W. 4 M., for a distance of [illegible] miles, to a point in Sec. [illegible], Tp. [illegible], R. 15, W. 4 M., Alberta.

18162—November 29—Authorizing C.P.R. to divert highway between S.E. ¼, Sec. 4, Tp. 40, R. 10, W. 3 M. and N.E. ¼, Sec. 33, Tp. 39, R. 10, W. 3 M., Saskatchewan.

Volume 23. Toronto, Dec. 19, 1912

Contents of this issue on page 891

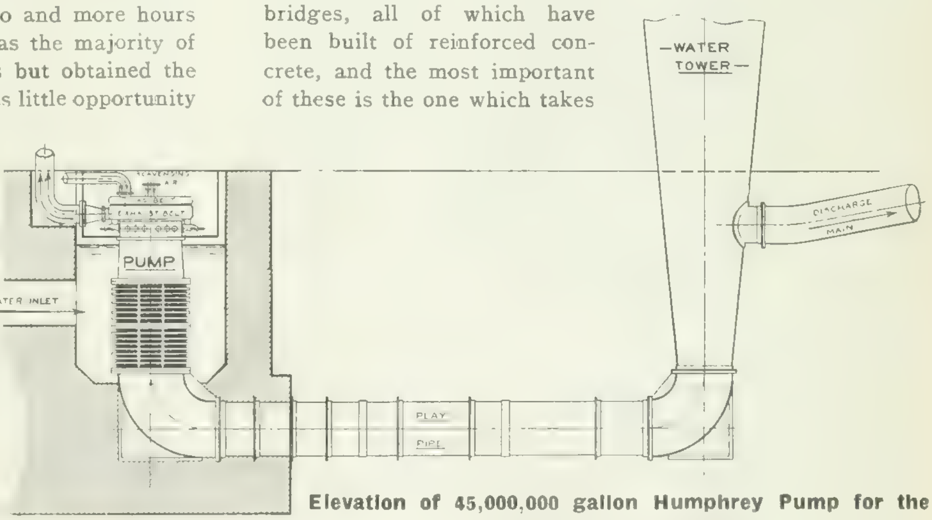
The Canadian Engineer

An Engineering Weekly

WATER SUPPLY FOR LONDON—LARGE HUMPHREY PUMPS.

A few years ago the water supply of Greater London was in the hands of various companies scattered throughout the suburbs; consequently, with so many suppliers, which varied in size and influence, and of course monopolized the business in their own particular districts, it is not surprising that the service for such an enormous collection of humanity, as is contained in the London area, left much to be desired. In many instances the companies did not increase the capacity of their plant in proportion to the growth of population, and during the prevalence of drought it was not unusual for the supply to be subject to great irregularity. In one particular area, in the north-east of the metropolis, serious inconvenience and danger to health were caused during dry summers by the supply being so inadequate that the water was occasionally cut off at the mains for 20 and more hours per day for many days in succession, and as the majority of the houses were not provided with cisterns but obtained the supply from the service pipe direct, there was little opportunity for the inhabitants to store any useful quantity. It was not uncommon to find that while conditions prevailed in some districts which closely resembled a water famine, only a short distance away—perhaps in the next street—plenty of water was available owing to the supply having been controlled by another authority who were placed in more fortunate circumstances.

In order to overcome these unsatisfactory conditions the various companies were merged into the Metropolitan Water Board at a cost of about £47,000,000 ($235,000,000), and it may be said that since then vast improvements have taken place in the service, and that, at least in comparison with the former conditions, the supply is now as nearly perfect in its regularity as it could be. However, to avoid a recurrence of the old difficulties the Board immediately started on the reorganization of the various plants and on the construction of several large reservoirs to form additions to those that then existed.



Elevation of 45,000,000 gallon Humphrey Pump for the City of London, England.

The largest of these reservoirs, which is situated at Chingford in the north-east of London, was begun in April, 1909, and is now practically completed. It is anticipated that it will be opened by the King towards the end of the year. The capacity of the reservoir is 3,000,000,000 gallons, as against 2,468,000,000 gallons, which was the total capacity of 12 reservoirs formerly belonging to the East London Water Company who supplied the district. The area of the new reservoir is 416 acres. It has 4½ miles of puddle core embankment, it is 1¾ miles long, about one-third of a mile wide at its narrowest part, and ¾ mile at its broadest. It has been constructed in the valley of the River Lee, a tributary to the Thames, and to make room for it the Lee has been diverted from its course for a length of three miles by a channel 55 ft. wide and 5 ft. deep, with side walls of concrete faced with Kentish rag stone and surmounted by a coping of concrete blocks. A smaller channel 3½ miles long has been provided to divert the contaminated water from the hill side and to discharge it into the old river channel clear of the site of the reservoir. The work has necessitated the construction of several bridges, all of which have been built of reinforced concrete, and the most important of these is the one which takes the public road over the river diversion. This structure is built on the skew and has three spans of 27½ ft. with 5 ft. rise and a width of 40 ft. between parapet walls. The embankment of the reservoir has been formed of material excavated from within its area, and it contains 2,000,000 cu. yds. of earthwork and 253,000 cu. yds. of puddle. The top of the embankment is 15 ft. wide, and is 5 ft. above top water. The outer slope is 2½ to 1, and the inner slope is 3 to 1 for a portion which is lined with concrete, beyond which the slope is 4 to 1. The core is 5 ft. wide at the top—three ft. below bank level—and is battered on both sides for a depth of 23 ft. 6 in., at which point it is 9 ft. wide. This thickness continues for 2½ ft. below the ground surface, and then it batters in with slopes of 1 to 1 on both sides to a thickness of 6 ft. until the London clay is reached. It then slopes in again with ½ to 1 slopes for a depth of 3 ft., forming a key into the clay.

The most interesting feature of the whole work is the installation of some very large Humphrey explosion pumps to deliver the water from the River Lee above the diversion into the reservoir. There will be five of these pumps, and in order to take advantage of sudden floods they will have a total capacity of 180,000,000 gallons of water per day, a quantity that is equal to two-thirds of the daily water supply of London. Four of the pumps will each be capable of delivering 40,000,000 gallons of water per day, while the fifth will have a capacity of 20,000,000 gallons. In normal circumstances the small pump only will be used. The fuel for the pumps will be producer gas, and they will, of course, work on the internal combustion principle with the explosion in direct contact with the water to be lifted. In the larger pumps the combustion chambers and valve boxes are both 7 ft. in diameter with a 6 ft. play-pipe. The vertical towers at the other end of the pipe are in the shape of an inverted cone and are 15 ft. in diameter at the top which is 58 ft. from the bottom of the tower. On each explosion 10 tons of water will be forced into the tower, from which it will flow into the reservoir by gravity. With anthracite at 22s. a ton delivered the guaranteed cost is 0.0196 penny per 1,000 gallons delivered into the reservoir, and the guaranteed consumption is 1.1 lb. of coal per actual water h.p. hour. It is expected that in practice the actual cost will be still lower, or 0.016 penny per 1,000 gallons.

This type of pump is of comparatively recent introduction, and in designing it, the inventor, Mr. H. A. Humphrey, has stated that his object was to produce a pump of great simplicity and strength in which the explosive force is exerted directly upon the water, and in which no fly-wheel, solid piston, connecting rod, crank, bearings, or glands of any kind are required. (See The Canadian Engineer of December 21st, 1911). When the explosion occurs there is a full bore passage from the combustion chamber to the final outlet; some of the water pumped to a high level by the energy of the explosion is allowed to return again in order to compress a fresh combustible charge. When sudden changes of velocity occur in masses of a heavy and incompressible liquid such as water, difficulty is found in controlling the movement of the liquid; all such difficulties, however, are removed in this pump by allowing the movements of liquid to control the pump and by causing the mass of liquid moved to be sufficiently large so that the velocities are never excessive. The mass of water forms a pendulum which swings between the high and low level, and, by its movement alone, serves to draw in fresh water, to exhaust the burnt products, to draw in a fresh combustible charge, and to compress the charge previous to ignition. With the movements of the liquid quite unrestrained by any of the usual mechanical appliances the result is a pump which works with freedom from shock and noise and requires very few working parts. The arrangement consists essentially of a horizontal pipe connected by two bends at its ends with a vertical closed combustion chamber and the open water tower. The parts thus connected are nearly full of water forming a heavy mass or column of liquid which is made to oscillate under the action of the explosion. This oscillation is free and occurs in such a manner that the movement of the water causes the intake of a fresh combustible mixture, the compression of the mixture, the explosion and expansion which give the power stroke, and the exhaust. There are thus four primary movements of the water during each cycle, two being from the combustion chamber towards the tower and two in the opposite direction. The success of the arrangement is due to the use of the momentum acquired by the moving mass of water, for it is this momentum which enables the outward swing of the water under the action of the explosion to continue after the expansive force of the gases has finished and thus to draw in scavenging air and to cause the intake of fresh water from the low level, or supply, during the first outward stroke. On the first inward stroke which takes place under the head to which the water has been lifted, the column of water is allowed to acquire velocity and momentum while merely exhausting the burnt gases, and then the momentum is utilized to compress a cushion scavenging air imprisoned in the top of the combustion chamber above the exhaust valves. Energy is thus stored in the compressed cushion, and the cushion expands giving the second outward stroke and also the momentum which is relied on to carry the water column far enough to draw in behind it a fresh mixture of gas and air. The second return stroke takes place, and the explosive mixture is compressed; once more, owing to momentum, the compression pressure far exceeds that which would be due to the static head of the liquid, and permits a high thermal efficiency. The admission valves for combustible mixture and the exhaust valves for burnt products are placed in the combustion chamber, and the valves for admitting fresh water are placed circumferentially round a vertical valve box situated between the combustion chamber and the bend which connects the horizontal pipe.

Some of the castings for these pumps at Chingford weigh upwards of 20 tons each. The contract price for the pumps and producer plant is £19,388, and they are being built by Messrs. Siemens Brothers' Dynamo Works, Limited. It is expected that the installation, which is the largest of its type undertaken up to the present, will be completed in December and that a test under actual working conditions will then be carried out. The contract has been accepted subject to a fine of £1,000 for every 0.1 lb. of fuel consumed in excess of the guarantee.

◆

COMPETITION FOR MINERS' LAMPS.

Under the auspices of the Acetylene Unions of the different countries, a competition for acetylene lamps for mines not containing fire-damp is opened from now under the care of the International Committee of Carbide of Calcium at Geneva. The prize or prizes will be awarded to the lamp or lamps which most completely fulfil the following conditions: Simplicity and regularity; cheapness; strength and lightness; easiness of upkeep; convenience in cleaning and refilling; resistance to upset; ease of handling and capability of being carried in the hand or being hung on the walls; solid material, light, durable, and unaffected by dampness or the results of the decomposition of the carbide; strong burner of long duration, and placed or arranged so as to avoid extinction from dripping water or by mine violences; production of gas as constant as possible, rational generation from the point of view of purity of the gas as well as the yield of the carbide; utilization of the present sizes of carbide intensity of 5/10 candle power as far as possible; duration of charge as long as possible. The competition will be divided into two categories: (1) Portable lamps for carrying by hand, duration of charge 8 to 12 hours; (2) portable lamps for carrying on the forehead, of extreme lightness, and a duration of at least 4 to 5 hours. At the discretion of the jury either one or two prizes may be awarded; of a total of 5,000 francs, which may be granted if two prizes are awarded, as to 3,000 francs for the best portable lamps for the hand, and as to 2,000 francs for the best portable lamps for the forehead. The models, with description, price of re-sale, &c., must be forwarded before March 20, 1913, to the International Committee of Carbide of Calcium, 5 Rue des Granges, Geneva. The jury will be composed of competent delegates from the different countries nominated by the respective Acetylene Unions.

LIGNITE AND ITS USES.*

By R. O. Wynne-Roberts.

The author, in another capacity, recently had the opportunity of collecting information regarding lignite and of presenting the same in a report to the government.

To-night it may be possible to supplement the report by discussing "Lignite and Its Uses" in a more general sense. It may, however, be necessary to incidentally refer to one or two items in the report because it is unavoidable.

Countless ages ago there were swamps and shallow lakes in which marsh-loving plants grow, deep waters in which algae flourished and aquatic mosses spread over the surface in tangled mats which, under the prehistoric condition, were such that these plants grow with a succulent freedom and rapidity unknown in later days. These plants died and fell into the water and by some preserving action of the water were gradually embalmed and fossilized. In course of time the deposit accumulated, fermentation took place and the vegetable matter was gradually altered in composition and character. This in time, and under increased temperature and pressure, became peat and afterwards converted into lignite and perhaps eventually became coal.

Coal is admitted to be the fossil remains of vegetation that flourished in the carboniferous period of the world's history, while lignite is that of the cretaceous and tertiary periods which are far more recent.

The nature of the compounds which go to build up coal of different kinds is still more or less a mystery, despite the fact that scientists have been investigating this subject for over 100 years. In nature there is a wonderful cycle of processes in continuous action by which the atmosphere is purified of the products of life and decay, through assimulation by vegetation, and under the influence of the sun's ray, the growing plant builds up its tissues from the carbon, hydrogen and oxygen, renders latent and storing the solar energy, and in the countless ages they were gradually converted into fuel.

According to Prof. Vivian Lewis, all the plants which were fossilized consisted of sedges and reeds, tree ferns, club mosses and trees akin to pine. The spores of club mosses of to-day give off a substance of so resinous in its nature as to resist the action of water and perhaps this has contributed to the preservation of plants in water. With some forms of vegetation the essential oils undergo oxidation and form resin and, these being more resistant to change, accumulate in masses of decaying vegetable matter so that large quantities of them are found in peat and lignite beds of Germany in a fossilized but little changed state, but whether they are to be found in this province, no information is yet to hand.

Peat, then, is merely decomposed vegetable matter, consisting chiefly of decayed moss and water plants, and is the lowest grade of fuel recognized in the classification of coals. It varies from yellowish or brown fibrous substance in which leaves and tissues of the plants are quite perfectly preserved through different stages of maceration to a dark brown colored material, in which little of the original structure can be recognized. Peat, after drying, is used for making coke, in gas producers, as domestic fuel, and in some countries it is briquetted. In the province of Schleswig-Holstein, a central power plant has been erected to supply electricity to 60 communities lying within a circle of 16 miles, and all power necessary is furnished by gas producers run entirely on peat.

Dr. Berguis, of Hanover, recently made some experiments in the artificial formation of coal. He made an apparatus consisting of a bomb bored out of a block of steel and having a coned lid, etc. He placed peat containing 85 per cent. of water in this bomb, and heated the same by an electric furnace to 660 degrees Fahrenheit and succeeded in obtaining coal similar to natural bituminous coal.

This experiment is confirmatory of the statement already made and it will be interesting to give the figures:

Material	Temperature in degree Fahrenheit	Time Taken Hours	Composition of the resultant Coal			
			Carbon	Oxygen	Hydrogen	Nitrogen
*Peat..	...	..	52.4	41.4	5.50	0.70
Peat...	480	8	74.3	19.4	5.20	1.07
Peat...	570	8	77.0	16.9	5.00	1.07
Peat..	645	8	81.2	13.3	4.65	0.89
Peat..	645	24	84.0	10.4	4.62	0.95
Peat..	660	11	85.2	10.4	4.50	....

* Composition of dry peat before treatment.

Lignite, again, is also formed by a mass of compressed and partly altered vegetable matter. Sometimes stems are found in it presenting the appearance of undecomposed wood. Lignite contains a larger proportion of oxygen than does coal. It is sometimes called fossil wood, wood coal and brown coal. Some lignite, however, so closely resembles good bituminous coal as to be indistinguishable. There are many varieties of lignite, ranging from soft and plastic substance that can be spaded like peat, to hard layers which have to be blasted. Some contain more than 40 per cent. of water. Its color ranges from brown to pitch black.

According to the 1911 report of the Canadian Commission of Conservation, there are 7,500 square miles and 20,000 tons of lignite in Saskatchewan, of which about two-thirds are located in the southeast portion.

The map exhibited will show the district where lignite deposits are found. That on the west is known as the Belly River formation and that on the south as Laramie formation. There appears to be in the neighborhood of Estevan, several lignite deposits down to a depth of about 600 feet; whether such layers extend into other parts of the province it is difficult to say, but it is probable they do.

Before discussing the uses of lignite, it will be desirable to refer to its quality. The quality of any fuel is dependent on the proportion of combustibles it contains. These consist of fixed carbon, and volatile matter. Sulphur is a combustible, but owing to its being present in lignite in such small quantities, it can be ignored. The impurities consist of shale clay and other inconsumable materials which give rise to ash, and this differs greatly with various kinds of fuel. Some fuels are now used containing over half their weight of impurities. Another item which has an important bearing on the use of lignite is the quantity of water which it contains.

Fixed Carbon.—Vegetable tissues are composed of carbon, hydrogen and oxygen. As these tissues, in the formation of coal, are not exposed to atmospheric conditions but are altered out of contact with air, the three chemical elements named rearranged themselves. For instance, carbon combining with oxygen forms carbon dioxide; carbon and hydrogen formed inflammable gas and hydrogen with oxygen formed water. The conditions which facilitate the formation and escape of these gases also favor the formation of coal having a high percentage of fixed carbon. Such conditions are pressure, heat, folding and erosion of the local bearing strata. So, in the Rockies, where great disturbances have occurred by tilting of the rocks, folding of the bed plane, and generally causing a tremendous pressure to take place, the coals found there have a higher percentage of fixed carbon than in those found on the east of the mountains, where no such disturbances have taken place, and this is one reason why lignites are relatively low in fixed carbon.

---

* Paper read before Regina Engineering Society, December 5th, 1912.

Volatile Matter.—Anthracite from Bankhead contains about 11 per cent. of volatile matter, and 85 per cent. of fixed carbon, while Souris lignite from Sutherland mine, for instance, contains 35 per cent. and 39 per cent. respectively. It will therefore be seen that in the anthracite the high percentage of fixed carbon gives off a hot, sustaining fire under steam boilers, whilst in the case of lignite the gases constitute one-half of the combustibles.

It is instructive to compare lignites from various countries and to contrast the same with American coal.

	Moisture	Computed to dry Bases			Heat value of coal as fixed
		Vol. Mat.	F. Car.	Ash	
1. Saskatchewan lignite	29.7	49.0	42.9	8.0	7520
2. Alberta lignite	8.3	37.5	51.5	11.0	10740
3. North Dakota lignite.	35.78	45.00	45.05	10.0	7279
4. California	17.36	46.5	35.0	18.8	8530
5. Texas	33.71	44.0	45.0	11.10	7348
6. Italy	12.5	38.0	45.5	15.16	9350
7. Hungary	24.0	48.6	24.3	21.2	5750
8. Germany	52.7	44.5	43.8	12.3	4500
For comparison with best American coal from West Virginia	1.36	15.0	78.0	7.7	14420

It will be observed that the moisture content varies greatly. In one case it was as much as 52.7 per cent., and yet the gas produced from it was good.

1. Montreal test on Western Dominion Colliery lignite.
2. Montreal, Galt Colliery lignite.
3. U.S. Bureau of Mines, Wilton Colliery lignite.
4. U.S. Bureau of Mines, Tesla lignite.
5. U.S. Bureau of Mines, Hoyt lignite.
6. From Kerpely catalogue.
7. From Kerpely catalogue.
8. From Kerpely catalogue.

The production of lignite, according to information received, is as follows:

		Tons.
1911	Saskatchewan	204,000
1910	North Dakota	400,000
1910	Alberta	784,000
1910	Texas	881,000
1911	Germany	8[illegible],000,000

The use of lignite in this province has not yet become extensive. One of the principal consumers in the Robin Hood Mill Company, where a new type of furnace will shortly be installed to consume it. Estevan Power Steam Plant is run on lignite. The Rouleau Electric Plant is operated by means of producer gas from lignite.

Lignite is occasionally consumed at the power plants in Regina and Moose Jaw. Special tests were recently made at Weyburn and Estevan in connection with the use of lignite under boilers. Alberta lignite is used at Edmonton, Calgary, and Lethbridge for raising steam; these three employing chain grates and mechanical stokers.

The Canadian Mines Branch in 1908 carried out a series of tests in raising steam and with gas producers, with a large number of Canadian coals and lignites. These tests were made at McGill University, Montreal, and are dealt with in reports published recently.

Collecting the results obtained at those places where relative figures are reported, they can be tabulated as follows:—

Steam Plant.—Estevan—One pound of lignite as fired, equivalent evaporation was 3.76 pounds of steam from and at 212 degrees Fahrenheit. Weyburn—One pound of lignite as fired, equivalent evaporation was 4.13 pounds of steam from and at 212 degrees Fahrenheit. Montreal—One pound of lignite as fired, equivalent evaporation was 3.91 pounds of steam from and at 212 degrees Fahrenheit. Average, ⅓ of 11.80, 3.93 pounds.

Thermal efficiency based on combustible consumed·

Estevan	50.85%
Weyburn	56.01%
Montreal	52.5 %

Average, ⅓ of 159.36, 53.12%.

Reference will later on be made to results obtained elsewhere, but it will be seen that in very instance the evaporation and efficiency were low. In each case the furnace and grade were practically the same as for superior coal. It is evident that much better results ought to be and are, no doubt, obtainable by adopting furnaces and grates better adapted for the consumption of lignites.

The United States Bureau of Mines conducted tests at Williston, North Dakota, steam plant, where a semi-producer furnace was built; superheated steam was used with Argand blower, and air was preheated in coils at the back of the boiler. The equivalent evaporation from and at 212 degree Fahrenheit was 3.17 pounds of steam and the overall thermal efficiency was 53.79 per cent. The moisture content of the lignite averaged 42.61 per cent.

Other steam tests were made at St. Louis, but the results were not so good.

Enough has been stated regarding the results of test obtained in raising steam with raw lignite.

It is well now to refer to results obtained with gas producers.

Two tests were made at the McGill University, Montreal, with the result that one brake horse-power per hour was obtained on a consumption of 2.58 and 2.70 pounds of lignite or an average of 2.64. These are the only tests made in Canada of which information has been received. Reference will be made to American tests later on.

Assuming that 18 pounds of steam are required per indicated horse-power hour to run a first-class steam turbine, then at least 4½ pounds of lignite are required, and with gas producers at least 2⅔ pounds.

The American gas producer tests will now be referred to.

So that this paper will not be overloaded with statistics, it may be stated that at St. Louis (Mo.) a large number of American coals and lignites were tested under steam boilers and in gas producers, and it required 8.46 pounds of lignite similar to that locally produced to generate one electrical horse-power at the switchboard when consumed under a steam boiler as compared with an average of 2.93 pounds of various lignites when used in gas producers.

In Texas the average consumption of raw lignite during last year at a 5,000 h.p. gas producer installation was 4 pounds per kilowatt hour, after allowing for all contingent losses, etc.

In these cases, with the exception of Williston, where the air was preheated, no attempts were made to utilize the waste heats.

You will readily understand that after the coal has been converted into gas and consumed under the boiler or in the gas-engine, there is much sensible heat left. If means were adopted to utilize the same by way of economizers, waterheaters, etc., the fuel consumption would doubtless be reduced.

It will be interesting now to discuss what is being done in Europe.

As has already been stated, peat is the forerunner of lignite, and if it can be used for any purpose with efficiency, then it is reasonable to expect equal, if not better, results with lignite.

Mond gas plant has been installed at Orentana (Italy) to consume 100 tons of peat per day. Part of this gas is used in three 500-b.h.p. double-acting gas engines driving alternators in parallel. The current is distributed over the surrounding district and to the town of Pontedva, 14 miles away. Another plant gasifies German peat containing 40 to 60 per cent. of water and producing 85,000 cubic feet of gas having a heat value of 150 B.t.u. per cubic foot out of every ton of theoretically dry peat.

Mond gas plant is economical if the ammonia can be recovered, but so far as the information extends at present, the cost of commercial sulphuric acid delivered in Regina is too great for this.

Reference may be made to the Volcker furnace, which is shown on cartoon. A test was made at Leipziger Cotton Mills, Leipzig, Linderau, Germany, in 1903. There were three boilers, each having a water heating surface of 302.5 square meters and in 1908 another test was made at the Renate Mines, Germany. The general results are given below:—

	Leipzig.	Renate.
Water heating surface of boiler	907.5 sq. m.	267. sq. m.
Superheater heating surface ..	107.5 sq. m.	87.8 sq. m.
Grate area	25.92 sq. m.	10. sq. m.
Heat value of lignite combustible	2503 cal.	2019 cal.
Duration of test	7¾ hrs.	8 hrs.
Coal consumed	34,620 kg.	19,900 kg
Coal consumed per sq. m. grate area and per hour	....	247 kg.
Water evaporated	101,012 kg.	41,324 kg.
Water evaporated per sq. m. heating surface per hr. ..	....	19.19
Actual evaporation	2.86	2.08
Water from 0 deg. C. to steam 100 deg. C.	2.91	2.34
Steam pressure	10.8 atms.	12.8 atms.
Temperature of feed water....	....	36.4 deg. C.
Temperature of superheated steam	245 deg. C.	356.2 deg C.
Percentage of C.O. in flue gas	15%	12.7%
Heat absorbed in calories per kg. of combustible	1,826.3 cal.	1,489 cal.
Net thermal efficiency	72.9%	73.7%

As no information is given as to the proximate or ultimate analysis of the lignite, it is not possible to express any opinions to the similarity of the lignites used to that found in this province. Even allowing for some difference in quality, the results obtained are high.

In connection with gas producers, it is possible to obtain a certain quantity of steam as well as gas by means of water jackets on producers, economizers on gas engine exhausts, etc. With regard to water-jacketed producers, this has been adopted to a small extent in the States and in England, but apparently this arrangement has been more developed in Germany. One of the cartoons on the wall depicts a Kerpely producer encased in a Marischka boiler, in other words, the producer is provided with an enlarged water jacket, while the fire brick lining which is usually found inside producers is entirely absent in this case.

A large installation of these combined producers and boilers have been erected in connection with the Vienna municipal gas works, at Leopoldau.

Coke breeze is used as fuel; this has a calorific value of about 10,000 B.t.u. per pound and contains 11.75 per cent. water and 15.8 per cent. ash.

These producers are 2 metres or 6 feet 8 inches in diameter, and have 55 square metres or 600 square feet heating surface. One kilogram of coke evaporated 1.13 kg. of water, and 11.4 kg. of steam were obtained per sq. metre of heating surface per hour at a pressure of 76 lbs. per sq. in.

The temperature of the feed water was 45.9 deg. C. or 114.6 deg. Fahrenheit, and that of the gas at the outlet of the producer was 220 degrees C. or 428 degrees Fahrenheit. As the temperature of the hot gas in other producers is ordinarily about 1,100 degrees Fahrenheit, it will be seen that a large absorption of sensible heat had taken place. The net value of the gas was 1,218 cal. per cubic metre, or 134 B.t.u. per cubic foot.

The gas had the following average composition:

Carbon dioxide	CO............	2.78%
Carbon monoxide	CO............	29.84%
Hydrogen	H............	9.12%
Marsh gas	CH............	0.8 %

The loss of carbon in ash was 1.43 per cent.

The heat contained in the steam was 689 caloric; 3.8 cubic metres of gas were produced per kg. of coke, the specific heat of which was 0.31, and the heat value obtained was 3.8 c.m. × 220 deg C. × 0.31 — 259 calories.

To gasify the coke 0.18 kg. of steam was required per one kg. of coke.

The efficiency of the combined producer and boiler may be calculated as follows:—

Heat value of coke	5,636	calories
Heat value of steam used	110	”
	5,746	calories
Heat obtained from steam	689	calories
Heat obtained from gas	4,628	”
Heat obtained from temperature of gas......	259	”
	5,576	calories

The total net efficiency of combined producer and boiler was $\frac{5,576 \times 100}{5,746}$ equals 97 per cent.

The heat balance may be struck off as follows:—

11.99%	in producing steam.
80.54%	in the gas produced.
4.51%	sensible heat of hot gas.

When the gas was cleaned and cooled ready for use in gas engines, the efficiency was reduced to 92,53 per cent. as compared with about 85 per cent. in other producers. As one kilogram of coke produced 1.13 kg. of steam of which 0.18 kg. was required in the generation of gas, the balance —0.95 kg.—was available for other uses. For example, as in this case, if 15,000 kg. of coke were consumed in 24 hours, the 600 kg. of steam per hour is available, which is equal to at least 60 h.p.

As this test was made with gas coke, it is a question that requires answering, whether equal results could be obtained with the consumption of raw lignite.

Another test made with the same make of producer, but without the encasing boiler, is stated to have resulted in a net thermal efficiency of 86.87 per cent., when consuming Syrian lignite of Austria.

Saskatchewan lignite is stated to correspond approximately in quality to the lignite of Bohemia and Upper Hungary. One German firm of engineers claim that the efficiency of their producers average about 80 per cent. and state that the efficiency of gas-fired boilers averages from 80 to 85 per cent., so that the combined efficiency of separate producer and boiler will therefore be 68 to 72 per cent. And, further, if Bonecourt surface combustion is applicable, then the combined efficiency would be in the neighborhood of 90 per cent. Whether Bonecourt's system can be applied depends on the quantity of dust and carbonaceous matter that may be discharged with the gas from the producer.

There is another method of using lignite for raising steam, and this is by using dust fuel. Lignite, in this case, would have to be dried and pulverized and the makers claim this can be done effectively and cheaply. The appliance which disintegrates the coal also acts as a fan and blows the fuel along into a burner fixed in the centre of a specially designed vertical boiler, and there ignited.

Four tests were made in Johannesburg, South Africa, with coal of the following composition:—

Moisture	2.15%
Volatile matter	22.80%
Fixed carbon	57.55%
Ash	17.50%

The average results of these tests were:—

Duration of tests in minutes	95
Steam pressure, in lbs. absorbed	189
Steam temperature, in deg. Fahr.	576
Feed water temperature, in deg. Fahr.	70
Percentage of CO_2, in flue gas	16.8
Factor of evaporation	1.265
Coal fixed per hour, in lbs.	3,451
Water evaporated per hour actual, in lbs.	25,190
Water evaporated from and at 212 deg. F., in lbs.	31,860
Water evaporated per lb. coal actual, in lbs.	7.30
Water evaporated from and at 212 deg. F., in lbs.	9.24
Net efficiency, per cent.	80.4

It will be unnecessary to discuss further the question of generating power by means of steam boilers or gas producers and sufficient proofs have been submitted to show that it is possible and in view of the cost of imported fuel and local conditions it is also cheap.

Before proceeding to another phase of the problem of using lignite, it may be desirable to submit a few points which might be profitably debated.

1. Lignite is a highly oxygenated fuel, containing a large proportion of volatile matter and moisture.

2. The efficient consumption of lignite for raising steam is dependent on the furnaces and boilers being specially adapted for its use.

3. If lignite is used in the solid form, there should be a large grate area, deep, fuel bed, efficient air preheater, and an ample sized combustion chamber.

4. Lignite is adapted for generating power by means of gas producers and engines. The producers, etc., must be designed for this particular fuel, as the grate area must be larger, fuel bed deeper, less steam is required and less tar is produced.

5. Ample provision should be made for reducing the formation of clinker and for its removal by mechanical means, because, barring by manual labor is both inefficient and expensive.

6. More economical development of power from lignite appears to be possible when the surplus heats are absorbed by suitable economizers, etc.

7. The most promising method of developing power from lignite on a large scale is by gas producers and engines with the installation of waste heat utilizers, together with steam boilers and engines.

8. Every unit of increase thermal efficiency obtained with any type of power plant means a tangible saving in dollars and cents for the steam user.

There is another method of using lignite and that is by converting it into gas by ordinary distillation process. This has been fully set out in the report and consequently only a general reference to this subject can be made to-night.

It is a question for the public to decide whether they want artificial gas of the same quality as is made in other Canadian cities, which can be used for lighting, cooking, heating and power, and which will cost more to supply owing to the great distance from which the gas-coal must be brought, or an artificial gas possessing small illuminating power but of good enough quality for heating, cooking and power, made from local fuel and costing less to supply. Natural gas is, of course, superior to both.

Lignite gas, which name is applied advisedly to differentiate it from ordinary coal-gas, can be made in an ordinary gas works plant, but the heat required for distillation will probably be less and therefore the cost of production will be less. Moreover, as lignite distils more quickly than ordinary gas coal, more gas can probably be made in a given time, and therefore smaller plant will be necessary. If the public should desire the lignite gas to be richer in lighting power, then it can be enriched at small cost.

Gas work may not be so familiar to some of you as steam and producer plants and therefore a short elementary description will be given of the process.

The gas works plant consists of retort benches, exhauster, condensers, scrubbers, washers, purifiers, station meter and gas holder with tanks for tar and ammoniacal liquor, all of which are connected together by pipes.

The retort benches are virtually ovens in which are placed a number of fire-clay retorts built over a furnace. These retorts are either circular, D shaped, or oval, in cross section. They are often "singles," that is, they are closed at one end and fitted with a cast iron mouthpiece at the other; in other places two retort benches are placed back to back and the retorts are "throughs," that is, they are open from mouthpiece to mouthpiece. There are flues from the furnace beneath surrounding these retorts to heat them. These furnaces, in small work, are direct fired with coke, but in larger work regenerative and producer furnaces are built with passages to preheat the air so that when the gases from the furnace meet and mix with the hot air, and burn in the combustion chamber, intense heat is generated. This is circulated around the retorts and finally passes up the chimney stack.

Retorts are usually laid horizontally but sloping retorts are in use, as well as chamber retorts. The latest development is the vertical retort, which consists of fire-clay rings surrounded by flues. These verticals are heated by producer furnaces, and as the coal is carbonized into coke, it gradually falls in the chamber. Outside the lower part of the vertical retort there are flues to preheat the air, and this at the same time cools the coke, so that when it is discharged it requires very little quenching.

Returning again to the horizontal retort, coal is charged into it, and the lid on the mouthpiece closed and made airtight. The externally applied heat causes the coal to be carbonized or distilled, gases and vapors are driven out and as there is but one outlet they perforce must travel up the ascension pipe from the mouthpiece into the hydraulic main when the heavier hydrocarbons and some vapor are condensed and deposited.

As the gas would, in the absence of pumps, have to force its way through water in the hydraulic main and through the condensers, washers, scrubbers, purifiers, meter and into the gas holders. There would naturally be some back pressure thrown on the retort and this would reduce the quantity and quality of the gas produced from each ton. So, an exhauster is installed, the function of which is to pump the gas out of the retort and thereby to keep the pressure on the retorts at a minimum, and also to drive the gas through the various clearing appliances and into the gas holder.

The gas, then, after it passes through the hydraulic main, flows along the "foul main" into the condenser, in both of which more tar and ammoniacal liquor are condensed. It then has to pass through washers and scrubbers where the remainder of the tar and ammonia are extracted, as well as some of the impurities, such as carbon dioxide and hydrogen sulphide.

The next step is to purify the gas, and this is done by means of lime or oxide where the remainder of the carbon dioxide and sulphuretted hydrogen are removed.

The gas, after passing through the various processes of purification, is stored in a gas holder and delivered to the cities as it is required.

There is another process by which gas can be manufactured, and that is by means of coke ovens where a large quantity of coal is distilled at one time.

The gas obtained from lignite by any of these methods will be equal to about two-thirds of the heat value of first-class coal gas, but much less so far as illuminating power is concerned. But in these days gas is not consumed in old-fashioned flat flame burners. It is burned in mantles which are heated to incandescence, thus causing the rare-earths to give off the brilliant light which we all know. Lignite gas used in this manner will yield a fair amount of light, and if desired, can be so enriched as to give any candle-power. The principal aim of gas engineer is to supply good and cheap heating gas. In many places in Europe coal-gas is now supplied of practically the same heating value as that to be obtained from lignite, because it is cheaper to make.

In the United States two-thirds of the gas supplied is made by another process, namely, the carburetted water gas. The plant for making this gas consists of generators which are similar in many respects to producers. Regenerators, which are chambers filled with checker or baffle brickwork, are in duplicate. The generators are heated to incandescence by means of air blast; the gas passes up out the regenerators, where they are burned, and the brickwork raised to a very high temperature. Steam is then admitted into the generator and in passing through the hot fire in the producer and then through the regenerators, it is converted into its component parts, namely, hydrogen and oxygen. The latter combine with the carbon to form carbon monoxide and the hydrogen is made free. Thus two gases are obtained, hydrogen and monoxide, which have higher values than producer gas, but not much lower than lignite gas. With gas producers, however, the process is continuous, whilst with water gas plant, owing to the fire being cooled by the injection of steam, it is intermittent.

The water gas burns with a blue flame and will yield no light, but oil is carburetted by volatilizing and fixing it and this raises its lighting power to that of the best coal gas.

Although examples of the production of water gas by consuming lignite is not yet to hand, there does not appear to be any reason why it should not be as feasible as when using coal. Until further information is collected, it will not be wise to dogmatize on this subject.

Reference might here be made to Bonecourt surface combustion. Gas is made to pass through a porous plate of, say, fire-clay, and is ignite on the outer side. The flame is of the ordinary white kind you see when burning coal gas. Then air is admitted with the gas and the flame alters in appearance and finally disappears, but gas continues to be consumed, maintaining the surface white-hot, whilst the inner surface remains cool. This form of heating can be applied to grilling, evaporating, etc.; the latest domestic application is to toast a few million pieces of bread per day in large cafés. This system can be applied for industrial purposes, for instance, it can be used to welt lead, to heat crucibles, muffled furnaces. The heat obtainable can be made so intense that it is difficult to find a material that will withstand it.

Steam boilers can be heated by this method, and when gas is made available it may be used to heat hot air, steam or hot water boilers for house warming.

What appears to be a simple adaptation of surface combustion is an arrangement for fitting ordinary drawing-room or other fireplace with a gas fire. The gas in this case passes through a bed of loose sand or granulated substance and the gas burns on the surface as already described.

This method of consuming gas results in high efficiency and economy.

Much is heard to-day of cooking by electricity and, as an incidental feature of this paper, it may be interesting to make a simple comparison.

Electricity sold at, say, 3 cents per kilowatt, having a heat value of 3,400 B.t.u., which equals 113,300 units for each dollar, and allowing an efficiency of 75 per cent., then the available heat is about 850.00. Coal at $7 per ton, having a heat value of, say, 10,000 B.t.u. per pound, will give 2,860,000 heat units for one dollar, but as the efficiency in this case is as low as two per cent., then the available heat is 57,200 per dollar.

Artificial lignite gas, sold at, say, $1 per 1,000 cubic feet, having a calorific value of 450 B.t.u. per cubic foot, will theoretically yield 450,000 heat units per dollar. The efficiency in this case is about 25 per cent., so, only 110,000 units are obtained per dollar. If Bonecourts system is applied, then the efficiency will be, say 50 per cent., in which case the heat value available will be 220,000.

The comparison will consequently be:—

Electricity at 3 cts. per kw.....	85,000	heat units per dollar
Coal at $7 per ton............	57,200	" " "
Lignite gas at $1 per 1,000 cubic feet	110,000	" " "

The water, which is condensed from gas and the additional quantity used for washing gas, contains ammonia This ammoniacal liquor is distilled and the ammonia drawn off and passed over acid.

The product, sulphate of ammonia, is an excellent fertilizer, and can also be used for rendering wood less inflammable. Ammonia is also used in connection with refrigerating plant, and by another process is used for the manufacture of explosives.

Having disposed of the question of developing power by steam producer-gas, lignite-gas and water-gas, we may now turn our attention to briquetting of lignite.

This is not so easy of solution. In raw lignite, one-third of its weight consists of water, and when it is air-dried, about one-half of the water is evaporated, but the lignite breaks up or crumbles and in that condition it is not so easily handled. Stokers object to it because it means more labor in firing and needs more careful watching. This can be obviated by using mechanical arrangements. Steam users object because at present full steaming capacity of the boilers are not secured, and there is more loss due to the small particles falling between the fire bars. This may be improved upon by installing lignite consuming furnaces. Householders object because it is too flashy when burned, and requires more attention, and this can be improved by using briquettes.

In this province we have no available asphalt supply; there are no gas works to provide coal-tar-pitch; but it is quite possible to utilize local material which will answer as agglomerations or binders for making briquettes.

If a lignite gas works is installed, some distillates from the tar, such as pitch, paraffin, wax, etc., may be useful.

A sample of local lignite was sent to a briquette machine maker and this he made into briquettes which are on view to-night. Owing to the smallness of the quantity of the sample, the maker referred to found he was unable to carry out the experiment as efficiently as he would wish. Consequently, the briquettes before you are not good specimens. Samples A and B have been briquetted by a certain special steaming process without the use of any binder, but these briquettes do not appear to be satisfactory. Samples C to F are made with five per cent. pitch, sample F being the best. It is hoped that further experiments will be made. Other experimenters are endeavoring to find a cheap and simple process by which raw lignite can be satisfactorily briquetted.

What promises to be a solution of this problem is the carbonization of lignite at low temperatures. Although North American lignite has not been subjected to this treatment, non-coking Illinois coals have, and a few of the results obtained may be stated.

When the coal was distilled for an hour at a temperature of 500 degrees to 900 degrees Fahr., the percentage of fixed carbon was increased more than 25 per cent., and there was a corresponding decrease in volatile matter, and furthermore, the fuel became smokeless. Another feature of low distillation of Illinois coal is the production of gas of exceedingly high heating value, almost equal to that of natural gas. Illinois coal is not of high quality, nor has it the propensity of making coke, and in these respects it is similar to lignite. Prof. Lewis, in another experiment, found it was cheaper to manufacture gas at low temperature of 720 deg. Fahrenheit and the value of the gas was higher, whilst more coke and ammonia products were obtained. The temperature of ordinary gas-coal distillation is about 2,200 deg. Fahrenheit and the composition of the tar produced is quite different from that at low temperature. The latter yield paraffin oils valuable for lubrication and power purposes.

In Germany thousands of tons of tar are annually produced by the distillation of lignite at low temperature. Gas oil extracted from the tar is used for making oil gas, and it is stated to be equal in value to the residuum of crude petroleum, known in the States as Pennsylvania gas oil, such oil could probably be used to enrich lignite gas. The German manufacturers also obtain paraffin wax from lignite tar, also the following:—

Solar oil is obtained by distillation of tar, and this oil is used for driving motors.

Putrol is a yellowish cleaning oil, used for cleaning greasy metal, for extracting and producing wagon grease.

Gas oil is a reddish brown oil used for producing oil gas.

Paraffin oil is used principally for driving Diesel motors.

Creosate oil for impregnating timber.

Peat, as far back as 1786, was converted into gas and coke and the tar more or less resembles lignite tar. Fifty years ago gas was made from peat in New England, New York and Jersey States, but the cost and quality of peat rendered the process unprofitable in these and other places.

There is, however, no known process by which lignite coke can be made into a coherent mass like gas-coke, metallurgical coke. As there are plenty of coals in the Eastern States which will produce good coke, very little attention has been paid to solving the lignite-coke problem.

In response to enquiries, the author has interested a number of people in different parts of Europe and America in this matter, and it is to be hoped that a process can be found whereby the raw lignite and lignite-coke can be made into serviceable fuel.

It will have been observed that low-temperature distillation of lignite promises to be the solution, and it may be advantageous at the point to outlive what the author considers the possible scheme.

The lignite should be partially distilled at low temperature, the gas to be either distributed for use in the district or in firing the furnace. The tar distilled to extract the paraffin and oils. The coke to be briquetted with some binder obtained from local products and waterproofed with paraffin, and made into a fuel which will equal any imported coal, and probably at a much less cost.

It will doubtless be recognized that whilst the information given to-night is limited, and necessarily supplementary to the report, which the author has prepared, it will require more time, funds and facilities to develop the enquiries and carry on experiments.

Lignite is out local fuel and it will manifestly be to the advantage of the community if fuller use can be made of it. If a central power plant is erected, its value will be circumscribed by the range to which it can be economically transmitted, and the increase in the consumption of lignite will be, say, 50 per cent.; but every farmer, householder and industry requires fuel, and the cheaper it can be supplied, so much the better. If, however, its quality can be improved for transportation and general use, then the demand will doubtless increase greatly, because it has the advantage over imported fuel, inasmuch as less freight has to be paid.

THE NEW CANADIAN PACIFIC LINERS.

Two new vessels for the Pacific service of the C.P.R. are now being completed at the Fairfield Works in England; the second, which was launched last week, is the eighth constructed by the Fairfield Company for the same owners. It will surprise no one who knows of the courage of the Canadian Pacific Railway, to learn that the new vessels will be by far the largest trading between the American continent and Japan and China, and, further, that they represent in their design the highest achievement in naval architecture, alike from the standpoints of safety, comfort, and economy. As regards the first, the water-tight bulkheads are more closely spaced than has hitherto been usual, so that four compartments can be opened to the sea without affecting the flotation of the ship. As to comfort, the 200 first-class, 100 second, and 800 third-class passengers to be carried are ensured every convenience which experience can suggest. As we hope later to illustrate the vessels, we need only here remark that one—namely, the Empress of Russia—is decorated in the Louis XV. and Louis XVI. styles, whilst the second, the Empress of Asia, is treated according to the Georgian period. The first-class cabins are all in a deck-house, 340 ft. long, on the bridge deck. Whilst the rooms are nominally for two persons, the arrangement is such that when one person is occupying a room, all evidence of the other berth is hidden, leaving only a single brass bedstead with the other stateroom furniture. In nearly every case each pair of cabins can be converted into a suite. The vessels are of 15,000 tons gross, the length being 590 ft., the beam 68 ft., and the depth 46 ft. A considerable amount of freight, particularly of the perishable type, can be carried. There is an innovation in connection with the form aft, as the vessels have been given a cruiser stern, which increases the water-line for a given over-all length and facilitates the propulsion, while adding to the available deck area aft. There is the further advantage that many of the lifeboats can be carried over the poop, and here it may be noted that boats are provided for the maximum number of passengers arranged for. The vessel is propelled by turbines, with the construction of which the Fairfield Company have had very large experience. A high degree of propulsive efficiency is thus sure to result.

THE RISE OF TEMPERATURE ASSOCIATED WITH THE MELTING OF ICEBERGS.

By Prof. H. T. Barnes, D.Sc., F.R.S., McGill University.

In a letter to Nature, published in the issue of December 1, 1910, I showed by means of microthermograms taken on a trip to Hudson's Straits that an iceberg melting in salt water produces a rise of temperature. The experiments were performed on the Canadian Government steamship "Stanley," and indicated that when approaching ice a rise of temperature occurred followed by a rapid fall of temperature a quarter of a mile abeam of the 'berg.

During the past summer I had an opportunity of examining in detail the temperature effects of icebergs. The Canadian Government placed its steamship "Montcalm" at my disposal for the tests, and three weeks were spent through the Straits of Belle Isle. Careful records were made of the temperature effects of icebergs and land. These tests have shown conclusively that it is the rise of temperature which is the direct action of the melting iceberg, and that when a fall of temperature is observed near ice it is due to the action of a colder current in which the iceberg is floating, and is not due to the cooling influence of the ice. Cooler currents may exist throughout the Arctic Current, whether accompanied by ice or not, but the presence of the ice causes a zone of warmer water to accumulate for a considerable distance about it.

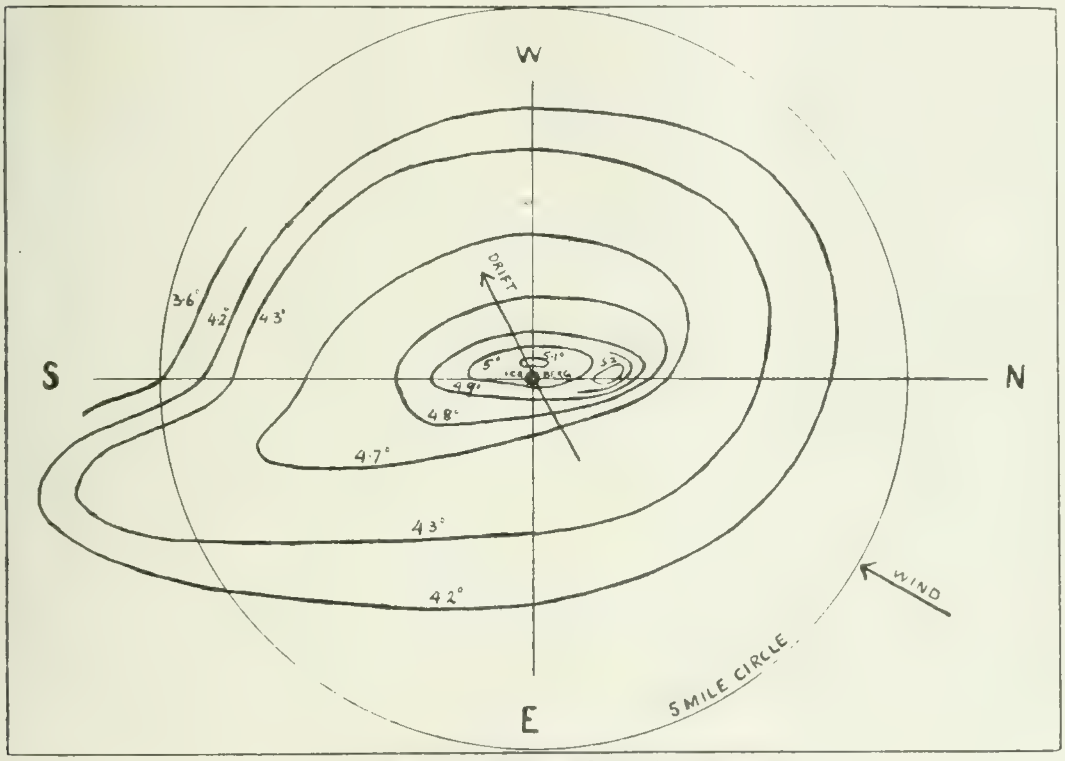


Fig. 1.—Isothermal Lines Around an Iceberg.

The icebergs I studied in the Straits of Belle Isle and off the eastern end of the Straits in the Labrador Current showed no appreciable cooling, even within a few yards of them. The rise of temperature approaching an isolated 'berg was somewhat over two degrees Centigrade. In Fig. 1 I show the isothermal lines about a typical 'berg off the eastern end of the Straits of Belle Isle. This diagram was obtained by arranging a number of courses for the ship from all sides up to a radius of six miles.

As a good illustration of how icebergs and groups of icebergs affect the water temperature I show a microthermogram in Fig. 2, taken from the records made passing westward through the Straits of Belle Isle. In every case the approach to ice caused a rise of temperature.

The explanation of this effect which I gave at my Friday evening discourse at the Royal Institution last May was founded on Pettersson's theory of ice melting in salt water. By this theory, which can easily be verified by a simple experiment, ice melting in salt water produces three currents: (1) A current of salt water cooled by the ice which sinks downward by gravity; (2) A current of warm salt water flowing towards the ice; and (3) A current of light fresh water from the ice rising and spreading out over the surface of the salt water.

I at first thought that it was this surface current of fresh water that influenced the microthermometer. The fringe of this lighter water would be warmer than the sea water on account of the action of the sun and scattered radiation, which is very strong at sea. The lighter water would retain the heat because it could not mix readily with the sea water. Near the iceberg I considered that a fall of temperature would result from the cooling influence of the surface current of fresher water.

My recent tests have shown, however, that an iceberg melts so slowly that no effect of the dilution can be detected, even right beside the berg. I took a number of samples of sea water at different distances from icebergs as well as samples taken far from ice. These samples I carefully bottled and brought home to the laboratory, where they were most accurately tested by the electric conductivity method in the Physico - Chemical Department by Dr. McIntosh and Mr. Otto Maass. No possible error could result in this way, and the tests, being carried out at a constant temperature under the most favorable circumstances, there is no reason to doubt their correctness. The comparison shows no dilution due to the icebergs, which goes to show how quickly the melted water from the 'berg is mixed with the sea water. Larger variations were found at different parts of the sea than were obtained in the proximity of ice.

It is evident that an iceberg in melting causes only two of the Pettersson currents, i.e., a cold current which sinks downward carrying with it all the melted ice water, and a horizontal surface current of sea water flowing in towards the ice to cause its melting. By this means we should expect the sea in the immediate proximity of icebergs to be warmer than further away, because the sea surface current is moving in towards the 'berg and does not share in the normal vertical circulation which tends to keep the sea surface temperature cooler.

The iceberg, in causing its own current of warmer water, provides for its own disintegration. Abundant evidence is at hand to show the melting process going on under the water line.

In my observations of icebergs I was greatly struck with the large amount of air dissolved in the ice. The white color of the 'berg is due to innumerable air bubbles in the ice, and not to snow on the surface. An iceberg is very deceptive in this way. While it looks quite soft, the ice is so hard as to make it difficult to chop it with an axe. Ice water which I prepared for drinking on board ship with iceberg ice appeared to effervesce like soda water, merely due to the liberation of the air from the melting ice. It is possible that the sudden disappearance of 'bergs with a loud report is due to their explosion from accumulated air in the interior. I passed close to one berg which was casting off small pieces, apparently by the pressure of the pent-up air.

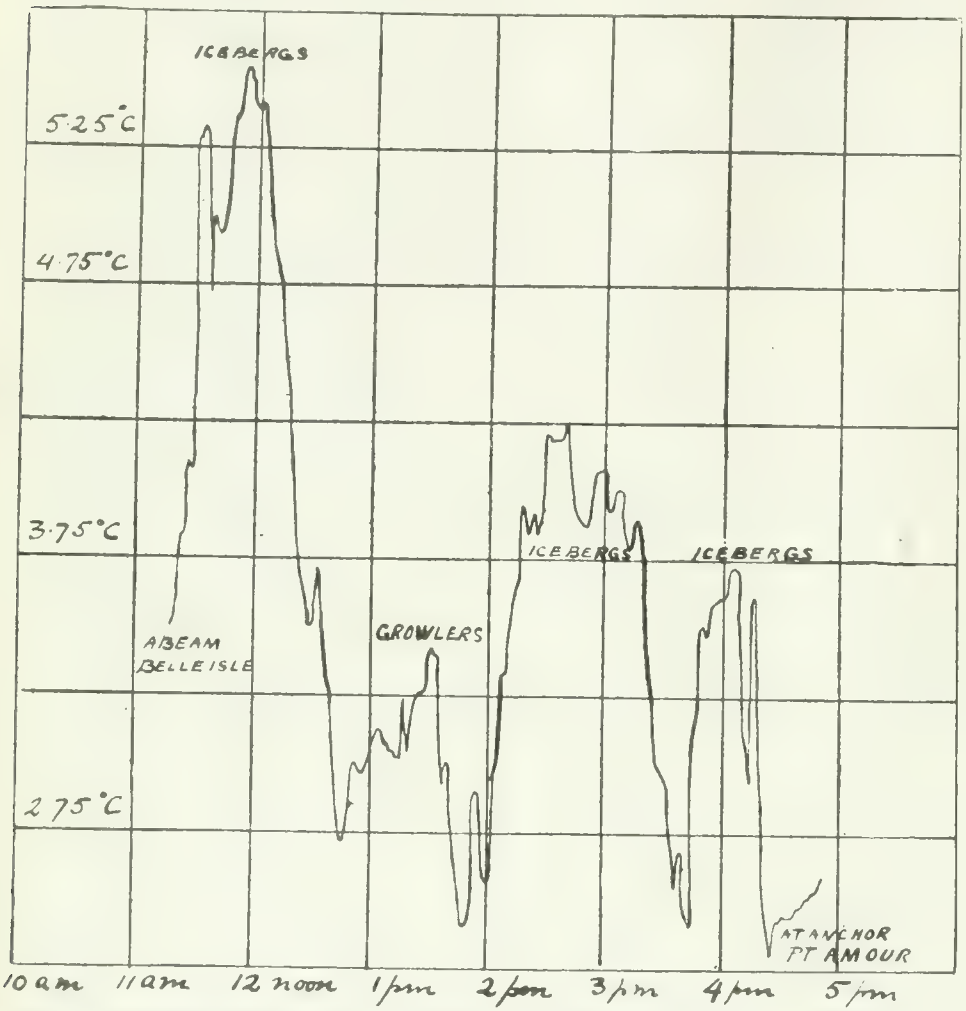


Fig. 2.—Microthermogram Taken Through the Straits of Belle Isle, Showing Effect of Iceberg Meeting.

While icebergs send the temperature of the sea up, land and coast line send it down. This was observed all along the coast in the Straits of Belle Isle. This effect is due to the action of land in turning up the colder under-water by the action of tides and currents. A great deal of work remains to be done in studying the effect of land and shoals on the temperature of the sea, but observations show the effect not only here, but on the Irish and English coasts.

From the point of view of the safety of our St. Lawrence route, the effect of land is most important. The iceberg causes us little worry because we have only a very short ice track, but to find means whereby the proximity of land can be determined is of the greatest importance.

WATER RATES.

The question of water rates comes under two heads, the engineering and the financial. The latter has probably been as productive of discussion as any single feature of waterworks operation. A few of the broader aspects of this subject particularly in the case of communities of 30,000 population or less were dealt with by Mr. Philip Burgess, consulting engineer of Columbus, Ohio, in a paper presented before the recent annual meeting of the Central States Waterworks Association. A summary of his remarks is given below.

In making an adjustment of the proper rates to be charged for water it is necessary to consider the three branches of service rendered, namely, domestic consumption, fire protection, and industrial use. The total annual revenue received must always at least equal the sum of (1) interest on investment, (2) operating and maintenance costs, and (3) annual fund required for replacement, commonly called depreciation. In considering these three factors every engineer knows how difficult it is to obtain from officials even a reasonable approximation of the cost of the first and third items. The books do not show a statement of the capital invested in the works nor is any attempt generally made to make the necessary corrections of the capital invested as may be required by replacements or even of extensions. Consequently, in making an adjustment of rates, the first step necessary for the expert is to determine the value of the works, generally assumed on the basis of the cost required to replace the works as they exist with other proper allowances.

In regard to the operating and maintenance costs, the former are comparatively easy to determine with accuracy. Maintenance, however, frequently is neglected or is charged to depreciation or replacement.

Waterworks and municipal officials may do a great deal of good towards the securing of equitable rates by seeing that the books are properly kept. The financial condition of the works may well be made public so that the consumers may know whether or not the water rates are reasonable and fair.

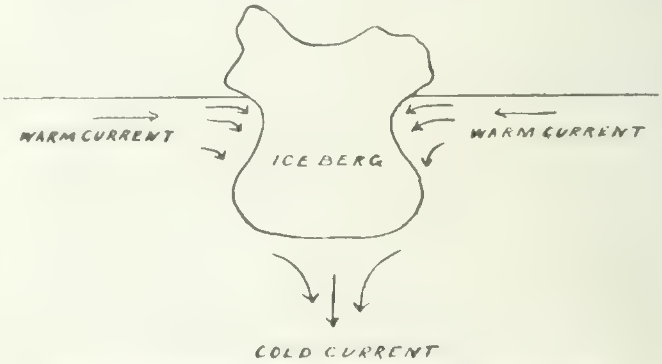


Fig. 3.—Currents due to Melting Ice in Salt Water.

In determining these rates it is understood that the total revenue is to be made up of that for domestic and industrial uses and for fire hydrants. The total amount received annually may be determined from the factors mentioned above, but the proper charge for individual service must always be determined by a very thorough study of local conditions by an expert.

In considering the matter of charges for fire hydrants and for other services directly of benefit to the community at large, it is now coming to be understood that the value of all such general services should be properly determined and charged for in all plants whether municipally or privately owned. In the case of a municipal plant, the charges for fire or hydrant and other public services should be met by a general tax levy in an amount equal to the value of the services rendered and the fund so received placed to the credit of the water department. The present more or less general policy of basing the charge for public service on so much per hydrant frequently results in poor service as well as poor compensation for the general public services rendered, and may place an unwarranted expense on the domestic consumers.

In the adjustment of rates for domestic service municipal officials may save much trouble for themselves and, perhaps, for the consumers by advocating and working for the installation of meters, which afford the only equitable basis for selling water.

The water served to a community must be of good quality. If it is thought desirable to correct a fallacious estimate of the cost of furnishing filtered water, as it is frequently stated that filtration of a public water supply necessitates rates at least 25 per cent. greater than would be required without filtration. The average cost of installation and operation of works, with and without purification, for a city of 30,000 population is shown.

Representative Waterworks Data for City of 30,000 Population.

	Without Purification.	With Purification.
Total cost of investment	$600,000	$675,000
Interest at 5 per cent.............	30,000	33,750
Replacement at 2 per cent.........	12,000	13,500
Probable cost of operation and maintenance	35,000	41,000
Total annual revenue required..	$77,000	$88,000

These figures show that the total annual revenue must be approximately 15 per cent. greater with filtered water than without. It should be noted, however, that the operating costs are less than one-half the total annual cost and it is well known that a plant may supply water at less cost per million gallons up to its full capacity than is possible at less than full capacity. Consequently, a waterworks should aim to get all the business possible, and it is believed that a filter plant will always bring in more revenue than it will cost. In fact, experience shows that the filter plant frequently is the only salvation for the waterworks, because you cannot make people buy poor water at any price.

As evidence of this fact the following figures refer to the waterworks situation at Niles, Ohio, a city which last year constructed a filter plant, under the direction of the writer: Ownership, municipal; population served, 8,000; estimated value of works, $125,000; investment per capita, $15.63; miles of mains, 21; number of hydrants, 125; source of supply, Mahoning River, unfiltered; quality of water, very poor; lift of pumps, 200 ft.; number of consumers, 900; consumers per mile of main, 43; total annual income, $8,758; total annual expenses, $14,942, including interest, depreciation, operation and maintenace.

In the above statement it is of interest to note that the waterworks were not self-sustaining although the rates charged for service compare fairly well with those charged in the neighboring communities. Attention is called to the low number of consumers per mile of main, namely 43, or about one-half of what might reasonably be expected were the supply of good quality. It is believed that the installation of the filter plant, although increasing the annual cost, will result in placing the works on a sound financial standing, due to increased business.

As compared with the above, the following data relate to the waterworks at Warren, Ohio, where there is in use one of the oldest mechanical filter plants in the United States: Ownership, private; population served, 10,000; estimated value of works, $268,000; investment per capita, $26.80; miles of mains, 31; number of hydrants, 161; source of supply, Mahoning River, filtered; quality of water, excellent; lift of pumps, 150 ft.; number of consumers, 2,300; consumers per mile of main, 74; total annual income, $38,783; total annual expenses, $34,466, including interest, depreciation, operation and maintenance; rates charged for service, 6-room house, $6, 1 bath and 1 basin, $2.75, 1 closet, $2.50, total annual, $11.25; sprinkling 50 ft. and street, $5.00.

In comparing the situations at the two plants, it is of interest to note that the Warren water supply has been maintained of excellent quality for many years, and that consequently the water is in general use, resulting in an excellent financial standing for the plant. It should be added, however, that the annual income at Warren contains a hydrant rental of $6,675 and that no hydrant rental is credited to the plant at Niles. As previously stated, however, there is a growing appreciation of the fact that all water departments, whether private or municipal, should be credited with and funds placed to their account for all public services rendered. Even on this basis, the conditions at Niles clearly warranted and required the installation of the purification plant even from a purely business standpoint, and not considering the health of the consumers.

EXPERIMENTS WITH KEROSENE FUEL.

An investigation of kerosene fuel is being conducted by the Engineering Experimental Station at the Pennsylvania State College under the direction of Prof. J. A. Moyer, of the mechanical engineering department. With the increase in the price of gasoline has come the demand for some cheaper fuel that will give as good results. Kerosene would meet the demands if a satisfactory carburetor can be designed, and it is with a view of determining the merits and defects of various types of carburetors that the investigation is being carried on. The price of gasoline has nearly doubled in this country in the past year, while in England the price has risen to 50 cents a gallon for "motor spirit." Many of the writers in the trade journals in England advocate the use of a mixture of gasoline and kerosene, but point out that without an efficient carburetor no such mixture may be used. Professor Moyer, who has made numerous experiments on smoke washing and electrostatic treatment of smoke, has already installed at the college a motor built to utilize the energy from either of the two fuels mentioned which is suitable for use on farms and country estates. Experiments will also be made on various mixtures, and a carburetor valve will be designed to shift the fuel supply automatically from a small gasoline tank, used only for starting, to the main kerosene tank. These experiments should be of interest to manufacturers and users of gasoline motors throughout the country.

IMHOFF TANKS.*

By **Henry N. Ogden.†**

The Imhoff tank is said to throw down 95 per cent. of the "capable-of-settling" suspended solids, and the advocates of the tank explain that the term "capable-of-settling" refers to that proportion of suspended matters in the sewage which will settle out in a measuring glass when allowed to stand quiescent for two hours. If Mr. Fuller's estimate of the amount of colloidal matter in sewage not capable of settling is 30 per cent., then the remainder, 70 per cent., is that which remains as precipitable after the use of chemicals; and if the Imhoff tank will throw down 95 per cent. of this it means that, of the total suspended solids, it will remove 66.5 per cent. This should be compared with the 50 to 55 per cent. which is obtained from strictly domestic sewage, and it is probably correct to say that the increased efficiency of the Imhoff tank due to the separation of the rising gas increases the deposit of solids from 10 to 15 per cent.

The second principle of the Imhoff tank is its remarkable performance in taking care of the sludge. Three reasons are assigned for this. In the first place, below the settling tank proper there is provided a large compartment in which the sludge is allowed to remain three to six months, during which time decomposition proceeds and effectively destroys the organic matter so that when finally the sludge is removed it is odorless and much reduced in quantity.

Perhaps no single element has worked more against a greater use of the septic tank than the fact that during the septic process offensive gases are given off. It is to the elimination of these odors that the energies of the inventor of the Imhoff tank were directed, and for this purpose he provides a separate tank for disintegration of solids, but he carries on that disintegration without producing odors. His second point, therefore, was that there must be through the sludge compartment no moving or renewed fresh sewage. The construction of the tank seems to solve this problem.

In the septic tanks the liquid sewage and the deposited sludge undergo decomposition together, while in the Imhoff tank all supernatant liquid passes through the tank so rapidly that no septic action is obtained, although in the sludge underneath a very high degree of septicization may be going on. It is said, therefore, that the organic matter in solution, either true or colloidal, is that part of any decomposition that is responsible for offensive gases, and that the deposited solids not subjected to renewed application of fresh sewage do not in their decomposition become offensive. This may explain why the Travis tank smells and the Imhoff tank does not.

The third point which seems to be fundamental in the design is that the deposited solids shall be overlaid with 25 or 30 ft. of liquid. Shallow tanks do not seem to be as effective as deep ones and the reason assigned for this is that the gases of decomposition which are produced in the lower strata must, on account of the high pressure, accumulate in greater volume and in their escape produce a greater separation of the sludge particles than in shallow tanks. It is to this action of the gases in the lower layers of the sludge deposits that Dr. Imhoff ascribes the marked porous condition of the sludge which gives it its rapid drying properties after being taken from the tank. The decomposition which goes on at the bottom of the Imhoff tank also gasifies and liquefies a large proportion of the solids originally deposited.

Based on experiments of Dr. Spilner and Mr. Blunk, chemist and engineer respectively for the Emscher Association, the fresh sludge deposited in the lower compartment contains, on an average, 95 per cent. of water. After remaining several weeks or months in the septic chamber it will contain only 75 per cent. of water, and about one-third of the original organic matter will have been either gasified or liquefied. Through these two agencies an original volume of 100 cu. yd. of fresh sludge will be reduced, according to their experiments and figures, to a volume of 16 cu. yd., a shrinkage in volume of about 84 per cent. They assert that through septic action only an original 5 cu. yd. of dry sludge matter will be reduced to 3.92 cu. yd., a reduction of 22 per cent. The largest part, therefore, of the reduced volume is gained by the loss in water, this being pressed out on account of the great depth of tank, or indirectly by the greater pressure of entrained gas.

Instead of being compact, non-porous and in texture much like asphalt or rubber, the Imhoff sludge is so porous that the contained water disappears readily, drying out so that it can be spaded in about five days and is thereby still further reduced in volume so that its volume is about 40 per cent. less than when emptied from the tank.

Since sewage disposal plants are generally built on the lowest ground where foundation soil is the poorest and where the ground saturation is most complete, it is inevitable that the cost of tanks 30 ft. down will be high. Wisner estimates the Imhoff tank to cost twice that of shallow tanks for the same volume of sewage, although the actual volume of the Imhoff tank is perhaps only one-fourth that of ordinary tanks in volume, but the storage compartment for sludge underneath is so great that the total volume of the tank is nearly that of an ordinary settling tank. Apparently the practice of Dr. Imhoff is to make the upper compartment large enough to hold about two hours' flow and to make the lower one twice this size. This makes the Imhoff tank large enough to hold about six hours' sewage flow, which is about the capacity of the more recently built septic tank.

The cost of the Imhoff tanks is higher even with smaller capacity because of higher unit prices in both excavation and masonry linings. The question, therefore, resolves itself into this: Is the greater sedimentation, the freedom from odor at the plant and the vastly reduced labor of disposing of the sludge sufficient justification for an increased cost of construction of the tank and for the patent fee which the inventor very properly claims? It has been said that there is no opportunity for equalizing the variable flow in so small a tank and that for best results a large sedimentation tank ought to precede the Imhoff tank action. But with every criticism considered, and with full appreciation of the difficulties of the deep tank construction, the boon of an odorless sewage disposal plant is so great and the elimination of the sludge problem so gratefully appreciated, that its rapid installation in this country cannot but follow its European successes.

---

* Abstract of paper delivered before American Society of Municipal Improvements, November 12-15.

† Professor of Sanitary Engineering, Cornell University.

◆

STREET RAILWAY FOR PRINCE ALBERT.

An estimate of the probable cost of a street railway at Prince Albert, Saskatchewan, consisting of eight miles of track and eight or ten cars to start, has been submitted to the civic authorities by Mr. J. S. Townsend, of the Messrs. Stone and Webster Engineering Company of Boston, placing the figure at $275,000.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1 75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404, 7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, DECEMBER 19, 1912. No. 25

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
Sewage Disposal in Alberta 891
Toronto and Her Six Million Dollar Water By-law 892

Leading Articles:

Water Supply for London—Large Humphrey Pumps 879
Lignite and Its Uses 881
The Rise of Temperature Associated with the Melting of Icebergs 887
Water Rates 888
Imhoff Tanks 890
Report of Mr. Child, City Engineer, and Deputation of City Council After Visit to Sewage Works at Ponoka 893
Report Upon Ponoka Asylum Plant by T. Aird Murray, to the Bureau of Public Health, Sask. 893
Construction of Concrete Lined Water Tunnel..... 896
The Durability of Grouted Granite Pavements..... 809
Increased Production of Structural Materials...... 900
The Plant of the St. Mary's Portland Cement Co... 902
Panama Canal Tolls 902
Unit Costs of Filtering Water in Four Slow Sand Plants at Philadelphia 903

Coast to Coast 906
Personals 907
Coming Meetings 908
Engineering Societies 908
Market Conditions 24-26
Construction News 65
Railway Orders 72

SEWAGE DISPOSAL IN ALBERTA.

In our issue of August 4th, 1910, we published a copy of a resolution passed by the Provincial Board of Health of Alberta calling upon municipalities to delay any contemplated sewage disposal undertakings until the Government had completed a plant, demonstrating what is purported to be a new system of sewage disposal, invented and patented by the engineer to the Board of Health under the name of "The Live Earth Bed System." In a further issue of September 1st, 1910, we published a description of the system, together with drawings, and also in an editorial called attention to the fact that the system was not new, but was apparently an adaptation of "Dibden's Slate Bed System," in vogue at several places in Great Britain for the treatment and digestion of the solids in sewage.

"The Live Earth Bed System" has been adopted by the Alberta Government in connection with the drainage of Ponoka Asylum. The system has created no little interest in the Province, especially as it has had the strong backing of the Provincial Board of Health. We have been informed on several occasions that engineers have had difficulty in getting plans passed by this authority unless such plans are in line with this system.

It is a somewhat unique position for any central authority having control over stream pollution to dictate or attempt to dictate as to the particular method of sewage disposal to be adopted by municipalities. We have always understood that expert authority is inclined to agree that there is no one system of sewage treatment which will meet all local conditions, and that it is only after a study of the particular conditions appertaining to a district that it is possible to define the system which will give the required efficiency. This is not, however, the policy of the Provincial Board of Health of Alberta, as is evident by the following letter, signed by R. B. Owens, the advising engineer to the Board. The town of Macleod, Alberta, having determined to treat its sewage before discharging into the river which eventually forms the water supply to Lethbridge, etc., further down stream, addressed a letter to the Provincial Board of Health, asking if the government had yet come to any conclusion with reference to "The Live Earth System."

This is the reply which the Provincial Board sent on:—

[Copy.]
Dated March 15th, 1912.

G. H. Altham, Esq., City Engineer, Macleod, Alta.:

Sir,—I am in receipt of your letter of the 11th inst.

The Provincial Board of Health are very well pleased with the showing made by the Live Earth Bed system installed at the Ponoka Asylum. The latest report, dated March 7th, from the general building foreman on the Ponoka Asylum works is as follows:—

"The amount of solids now distributed over the face of the slates is about fifty per cent. less than it was the first of December. This alone shows an increase in efficiency of more than 100 per cent. now in comparison with the same time two months ago.

"The temperature in the building has been very even, never ranging over ten degrees of a variation during the winter. Our lowest inside temperature was 36 and our highest 46, while the outside has ranged from 47 below zero to 46 above zero. There is always two degrees difference between the inlet and outlet of the tank."

This system can be constructed for much less than any other; it can be operated for less than any other; every other system will freeze solid in winter in the filter portion; it is the only system odorless in its operation; it fulfils the requirements of the Provincial Board of Health, and the certificate that it can be constructed, operated and carried out without injury or danger to the public health will be granted to those installing it. The sterilization process used in connection with it ensures the total destruction of pathogenic organisms. There is practically no sludge, which is practically the whole of the solids in sewage, to be pumped out and removed, a filthy and costly job, as is the case in others such as, say, the proposed Lethbridge plant. What more could you wish?

The proposed Lethbridge plant, on an old, out-of-date system, is to cost $63,522, and is supposed to give an effluent free from pathogenic organisms, but it will certainly leave practically the whole of the solids to be dealt with by pumping out and drying in the atmosphere, thus creating a serious menace to health, whereas my system could be installed in Lethbridge for less than $40,000, and would give an effluent free from pathogenic organisms and would leave practically no sludge to be dealt with.

I unhesitatingly recommend the Live Earth Bed System for Macleod.

Messrs. Dutcher, Maxwell & Co., Civil Engineers, who are now installing a sewage disposal plant, etc., in Camrose, are making a speciality of sewage disposal, and should you feel that you would like a firm of consulting engineers to help you out in this work, you communicate with them. Their address is Camrose.

I am, Sir,
Your obedient servant,
(Signed) R. B. Owens.

From the above letter it would appear that the Provincial Board of Health of Alberta has come to the definite conclusion that the "Live Earth Bed System" of sewage disposal is the only one on earth which deserves any consideration, and is, further, the only system which warrants a certificate from the Board that it can be constructed, operated and carried out without injury or danger to the public health. This Board of Health appears to have finally solved the much-discussed sewage disposal problem upon the strength of a single experiment made at Ponoka Asylum, and apparently upon the report of the general foreman, dated March 7th, 1912.

We know that up to March 15th, this year, no chemical or bacteriological examination of the effluent from the Ponoka Asylum had been made by the Provincial bacteriologist attached to the Board of Health.

We know that even up to May 23rd, this year, an examination of two samples of the treated and untreated sewage at Ponoka Asylum showed results for removal of solids as follows: Sample No. 1—Untreated sewage, 603 parts per million of suspended matter; treated sewage, 570 parts. Sample No. 2—Untreated sewage, 500 parts per million of suspended matter; treated sewage, 448 parts per million.

It will be noted, however, that the remarkable letter to Macleod above quoted is signed on behalf of the Board of Health by the patentee and inventor of this system.

Two independent examinations and reports have been made with reference to the Ponoka Asylum plant, one by Mr. Child, the late City Engineer of Calgary, dated April 17th, 1912, and another by Mr. T. Aird Murray on behalf of the Bureau of Public Health, Saskatchewan Government. These reports, published in this issue, will be read with interest, and generally bear out the remarks and criticism which *The Canadian Engineer* thought fit to make in the 1910 issues referred to.

TORONTO AND HER SIX MILLION DOLLAR WATER BY-LAW.

A by-law for the provision of $6,000,000 for an additional water supply for Toronto is one of the items to be voted on by the citizens on the first of January. The Board of Commissioners, who reported a few months ago on Toronto's water supply, emphasized the necessity of an additional and alternative supply to the present system now operating on the Island.

The plans, as outlined by the Commission, for which funds are now being asked, contemplate the establishment of the duplicate system on the heights at Scarboro, about twelve miles east of the Island plant.

The Scarboro plant, if installed, will cost about five and one-half million dollars, and will give an additional capacity of sixty million gallons per day.

The city is voting at the same time, on money by-laws for other purposes, with a total of six million dollars. The present state of the money market is such that the prospects for floating twelve millions of bonds this coming year are rather dubious.

Before the citizens are asked to provide the money for this duplicate system, they must be assured that the very best location has been picked for the plant, and that adequate returns in the way of an abundant supply of pure water at the lowest possible cost will be secured.

Is the report of the Commission, recommending the location of the new plant at Scarboro, the solution of the problem? Are the public satisfied that the conclusions of the experts as outlined in their reports, are justified? In next week's issue we hope to deal with some features of the report which have been overlooked.

SPELLERIZED PIPE.

Spellerized pipe has been on the market for some time, but no explanation has heretofore been offered as to what the process consisted in. The method is now explained by the National Tube Co. as follows: Spellerizing consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surface, then subjecting the bloom while still hot to the action of smooth-faced rolls, and repeating the operation, thereby working the surface of the metal to a uniformly dense texture, adapted to resist corrosion, especially pitting.

This process is, of course, of most service on 4-in. pipe, or smaller, because of the thin walls. The larger sizes, because of their thickness, do not require so much extra work of this character.

REPORT OF MR. CHILD, CITY ENGINEER, AND DEPUTATION OF CITY COUNCIL AFTER VISIT TO SEWAGE WORKS AT PONOKA

COPY.

Dated Calgary, April 17th, 1912.

City Commissioners,
Calgary.

Gentlemen,—Re the live earth system recommended by R. B. Owens, B.A., sanitary engineer for the province of Alberta.

This system of dealing with sewage appears to be adapted entirely to the retention and decomposition of the solid matter in sewage and takes no cognizance of the purification of the sewage liquid.

The system consists of a series of tanks, generally three in number, as illustrated by a plan submitted by Mr. Owens. The first two tanks are simply rectangular receptacles filled with layers of concrete slabs. The third tank is a rectangular receptacle for holding the liquid sewage after it has passed through the first two tanks. In the last tank provision is made for disinfecting the liquid sewage by means of the addition of chlorine.

The theory upon which the first two tanks is based is apparently the well-known attraction of matter to matter, and it is held that the concrete slabs attract the solids from the sewage which settles on the surface of the slabs and then gradually undergoes putrefaction until it becomes like ordinary earth. The essential difference between these tanks and ordinary sedimentation tanks exists in the adoption of the concrete slabs producing a greater surface area on to which the solids may settle. I understand that the system has been put forward in England by Mr. Dibden, who uses layers of slate instead of concrete slabs, and that in 1902 the Massachusetts State Board of Health carried out several exhaustive experiments with tanks similarly constructed filled with layers of slate about a half inch apart. Quoting from the State Board of Health, I find as follows: "The effluent was never of good quality. During May and June anaerobic conditions were noted and later became strongly marked and the experiment was discontinued. The filter lost open space rapidly and showed signs of choking." Mr. Owens claims that the action is aerobic and not anaerobic.

It is generally reported in England that the system has gained no ground, as the beds invariably choke and are difficult to flush or clean. The system of sludge removal, as now being adopted, appears to be based upon an entirely different process from that which is adopted in the concrete or slate bed systems. It appears to be recognized in all the newer forms of tank that the chief aim should be the immediate removal of the putrefying sludge from contact with the flowing sewage. This is exemplified in such forms of tanks as the Emscher or Imhoff types, the Traver's tanks and the forms as adopted at Lethbridge. With the slab system the liquid sewage must pass over the surface of the decomposing sludge and in this way much of the finer matter in recollected and the products of decomposition such as the sulphides, etc., are carried away with the liquid. Thus there is produced a septic effluent which it is acknowledged is most difficult to purify or disinfect. In fact, there is little essential difference between this form of tank and the old septic tank. It is simply a septic tank filled with concrete slabs. Mr. Owens claims that the tanks are essentially contact beds, and this form of tank has been shown to be simply a septic tank when it stands full of sewage and the air driven out.

Apart from the question as to whether the tanks are based upon a good working principle or otherwise, they are not suited to conditions at Calgary. Gravel here of any size and quantity is available for filtering purposes, and would be out of the question to substitute for gravel expensive concrete slabs, of which an enormous quantity would be required.

While the system may be suitable for some small installation it certainly does not lend itself to any large plant where extensive contact beds would be required.

One of the main difficulties in connection with the system appears to be the difficulty of removal of the settled sludge between the concrete slabs. While this may be possible in a small tank, it appears almost impossible in any large tank consisting of a huge body of such slabs. The slabs, once being put into position, it would be most expensive to remove them and reset them, and it does not appear possible that any working principle of flushing can be adopted for a large area.

All the newer systems of sewage disposal with which I am acquainted appear to aim at the immediate and automatic removal of sludge by means of slow velocities and secondary sludge storage receptacles, into which the precipitated sludge at once gravitates.

Another and very vital objection is the amount of fall requisite. Mr. Owens' plans show 15 feet. The tanks as proposed at Lethbridge for the removal of solids require only 1 foot, the difference between inlet and outlet weirs.

From personal observations obtained whilst visiting the Ponoko asylum sewage disposal works, one is able to deduce the following: The works, according to Mr. Owens' own statement, is overtaxed four times its capabilities, that is to say, instead of 300 people accommodated these works would be overtaxed with anything over 75 persons. The cost of the system was $6,236.10. Proportioning this to a city of 75,000 the cost would be $6,236,000.

The noticeable features in connection with the Ponoka system are, that an objectionable odor is very apparent, caused by putrefactive process in connection with the sludge retained on the slabs, and that the effluent is far from clear. The discharge is into an open ditch extending some 300 yards, and depositing onto a ploughed field. The bottom and sides of this trench are lined with slime and the effluent itself has a distinct odor. This, no doubt, is accountable to the system being overtaxed, still, without filtration as a final treatment before discharging into our rivers, there are grave doubts as to the health authorities allowing this city to adopt a system of this nature without filters, which, after all, are the essential points of sewage disposal works.

Respectfully submitted,
[Signed] J. T. CHILD,
City Engineer.

REPORT UPON PONOKA ASYLUM PLANT BY T. AIRD MURRAY TO THE BUREAU OF PUBLIC HEALTH, SASKATCHEWAN

July 26th, 1912.

Dr. M. M. Seymour,
Commissioner of Health,
Regina, Sask.

Dear Sir,—You informed me on the 19th of April last that you had received enquiries as to whether you would accept, as satisfactory, proposals to install schemes of sewage disposal within your provincial jurisdiction of Saskatchewan similar in principle to a scheme recently installed under the auspices of the Provincial Board of Health of Alberta in connection with the government asylum at Ponoka. I informed you that I had no personal actual knowledge of this plant, but that I had seen plans and a description of it, but had not seen any data referring to its working efficiency.

You commissioned me to proceed to Alberta, visit the plant at Ponoka asylum and confer, if possible, with the authorities of the Provincial Board of Health with reference to this matter and report direct to you upon this plant.

I inspected the plant in question on the 22nd of April, and interviewed the provincial bacteriologist at Edmonton on the 23rd.

I took two samples of the sewage, one representing the raw sewage influent as it entered the works, and the other representing the sewage effluent as it left the works after treatment. These samples I divided, leaving a portion of each with the provincial bacteriologist, and the other two portions I had sent direct to my analyst in Toronto. I considered this a proper course to pursue, as I take it, that more accurate results would be obtained by immediate analysis at Edmonton than I could obtain after sending samples over so long a distance occupying the considerable period of time between sending off from Edmonton and arrival at Toronto. The provincial bacteriologist promised to examine the samples left with him and report to me the nature of the results obtained. He has done so, and a copy of his results are appended.

The System of Sewage Disposal as Installed at Ponoka Asylum.

I met at Ponoka the foreman in charge of the works, who kindly went over them with me and freely gave me all the information which he could. It appears that the system of disposal has only been in vogue for about 10 months; it treats of the sewage, which is purely domestic, from the asylum, representing about 300 people, with a normal discharge of about 24,000 gallons per 24 hours, or 80 gallons per head per day.

The location of the disposal works is a considerable distance from the Asylum buildings, and is upon falling ground forming an ideal site for treatment of sewage upon the modern biological methods, there being ample fall. The character of the site presents ideal conditions which are not often met with in the prairies, as the main difficulty is, generally, lack of fall.

The plant consists of duplicate primary contact beds, each with a capacity of 1,000 gallons, rectangular in shape, 19 feet 9½ inches x 11 feet 11½ x 3 feet deep, and one secondary settling tank of 1,000 gallons capacity. The sewage first enters the primary tanks and is held there for a period of about 4 hours, when a valve is operated and the sewage allowed to flow into a channel pit and then into the secondary or final settling tank. From the latter tank the effluent discharges into an open channel and terminates in a hollow forming a small slough, from which it appears to percolate and evaporate. The soil is sandy and very friable, and will probably continue to absorb sewage effluent for some considerable time.

Laid longitudinally in the entrance channel to the secondary tank is a perforated zinc pipe which is periodically filled with chloride of lime, the object of this is, that the flowing sewage may absorb chlorine from the lime and be disinfected.

The whole of the works are extremely simple and compact and are housed in a roofed building.

The cost of installation was reputed to be $6,236.10, and the intended capacity designed for 300 persons, representing a sewage discharge of 24,000 gallons per day. The plant has, however, been found to be too small and incapable of producing satisfactory results, and work was in progress for doubling the capacity of the system and building similar tanks alongside the present ones.

The chief feature in connection with this plant is the adoption of what is called in England "Dibden's Slate Bed System"; the only difference being that instead of slates, concrete slabs are used. The concrete slabs are laid in the tanks in layers. Each slab is 24 inches x 12 inches with square openings 8 inches x 6 inches in each slab. Concrete rests are placed between each layer to keep the slabs apart. In the primary tanks the slabs are 4 inches apart, and in the secondary tank 2½ inches apart.

I understand that the system has been patented in Canada by the sanitary engineer to the Alberta Provincial Board of Health, under the name of "The Live Earth Bed System."

I have read certain descriptions and explanations of the working of the plant sent out by the Alberta Provincial Board of Health, and it is claimed chiefly that the presence of the slabs in the tanks will effect the retention and collection of the solids contained in the sewage, which will be transformed into some substance resembling live earth, because of the great number of worms and other living organisms which will be germinated in the retained solids. It is claimed that these organisms have the faculty of turning the solids into an inoffensive material and that the sludge difficulty is thus obviated. I suspect that what is really meant is that the sludge undergoes very rapid decomposition and is charged into a humus state resembling the thoroughly septicized material resulting from a septic tank or tanks of the Emscher design, where decomposition of the sludge is aimed at.

I was informed that no analyses of the effluent had been made up to the date of my visit, and no actual data existed as to the results, but that it was acknowledged that the capacity was too small for the amount of sewage under treatment.

On entering the building in which the tanks are located, the odor peculiar to septic tanks, when covered in, was at once apparent. In the primary tanks the top slabs, which only were visible, were well covered with sewage solids. The secondary tanks presented a sewage which appeared to be highly charged with solids also. The ditch leading away from the tanks was very black with sewage solids and slime, and the slough at the terminus of the ditch was simply a lagoon of sewage solids. For all practical purposes the tanks did not appear to be doing anything more than might be expected from an ordinary septic tank and the effluent had all the appearance of an ordinary septic tank effluent. Owing to the lack of any collected data relating to periodic examination of the raw sewage and effluent, nothing more can be said as to efficiency in this particular instance, except that the samples which I personally took showed distinct signs of septic action, but that owing to distance of travel they were of little value for basing conclusions.

With Reference to the System in General.

The system is termed by the Alberta Provincial Board of Health to be essentially one of contact beds, with laminated concrete slabs in lieu of ordinary filtering material. The action of filling the beds and retaining them full of sewage for a period of time excludes all oxygen, and tends to rob the sewage of any dissolved oxygen it may originally contain. The action is essentially septic and not one of oxidation as with the percolating filters, where air is always present. It is universally acknowledged that the percolating system has decided advantages over the contact system, see Dunbar's "Principles of Sewage Disposal," fifth report of the British Royal Commission on sewage disposal and recent research work of the Lawrence Experiment Station, Mass.

The tanks may be described as merely septic tanks with the exception that they are periodically emptied, when oxidation may take place in connection with the matters retained on the slabs. The object of the system cannot be to obtain a non-putrescible liquid effluent, as such cannot be done without oxidation.

I do not consider that there is any efficient or economic reason for the use of the slabs, which add a very great expense to the tanks, and must in the case of large installations make it difficult to clean out the tanks. I believe that just as satisfactory results are obtained by such tanks as the septic tanks at Moose Jaw and Indian Head which are being superseded by more modern methods. The method of disinfecting the sewage by means of a pipe filled with chloride of lime and laid in the flowing sewage is too crude and so obviously inefficient, that it is not necessary to remark further with regard to this unless to say that I was informed that the pipe was freshly charged with the lime once a week, and it is apparent that the whole of the disinfecting efficiency of the lime must be lost almost immediately it came into contact with the sewage liquid. Except for about one half-hour during the week this disinfecting process must be valueless.

Assuming the present installation to be sufficient for 300 people (it is acknowledged that it is not) then the cost per head for sewage treatment is over $20. At the same proportion the cost for 4,000 population would be $80,000; and for 10,000 population $200,000. As the system requires doubling in capacity it really works out at $40 per head. Efficient sewage disposal consisting of removal of solids, putrescibility and disinfection should not exceed $5 per head unless under very exceptional circumstances. It may be pointed out that small installations cost more per head than large ones, at the same time with the ideal situation as presented at Ponoka, it is safe to estimate that an efficient system of sewage disposal could have been installed at a cost of under $3,000. In fact, the Northumberland and Durham Counties have a system of sewage disposal in vogue consisting of sedimentation, sprinkling filters, and slow sand filtration for removal of bacteria for a similar institution at a cost of less than $2,000.

I may conclude by stating that I cannot recommend the system as an efficient one from what I saw at Ponoka or from what one would naturally expect as results from such a system. It does appear apparent that the system even as one for the treatment of solids is not in accordance with modern recognized sedimentation tanks. The principle which is being adopted very generally in connection with sedimentation tanks and removal of solids is to separate immediately precipitated solids from all contact with flowing sewage, so that the flowing sewage may not come into contact with solids which are undergoing decomposition. The opposite of this principle is attained by the Ponoka plant.

Allow me to sum up what I consider the various points of objection to the "Live Earth System" as inspected at Ponoka Asylum:

(a.) That it is only a system for removal of solids and not for treatment or putrification of the liquid sewage.

(b.) That the liquid sewage is certain to be putrescible and septic in character owing to, 1st, no oxidation, and, 2nd, contact with the decomposing sludge.

(c.) That even if a large proportion of the solids are retained by use of slabs inserted in the tanks, that there are other less expensive methods of retaining a sufficient proportion of the solids to allow of the remaining liquid sewage being efficiently dealt with by means of oxidizing filters.

(d.) That even if the retained sludge undergoes decomposition so that it resembles earth of humus, that there are other methods more simple and less expensive of obtaining similar results (as per experiments at Chicago and elsewhere).

(e.) That the system does not lend itself to efficient disinfection, and that disinfection is more efficient and less expensive when an oxidized effluent is obtained.

(f.) That similar systems have been tried and experimented with by the Massachusetts Board of Health and others and have failed in results.

(g.) That a similar system has been tried in Great Britain, but that recent reports are not of a favorable nature unless with very small installations, and that such systems in Great Britain do not pretend to do anything more than treat with the solids contained in the sewage and are not for the final purification of sewage.

(h.) That the cost, owing to the provision of the slabs, causes the system to be prohibitive.

(i.) That the great amount of fall required by the depth of the primary and secondary tanks would in most localities prohibit its use unless the sewage was pumped.

Your obedient servant,

(Signed) T. AIRD MURRAY,
Consulting Engineer.

* * * *

COPY.

May 23rd, 1912.

Mr. T. Aird Murray,
Consulting Municipal & Sanitary Engineer,
303 Lumsden Building, Toronto, Ont.

Dear Sir,—I have yours of the 17th inst., and am glad to furnish you with the results shown by the two samples of sewage which you left with me.

Estimation of the suspended matter gave the following:

No. I. (Influent).

Unfiltered	603 parts per million.
Filtered	570 parts per million.
Difference	103 parts per million.

No. II. (Effluent).

Unfiltered	500 parts per million.
Filtered	448 parts per million.
Difference	52 parts per million.

As the capacity of the beds at Ponoka is, I understand, being greatly exceeded by the daily amount of sewage the above figures cannot be regarded as a test of the work of this type of bed in the removal of suspended matter put through them. This deficiency, however, I believe is being made good by adding more beds.

I shall be very pleased to have the promised copy of your report.

Yours very sincerely,
(Signed) D. G. REVELL.

CANADIAN NORTHERN MAKES OFFER TO LONDON.

Judge Phippen, Colonel Davidson, and Engineer McCrea, representing the Canadian Northern Railway, have made a definite offer in regard to the leasing of the London and Port Stanley road, which is owned by the city.

They offer to lease the road for 99 years at $20,000 a year for the first ten years, and $25,000 a year for the balance of the time. They agree to run a line of steamers to Port Stanley, and make London a divisional point, with shops that will employ from 150 to 250 men. They promise also to place London on their main line

Michigan Central Railway and Pere Marquette will be given running rights over the system and summer excursions to Port Stanley.

CONSTRUCTION OF CONCRETE-LINED WATER TUNNEL.

The municipal aqueduct tunnel for the city of Santa Barbara through the Santa Ynez mountain range in California is nearing completion. The tunneling, now practically completed, involved many difficulties in the form of poor rock and large inflows of both water and inflammable gas. The tunnel construction was begun under contract and abandoned when about half finished. The following account of how the work then was taken up by the city directly and carried to a successful conclusion under force-account methods is from a paper presented recently before the League of California Municipalities by Mr. Lee M. Hyde, supervising engineer.

The peculiar topographic conditions surrounding Santa Barbara have presented difficult barriers to water development and have demanded expensive and drastic treatment for solution. Paralleling the coast for a distance of 75 miles is the Santa Ynez range of mountains, leaving between it and the ocean a narrow strip of tillable lands. This range at the crest has an average height of from 3,500 to 4,000 ft. elevation, but on account of the steep slope southward affords a very small area of watershed. The creeks are in consequence short, having very little summer flow and on account of their severe grades prohibit reservoirs for impounding winter flood waters.

However, the early water supply was gained by diverting water from two creeks north of the city and later by driving a tunnel 5,000 ft. deep into the Santa Ynez range. This first tunnel is located about 4 miles west of the tunnel now under construction and was projected merely for the purpose of developing water in the Santa Ynez mountains. During construction the constant tapping of new water strata maintained a very good flow, but as soon as work ceased the saturative power of the formation was reduced to a small normal output which would soon be insufficient to meet the city's needs. Moreover, the lowering of the water plane in the mountain depleted the surface flow and the city was soon confronted with legal complications brought by riparian owners on the creeks affected.

It was at this time that public officials, realizing that the city's growth was being jeopardized by an insufficient water supply, called into consultation Mr. J. B. Lippincott, of Los Angeles, who has since been consulting engineer on Santa Barbara's water supply. The result of Mr. Lippicott's investigation was the acquiring of two reservoir sites in the upper Santa Ynez River basin below a water-shed of 210 square miles, the rights of way for a tunnel through the Santa Ynez mountains and the purchasing of power plant locations immediately north of the city.

The city immediately prepared for the construction of the tunnel 19,560 ft. in length, and contracts were let in accordance with the provisions of the city charter. The contractors drove a little less than 50 per cent. of the tunnel and were then forced to relinquish their contracts by the city Water Commissioners and Council. Their inability to prosecute the work properly, Mr. Hyde states, was partially the result of adverse conditions of formation, gas and water encountered, which had not been given sufficient weight in preparing their estimates, but for the most part was the direct result of inefficient equipment. For economical and rapid progress there must exist a high state of organization, both as to equipment and labor forces, and to this end the best of mechanical appliances should be purchased and duplicate plants installed, to eliminate delays from breakdowns of machinery. Such delays are expensive and have a discouraging effect on the workmen. To secure and retain the most energetic and skilled workman the camp should provide clean boarding houses, comfortable and sanitary quarters and good change rooms.

The city after taking over the work was occupied for some time in the installation of equipment, both surface and underground, and also in remodeling and adding to the camp quarters. On the north portion of the tunnel poor ventilation had resulted in a fungus growth vigorously attacking the timbers, causing dry rot, and it was necessary to line immediately with concrete about 2,600 ft. The timbers, in a great many places where heavy ground was being supported, were dangerously weak, and great care was necessary to protect the workmen as well as the tunnel. In certain portions, smaller sets, reinforced by sprags, were put in and the weakened 8 x 8-in. sets removed. In many places it was also necessary to centre post the caps. Under ordinary conditions the original lagging was not removed, although there were places where the fungus had caused such a severe rot that the ground had broken through. In these places the lagging was replaced and such additional timbering done as was necessary to withstand the ground weight during concreting.

The tunnel section is 6 ft. wide at the bottom, 4 ft. 6 in. wide at the top and 7 ft. high in the clear. The concrete forms, therefore, required a design occupying as little space as possible. The forms consisted of steel ribs placed on 5-ft. centres which supported 2-in. lagging. These ribs were made of 5-in. channel steel with 1½-in. web and were bent to conform with the tunnel section, being cut in two in the centre of the arch and the two halves joined together by an iron strap and four bolts. Form setting and concreting followed very closely the timber repair. The steel ribs were set on wooden foot-blocks and at the bottom were braced from the track rails. They also had additional braces at the spring line and arch centre, only these braces were to the rib and back of the tunnel. Before the forms were set a trench was excavated on each side of the tunnel to solid formation for the foundation. The width of this excavation depended on the thickness of wall to be placed, although it was always from 6 in. to 2 ft. wider than the wall.

When ready for concrete the bottom board behind the steel rib was not placed lower than the grade line of the tunnel floor. This allowed the concrete to fill the foundation excavation outside of the forms. The concrete was delivered to the shovelers in a specially designed watertight galvanized-iron box, built on a flat car. This box was 3 ft. wide, 14 in. deep and 9 ft. long with an outward slope at each end of 1 to 1, which facilitated shoveling. This car also was used to remove the foundation trench cleaning, being hosed out before again filling with concrete. After the foundation was in the walls were carried up to a point that left about 14 in. of key. Then the lagging was placed over the arch and the key of 5 ft. in length rammed from the end. A stiffer mix of concrete was used in the key than the walls. The average thickness of concrete lining was from 6 to 8 in., although in some of the loose or swelling formations the lining was heavily reinforced with steel and had a thickness of 12 to 20 in. It was in these sections and where temporary sets were used that centre posts and sprags were placed.

In order to get a good uniform thickness of lining, it was necessary to take out sets of 10 x 10 in. and 12 x 12 in. or trim them down to one-half or even one-third the original size. The sprags were placed above the cut to be made and supported the weight until the weakened portions could be covered with concrete. If necessary, these sprags could be concreted in and removed after the forms were taken down. Considerable precaution was taken when concreting a section where the water inflow was a perfect rainstorm.

Sections have been concreted where the flow of water in 5 ft. of tunnel was 25 or 30 miners' inches. In these places wood strips of ½ or 1 in. in thickness were nailed to the lagging of the timbers and then covered with sheets of tin. This tin would entirely cover the section and the water was conveyed down the sides to the foundation trench. Here pipes were placed to carry the water through the concrete wall. Ordinarily, a hole was cut through the timber lagging and the pipe placed so the intake was on the outside. Then a rich concrete or cement filled the trench above the tin and forced the water through the pipes.

The average cost of placing 4,614 ft. of concrete lining in the north portion of the tunnel was $9.79 per foot. This included a teaming charge from Santa Barbara to the north portal of $3.75 per barrel of cement and $28.12 per 1,000 ft. on lumber. Gravel from the Santa Ynez River bed was hauled about three-quarters of a mile. The divisions of cost were as follows:

Cost of Lining Per Foot of Tunnel.

Administration and labor	$4.63
Cement	3.64
Forms	.18
Sand and gravel	.24
Miscellaneous supplies	1.10
Total	$9.79

Santa Barbara's tunnel has presented many expensive and difficult problems. The Santa Ynez range generally is a highly stratified shale and sandstone alternating from one to the other in layers of a few feet to several hundred feet in thickness. The tunnel attack is at a strike and dip, ranging from 75 to 85 deg. The formation at contact points is ordinarily quite shattered and this loose condition is aggravated in water-bearing sections. When the north portion had been driven to a depth of 4,800 ft. from the portal a highly inflammable gas in large quantities was encountered. This gas section extended for a continuous distance of 1,300 ft. The formation for the first 700 ft. was shale, followed by 400 ft. of oil sand. Here the formation was badly faulted at its contact with the shale, which was the formation to the end of the gas section.

The quantity of gas at first was not alarming, although as a safeguard against accident safety lamps were used to test the heading after each blast. Small accumulations of gas located in the higher portions of the tunnel would then be burned out by touching them off with a torch. This done, the seepages would be lighted and if the inflow was sufficient would maintain a constant flame during the next shift, being extinguished by the next blast in the heading. As the heading neared the oil sand gas was encountered in larger quantities, and finally when this formation was opened up a larger amount of gas accumulated in the tunnel immediately following the blast and was accidentally exploded by the workmen. The force of the explosion was terrific and those not severely burned were hurled along the tunnel. Besides one killed, all the men were seriously injured. This was an exceptionally large quantity of gas, being about 25,000 cu. ft., and had been released by opening up 5 ft. of ground in the heading. It was not the seepages of gas in the tunnel that gave trouble, but the unknown quantity that was released by advancing the heading.

To guard against and safely dispose of this unknown inflow, Mr. Lippincott and Mr. Hyde placed a system of electric arcs in the tunnel which were used to ignite the gas after firing a round in the heading. The arcs were specially made, being designed to withstand the concussion of the blasts and explosion of gas. When the round was ready to fire these arcs were placed in high points along the tunnel about 200 ft. apart, the first one being located about 150 ft. back of the heading. The round was then fired and the crew retired to the portal. A fire boss and helper then took charge of the tunnel and 4 hours were consumed in testing before the next heading crew went on shift. The fire boss waited for about 30 min. after the blast before turning an electric current into the arcs from an outside switch. This wait allowed a better chance of gas removal by the blowers, which were always reversed to exhaust from the heading after blasts. An ammeter was used at the switch to indicate whether the arcs responded or not, and all the arcs were connected in series.

After obtaining results of arcing from the portal the fire boss and helper advanced to another arcing station 3,500 ft. from the portal. Here the electricity was again turned into the arc circuit. If there was no gas explosion the fire boss with a safety lamp tested the entire tunnel ahead. If no large pockets were discovered he returned to the station, where he again switched the electricity through the arcs. This time with the arcs burning, he returned to the heading and placed torches at intervals of 100 ft. through the gas section, which were kept burning during the next shift.

Ordinarily the muck pile would burn like coal for some time, and on one occasion was ablaze for fourteen hours. Drilling and firing a round of holes was often quite spectacular and required a great deal of care. As soon as the hole was drilled the gas from it would be lighted, sustaining a good sized flame. I have seen as high as six out of eight holes on the top round burning like blow torches. Before loading a round the holes had to be cooled. For this purpose two lines of water and two of air, each under 100 lb. pressure, were turned into them. This extinguished the flame, and as soon as the accumulation of gas reached a point 20 or 30 ft. back of the breast it was exploded and then immediately put out at the holes again by the air and water. This operation was repeated until the holes were cooled sufficiently to load and were then immediately fired. Driving through the gas section using the sparking devices was comparatively safe and not very expensive. Two heading shifts were maintained, and aside from the two 4-hour periods of fire boss shifts the work was uninterrupted.

The north portions of the tunnel required timber for about 71 per cent. of its total length, and although spiling and breast-boards were necessary in a great many places, most of the timbered sections offered no particularly severe problems on account of the absence of water. Good average progress was maintained by city force account during the entire work, and one very good record was made when the heading was advanced 337 ft. in thirty days by two drilling and three mucking shifts. About 48 per cent. was timbered.

After passing through the gas section, water was continually encountered until the inflow was taxing to their capacity the pumps and water columns. This meant the installation of larger pumping equipment or abandonment of the tunnel. As the distance to be driven did not justify the expense and moreover could be easily accomplished from the south side, the latter course was followed. Before abandonment the tunnel was concreted in sections where the ground was loose and heavy. The equipment was then transferred to the south portion of the tunnel and all work has been prosecuted from this end since.

The cost of driving 2,779 ft. of the north portion was $25.55 per foot, including the cost of timbering 1,736 ft. The distribution of this cost was as follows:

Cost of North Tunneling Per Foot.

Administration	$ 1.68
Labor	10.90
Power	3.81
Explosives	1.30
Timber	2.25
Track and pipe	1.76
Miscellaneous supplies	2.94
Drill parts	.62
Bonus	.20
Total	$25.55

The south portion of the tunnel differs very little in formation from the north, only larger bodies of sandstone have been penetrated. The sandstone contains crevices, and large water courses have been opened up in this formation. This blocky ground is the saturated portion of the mountain, and the intervening shale bodies act as the sides of what might be termed vertical reservoirs. The average flow for the past two years has been from 350 to 400 miners' inches.

In passing through sandstone, particularly after the tunnel had gained a depth of about 1,000 ft. vertically from the surface, the pressure of water in drilled holes has at times been very severe. Instances where drill steel was forced tight against the machine, requiring two or three men with Stilson wrenches to release it from the chuck, were frequent, and jets of water shooting down the tunnel in a horizontal line for a distance of from 25 to 75 ft. are not uncommon. Some of the main crevices yielded a flow when first tapped of from 75 to 150 miners' inches of water, and one main water course released a flow of 350 miners' inches. This drained down rapidly and within a week had diminished to about one-half this volume.

In driving from one point of contact to the other in sandstone the water follows the heading to a large extent and is a general handicap to the work. In drilling rounds, extra holes are required to release the pressure of water from the ones to be loaded. Even then it is necessary to load the holes by inserting stick after stick without tamping and then wedging at the collar. Mucking and track laying is also a task on account of the shifting sand which collects along the floor of the tunnel and over the rails for hundreds of feet back of the heading. All of the large water strikes were made in loose caving formation and greatly increased the difficulties of timbering problems. Through these sections spiling was necessary, and sometimes breast boards.

The large volume of water constantly flowing through the tunnel has had a severe effect on transportation of muck trains, as the track is always covered with water from 8 to 12 in. or more in depth. It is difficult to do repair work on the track, and besides floaters are being constantly encountered, causing wrecks. The depth of water is also a hardship on the motor cars, causing shorts and grounds in the fields, armatures, resistance and wiring, which have to be continually repaired. Water has been the most embarrassing feature of the construction. However, good progress has been maintained, the heading having been advanced 439 ft. during one period of thirty days, the average progress by city force account in the last 4,800 ft. being about 275 ft. per month at a cost of $26.16 per foot.

On April 7 of this year one of the timbered sections caved in at a point 7,360 ft. from the portal. The total collapse of the entire string of timbers 33 ft. in length occupied but a short time, and the workmen at the heading 4,500 ft. beyond had barely room to escape by the time they reached the caved portion. Special mention is due Frank Fizer for his presence of mind and heroic action in notifying the workmen of their danger. Mr. Fizer was acting as motorman and discovered the case on his outward trip. On account of breaking a trolley pole it was necessary for him to wade through water to the heading. A short time after the crew reached the portal side the tunnel filled with muck. The total water flow of the tunnel at this time was 395 miners' inches, of which about 300 miners' inches was coming into the tunnel on the heading side of the cave. This water was immediately shut off by the impervious nature of the muck pile which was mostly a mixture of soft clay and running shale. In a few hours the large volume of water had entirely filled the tunnel between the cave and heading and then on account of the small displacement necessary to resaturate, the formation above gained headway rapidly and soon exerted a pressure against the muck pile. This carried the muck pile toward the portal of the tunnel and forced the workmen back. The water then would gain a greater pressure, which would again overcome the resistance of this muck pile and move it down the tunnel. This process continued until the tunnel was filled with muck for a distance of 437 ft., at which point further action was blocked by two bulkheads, a temporary wooden one to protect the workmen while the permanent concrete bulkhead was placed.

By placing a pressure gauge on the compressor air line some idea of the pressure was gained during the early stages, but on account of the line giving way few readings were obtained. However, these showed a gain from 19 to 122 lb. per square inch in 14 hours.

A side drift was then projected around the caved and filled portion of the tunnel, and opposite the soft caved stratum was 100 ft. distant. At this point 12 x 12-in. timbers with 4 and 6-in. spiling and 3 x 12-in. breast boards were used. It was necessary to hold every inch of ground in place, as a slight movement might allow the terrific water pressure in the main tunnel to cause a general movement of the loose muddy formation, separating the two bores, and in this case the muck could very quickly slide into the side drift and duplicate the muck shifting process following the cave. The progress through this section was very slow, but the results obtained were most satisfactory. However, it was necessary to concrete this timbered section immediately after passing through the ground to insure safety.

The side drift was then advanced and turned toward the main tunnel again so the approach was at an angle of 41 deg. The side drift is 785 ft. in length, some of this distance being necessary to gain a location in the old tunnel where the formation was considered solid enough to tap through. When the side drift had gained a location that left 18 ft. of wall between the two tunnels the heading was stopped and preparations made for tapping the main tunnel. The formation was a tight and tough slate shale and was practically dry, but owing to its brittle nature was flaking off with loud, quick reports for the last three days before the tap on account of the water pressure, which was probably 500 lb. per square inch. In order that the attack might be at right angles with the main tunnel, a cross cut of 7 ft. in length, carrying a 3-ft. 6-in. bench, was made. The tapping holes, 11 ft. long, were drilled in this face. Four holes were drilled from a cross-bar. These were collared about 20 in. apart and brought together at the bottom. A pilot hole was kept 2 ft. in advance of these four to indicate the exact location of the main tunnel rib. When this was determined the holes then about 12 in. from the rib were charged with 50 lb. of 40 per cent. powder and fired. Fifty-foot fuse was used, which allowed plenty of time for the shift to get out of the tunnel. The results of the blast were particularly successful, the water being gradually reduced. The connection of the side drift with the main tunnel was then made and the clearing of the main tunnel to the heading started. The main tunnel has suffered somewhat on account of the action of the long storage of water, the full extent of which has not yet been determined.

Timbered and untimbered sections have been affected, and it will probably be sixty days before the heading is reached.

The cost of driving 6,215 ft. in the the south portion was $26.16 per foot, including the cost of timbering 1,075 ft., distributed as follows:

Administration	$ 1.55
Labor	12.15
Power	2.98
Explosives	2.35
Timber	.57
Track and pipe	1.41
Miscellaneous supplies	3.30
Drill parts	1.32
Bonus	.53

THE DURABILITY OF GROUTED GRANITE PAVEMENTS.*

By William A. Howell.

In the city of Newark, N.J., on November 1 there were 12.54 miles of completed grouted granite pavement covering 235,825 sq. yd., laid under public contract at a cost, including inspection and advertising, of $922,214. About 0.8 mile of this pavement has been in service three years and 3⅔ miles is at least two years old. The important part of the work of producing a satisfactory grouted granite pavement, with close joints, is the preparation and application of the grout mixture. In Newark the specifications for grouted granite pavements are those adopted by the Association for Standardizing Paving Specifications. The grout mixture must be at least as rich as one part of cement to one part sand; the exact proportions depend upon the hardness of the granite used, and this quality should be ascertained by experiment so as to produce a grout which will wear down uniformly with the granite.

The very hard granites are not well adapted to this type of pavement, but there is no question as to the durability of the grouting where comparatively soft granite is used and where the specifications are rigidly adhered to. Horses very seldom fall on grouted granite block pavement, even when the grades are moderately steep. The grouted granite pavements in Newark are wearing exceedingly well under heavy traffic, and even along street railway tracks the results are good. The New Hampshire granites appear to give the best satisfaction, for they are soft enough to wear down without polishing and becoming slippery.

To secure good grouted pavement of granite blocks, the following points should be kept in mind: Be sure the sub-grade is well rolled and all soft places eliminated. The concrete base should not be too rough and there should be a uniform thickness of 2 in. of sand under the blocks. The blocks should be carefully culled and well rammed. A small percentage of loam in the sand, not over 5 per cent., is desirable as a builder. The sand and cement should be mixed in the proper proportions, and the mixture should be continually agitated. The blocks should be thoroughly sprinkled immediately before grouting. Grouting should not be attempted during cold weather; good results are seldom secured after November 15 in the latitude of New York City. If grouting is done during very hot weather the finished work should be covered with ½ in. of sand and kept moist. Traffic should be kept off grouted pavements for at least seven days after completion. The use of a moderately soft granite, similar to New Hampshire granite, is recommended.

---

* Abstract of paper delivered before American Society of Municipal Improvements, Nov. 12-15.

FACTORY GROWTH IN WESTERN CANADA.

Some figures relative to factory growth in Western Canada are given and are of interest, showing as they do that real estate is not the only form of investment open to the residents in that section.

Manitoba.

(1910 Compared with 1905).

	Per cent.
Establishments: Increase	24
Capital: Increase	74
Employees: Increase	70
Salaries and wages: Increase	100
Value of products: Increase	90

Saskatchewan.

(1910 Compared with 1905).

	Per cent.
Establishments: Increase	116
Capital: Increase	77
Employees: Increase	125
Salaries and wages: Increase	170
Value of products, Increase	151

Alberta.

(1910 Compared with 1905).

	Per cent.
Establishments: Increase	142
Capital: Increase	432
Employees: Increase	241
Salaries and wages: Increase	265
Value of products: Increase	266

Manitoba.

The following tabulates the specific details:—

	1900.	1905.	1910.
Establishments	324	354	439
Capital	$ 7,539,691	$27,517,297	$47,941,540
Employees	5,219	10,333	17,325
Salaries and wages	$ 2,419,549	$ 5,909,971	$10,912,866
Value of products	$12,927,439	$28,155,732	$53,673,609

Saskatchewan.	1905.	1910.
Establishments	80	173
Capital	$3,973,075	$7,019,951
Employees	1,444	3,250
Salaries and wages	$ 721,875	$1,936,284
Value of products	$2,520,172	$6,332,132

Alberta.	1905.	1910.
Establishments	120	290
Capital	$5,545,821	$29,518,346
Employees	2,045	6,980
Salaries and wages	$1,167,107	$ 4,365,661
Value of products	$5,116,782	18,698,826

SUBWAY AND BRIDGE COSTS.

A reinforced concrete highway bridge spanning two railway tracks, waterproofed, paved with vitrified brick and designed for a moving weight of 100 lbs. per sq. ft. of floor area, or a 10-ton road roller, can be built for $1.65 per sq. ft. of floor, including the spans, supports and ordinary foundations, according to a statement made by H. N. Rodenbaugh, assistant engineer, Southern Railway, Atlanta, Ga., in a paper read before the Engineering Association of the South. Such a structure is only slightly higher in first cost than the typical steel girder bridge of similar capacity with a wooden floor, which costs about $1.50 per sq. ft. of floor area complete. A very satisfactory wooden Howe truss bridge of modern design has been built by one railway at a total cost of $45 per sq. ft. of floor area, and as between the latter two structures. Mr. Rodenbaugh very much favors the wooden bridge. Commenting on shallow floors, which are very common in subway design, he states that a typical open floor—that is, one having ties resting on steel stringers without ballast—will have a depth from base of rail to under clearance of about 3 ft. 4 in., and will cost about $1.20 per sq. ft. of floor area. A transverse steel I-beam construction with ballasted deck on flat plates will have for the same span a depth of 3 ft. 1 in., and will cost about $1.90 per sq. ft. of floor area. A transverse steel rectangular trough floor will have a depth of 2 ft. 10 in., and will cost about $2.50 per sq. ft. of floor area. The last two designs are assumed to have waterproofed floors with a minimum of 8 in. of ballast under the ties, the cost given being for the steel work only.

INCREASED PRODUCTION OF STRUCTURAL MATERIALS

Canada's mineral production includes these important and valuable structural materials:—Cement; clay products of various kinds, such as brick, sewerpipe and tile pottery, etc.; lime; sand-lime brick; sands and gravels; slate; and stone for building and other purposes, including granite, marble, limestone, sandstone, etc. No complete record of production of sands and gravels throughout Canada has been obtained, but statistics of exports are published. The statistics of stone production do not include the stone used in making cement or lime, but are as complete as possible for all other established stone quarries; but there is a large production of stone for foundation work, road-making, and railway construction of which no record is available.

The total value of the production of these structural products in 1911 according to the record obtained was $22,709,611, as compared with a value of $19,627,592 in 1910, an increase of $3,082,019, or 15.7 per cent. The total production in 1909 was valued at $16,533,349, as compared with which the 1910 production showed an increase of $3,094,243, or 18.7 per cent.

The Canadian consumption of products of this class is apparently increasing at an even more rapid rate than the production. The consumption based upon the above figures of production in conjunction with the record of exports and imports was in 1911 only a little less than $30,000,000, as against about $25,250,000 in 1910 and $20,350,000 in 1909, the increase in 1911 being 18 per cent. and in 1910, 24 per cent.

The large increase in production and consumption of structural materials is only a natural accompaniment of the great national development taking place in Canada. The normal growth of population supplemented by the large immigration now constantly in progress has resulted in a great wave of construction in the building up of cities, the construction of railways, highways, and public works of all kinds.

The building permits issued in a number of the principal cities and towns are but one proof of this growth.

Building permits in thirty-four cities in 1911 aggregated nearly $32,000,000 in value, as against $29,000,000 in 1910, an increase of over 28 per cent. and the year 1910 shows a similar increase over 1909 in permits issued of nearly 46 per cent.

A summary of the production of structural materials and clay products since 1907 is shown below:—

	1907 $	1908 $	1909 $	1910 $	1911 $
Cement	3,781,371	3,709,954	5,345,802	6,412,215	7,644,537
Clay Products	5,772,117	4,500,702	6,450,840	7,629,956	8,359,933
Lime	971,595	712,947	1,132,756	1,137,079	1,517,599
Sand-lime Brick	167,795	152,836	201,650	371,857	442,427
Sand & Gravel (exp'ts)	119,853	161,387	256,166	407,974	408,110
Slate	20,056	13,496	19,000	18,492	8,248
Stone	2,027,262	2,088,613	3,127,135	3,650,019	4,328,757
Total	12,863,049	11,339,955	16,533,349	19,627,592	22,709,611

The increase in the value of cement sales in 1911 over 1910 was 19 per cent.; clay products show an increased production of 9.6 per cent.; stone an increase of 18.6 per cent.; lime an increase of nearly 29 per cent.; sand-lime brick an increase of 15.6 per cent. The production of slate is at no time large, but shows a falling off in 1911.

The export of products of this class is comparatively small being valued at only $484,047 in 1911, of which over 90 per cent. was made up of sand and gravel. The imports, on the other hand, aggregated $7,710,552 in value, and included Portland cement, $834,876; clay products, $5,156,544; lime, $161,985; sand and gravel, $246,613; slate, $169,685; and stone, $1,140,846.

CANADIAN CAR AND FOUNDRY REPORT

Gross sales amounting to $16,500,000 are shown in the Canadian Car and Foundry Company's third annual report, and the profits for the year available for dividend purposes after providing for the first instalment of the bond sinking fund, as shown by the profit and loss account, were $1,040,000.

At the close of the fiscal year, the unfilled orders amounted in value to over $15,000,000, and at the date of the report the value of unfilled orders is $16,000,000.

An analysis of this year's statement shows that the total capital assets have grown from $11,607,734.91 to $13,384,212.65. The current assets have increased from $5,217,699.36 to $7,334,492.82. The capital liabilities amount to $15,088,306.67 as against $13,875,000 in the previous report. Current liabilities are increased $1,784,710.90 to $3,561,418.79. An increase of $383,932 is given in the balance carried forward.

A further increase in working capital is shown will be a need of the company, but until the Fort William plant is completed the directors prefer temporary banking accommodation to supply the requirements.

The comparative figures for 1912 and 1911 of the company's assets and liabilities follow:

Assets.

	1912.	1911.
Property account	$10,652,747.95	$10,147,297.41
Investment account	2,621,299.39	1,460,437.50
Cash in hands of trustees for bond sinking fund	275.31	....
Current assets	7,334,492.82	5,217,699.36
Deferred charges to operations	188,396.25	199,918.01

Liabilities.

Capital stock	$10,075,000.00	$ 9,975,000.00
Bonds	3,933,306.67	3,500,000.00
Platt & Letchworth Co.	780,000.00	....
Purchase money notes	400,000.00	400,000.00
Canadian Steel Foundries Bonds	3,650,000.00	3,650,000.00
Current liabilities	3,561,418.79	1,784,710.90
Reserve funds	707,219.47	309,307.14
Surplus	1,440,266.00	1,056,334.00

When the Fort William works are finished the company will own eight complete plants, in addition to the Rhodes-Curry building and contracting business, extending from Sydney, Cape Breton, N.S., to Fort William, Ontario, and will probably be the most self-contained car building company in the world, manufacturing, as it does, nearly everything that enters into the construction of railway cars.

The number of employees on the pay rolls and its subsidiary companies at the present time is about 7,500, and this number will be materially increased when present enlargements are completed and the Fort William Works are in operation. The pay-rolls aggregate about $500,000 per month.

◆

The Canadian Porcelain Company, Limited, has been incorporated with a capital stock of $300,000 to manufacture vitrified white porcelain for electrical and other purposes. They have purchased a 20-acre site in Hamilton, Ontario, and will erect a plant, the first unit to cost $150,000. The buildings will be of steel and brick and will be ready for operations next spring. Messrs. John Alden and Chas. Palmer, of Rochester, N.Y., and Mr. Fred D. Palmer, of Galt, Ont., are the principal directors.

COAL OF THE UNITED STATES.

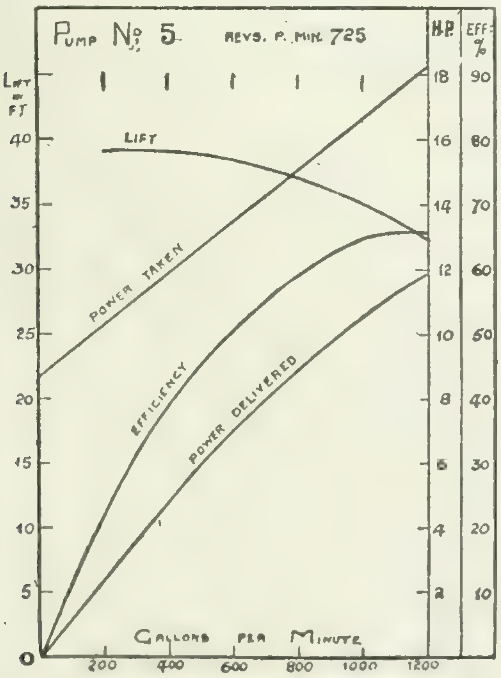
The known coal fields of the United States embrace a total area, according to the U.S. Geological Survey, of 310,296 sq. mi., to which may be added something over 160,000 sq. mi., of which little is known, but which may contain workable coals, and about 32,000 sq. mi. where the coal lies under heavy cover and is not considered available under present conditions. The supply of coal before mining began is estimated to have been 3,076,204,000,000 short tons, of which 1,922,979,000,000 tons were considered to be easily accessible and 1,153,225,000,000 short tons to be either so deep or the beds so thin that they are accessible only with difficulty. Classified according to the character of the coal, the original supply consisted of 21,000,000,000 short tons of anthracite, 1,661,457,000,000 tons of bituminous coal, 650,157,000,000 tons of sub-bituminous coal, and 743,590,000,000 tons of lignite.

The total production of coal to the close of 1911 has amounted to 2,270,798,737 short tons of anthracite and 6,468,773,690 tons of bituminous coal, or an aggregate of 8,739,572,427 tons. This total production to the close of 1911 represents including the waste of coal in mining, an exhaustion of the beds equal to 14,181,980,000 short tons, or somewhat less than 0.5% of the original supply. In other words, the quantity of coal still remaining to be mined amounts to 3,062,022,020,000 short tons, or a little more than 99.5% of the original supply. The annual rate of exhaustion at the present time as represented by the production in 1910 and 1911 is 0.025% of the supply. The quantity of coal still in the ground at the close of 1910 was 6,000 times the production of that year, or, estimating a half ton of coal lost for every ton recovered, the supply is equivalent to 4,000 times the present annual rate of exhaustion.

◆

THE STEREOPHAGUS PUMP IN OPERATION.

An eight-inch Stereophagus pump, manufactured by Messrs. Hathorn, Davey & Co., Limited, of Sun Foundry, Leeds, has been installed at The Knostrop Sewage Purification Works, of Leeds, England, with the object of testing its action under conditions exactly parallel with those prevailing with the centrifugal pumps of ordinary type now in use.



The Stereophagus pump is placed in such a position that its suction pipe dips into the stream of crude sewage issuing from the main sewer before the sewage is subjected to any screening or treatment whatever. A quantity of sewage, amounting to 500 gallons per minute, is lifted by the Stereophagus pump and deposited into a tank where it can be examined and measured.

The remaining sewage is passed on to the main centrifugal pumps, which are of large size, but before arriving at these pumps the sewage is carefully screened, so as to remove from it all substances likely to impede the action of these pumps. In spite of this, however, they require opening out for cleaning almost daily, while the Stereophagus pump, on the other hand, has not once needed cleaning, although the sewage pumped by it is unscreened.

The Stereophagus pump, which is driven by an electric motor, gave, when installed, an efficiency of over 60 per cent., as is shown by fig. 1, and that this has been maintained is proved by the fact that the quantity of sewage delivered is undiminished. The speed of the pump, and consequently the power, have, therefore, remained constant, showing an unimpaired efficiency in the pump, although during the trial a considerable amount of road grit has passed through it.

The Stereophagus Pump and Engineering Co., Ltd., 39 Victoria St., Westminster, S.W., have acquired from the Hon. R. C. Parsons the rights for the sale in Great Britain and abroad of the Stereophagus pump which was patented by him. They therefore control the Canadian rights.

◆

CANADA SOUTHERN RAILWAY BOND ISSUE

The holders of the first and second mortgage bonds of the Canada Southern Railway Company are being given the opportunity to reinvest the proceeds resulting from the payment of their maturing bonds in the company's new issue of $22,500,000 consolidated guaranteed fifty-year 5% gold bonds, Series A, dated October 1, 1912, and maturing October 1, 1962, at 105¾ and accrued interest, for each $1,000 bond of the new issue. At this price the new bond, if held to maturity, yields approximately 4.70% per annum. Messrs. J. P. Morgan & Company are authorized to handle the matter.

The consolidated guaranteed fifty-year 5% bonds upon the payment early in 1913 of a total of $20,000,000 first and second mortgage bonds now outstanding will become a direct first mortgage lien upon all of the property of the Canada Southern, except for the first mortgage of $130,000 upon the Leamington Branch, about fourteen miles in length.

Subject only to this divisional issue, the consolidated mortgage bonds after March 1, 1913, will be a first mortgage upon the 380 miles of railway lines extending with branches from the Niagara to the Detroit River. Two hundred and twenty-six miles are standard double-track trunk line railway of exceptional strategic importance, being the integral indispensable part of the Michigan Central Railroad Company route, connecting the manufacturing and distributing centres of Buffalo and Detroit, and forming with the Detroit Tunnel Company and the Michigan Central Railroad Company a part of the shortest line of the New York Central system from New York to Chicago.

The property of the Canada Southern Railway Company includes the entire main line between Suspension Bridge, Ontario, and Windsor, Ontario, opposite Detroit, with branches running to Courtright, Leamington, Amherstburg, Old Fort Erie and Niagara-on-the-Lake. Its road is of modern construction, with low gradients, easy curve, and is equipped with electric automatic block signals, etc. The lines of the Canada Southern were leased to the Michigan Central Railroad Company for a period of 999 years from January, 1904.

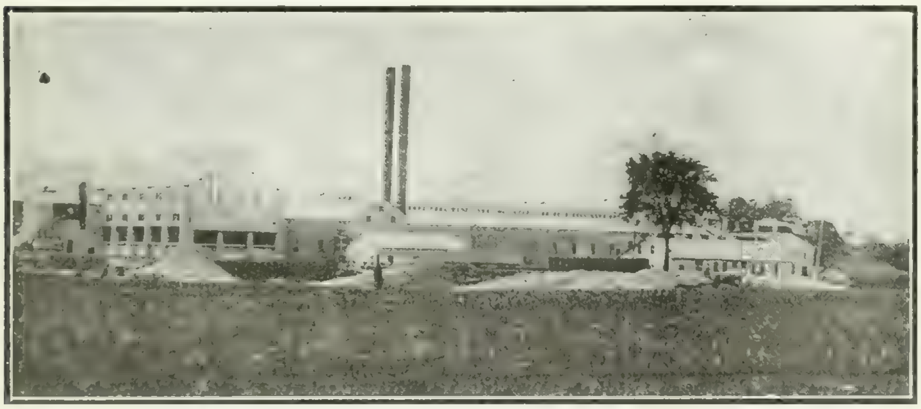
THE PLANT OF THE ST. MARY'S PORTLAND CEMENT COMPANY.

The plant of the St. Mary's Portland Cement Company is located at St. Mary's, Ontario. Its daily capacity is 1,500 barrels, and storage capacity has been provided for 75,000 barrels.

The illustration shows the buildings, but the photograph was taken before they were completed.

The quarry for limestone and the clay beds are contiguous to the mill. The plant is operated by hydro-electric power, 550-volt, 25 cycle, three-phase current being used. The company have their own substation, and find the power very satisfactory.

At the raw end a No. 8 Kennedy crusher is set over a No. 5 Jumbo Williams mill. The limestone is crushed by this to 1½ inches down. The clay is washed as it goes to the mill. The machinery includes two large size kominuters with Trix separators; two large size Smidth tube mills, and five concrete tanks. The kilns are two in number, and are 8 ft. by 160 ft. The coal is brought in on elevated tracks, is dried in a Cummer dryer, and is ground in a 42-inch Fuller Lehigh mill. Two coolers, 6 ft. by 70 ft., are provided, with a fan attachment which is used for blowing the cold air in at the lower end and using the hot air from the upper end of the cooler both for the kilns and drying the coal.



View Showing Plant of the St. Mary's Portland Cement Company During Construction.

In the finished product end, there are three Dreadnought Fuller Lehigh mills for finishing the cement.

The mill is provided with two electric cranes, one in the raw end and the other for handling the clinker. For shipment by rail, the company has both Grand Trunk and Canadian Pacific Railway connections.

The president of the St. Mary's Portland Cement Company, Limited, is Mr. Geo. H. Gooderham, and the secretary-treasurer is Mr. Mark H. Irish, both of Toronto. Mr. John G. Lind, the manager of the plant, is located at St. Mary's.

ROLLING STOCK FOR THE C.P.R.

The Canadian Pacific Railway will spend $18,000,000 in new rolling stock ordered this year. This money will secure them 467 locomotives and 28,671 cars of various descriptions. When this large order is completed the company will have in commission [illegible] locomotives and 98,804 cars. The new locomotives ordered cost nine millions, the balance of forty-eight millions being expended for cars of various kinds. This equipment will be operated over a trackage of more than 12,500 miles.

PANAMA CANAL TOLLS

Now that President Taft has proclaimed the basis of the Panama Canal toll rates to be paid by foreign shipping and ships under the American flag trading with foreign ports, steamship men in the New York shipping offices are busy figuring out estimates of what total sum an average ship may have to pay.

Owing to the many technical considerations involved it has been impossible for shipowners to make their calculations with any degree of assurance.

The provisions of the proclamation as regards merchant vessels are:

On merchant vessels carrying passengers or cargo, $1.20 per net vessel ton—each 100 cubic feet of actual earning capacity.

On vessels in ballast without passengers or cargo, 40 per cent. less than the rate of tolls for vessels with passengers or cargo.

This still leaves many important points still in doubt, and the proclamation must be taken as merely the preliminary announcement, since the rules for the measurement of vessels have still to be drawn up by the Secretary of War. Until it is known definitely whether the Panama rules of measurement will follow the British, American or Suez Canal systems of measurement for calculating the net vessel tonnage, only rough estimates can be made.

The basic rate is made to correspond closely to the Suez Canal toll, the $1.20 being practically the equivalent of the 6.75 francs, the rate which is to become effective on the first of the new year, showing a reduction of 50 cents from the present toll. It is probable that the American system of measurement will be followed, and as the American measurements come nearer to the Suez rules than to the British some clue may be obtained from ships which have the American measurement as trading with this port and have actually paid Suez Canal dues.

A steamship company's agent, in speaking of the subject, said that he was engaged on making mileage and tonnage calculations so that he could form some judgment on what it would cost his boats through the Panama Canal in order to compare the relative expenses of the alternative routes, namely, through the Straits of Magellan or by the Panama Canal. He said: "No positive or definite working criterion can yet be made. Only a rough approximation is possible, but every line knows what the net register means sufficiently to be able to take it as a guide. The American government assesses its tonnage dues on a given measurement capacity known as the American net register, and this, as I understand it, will be the measurement used in the rules to be issued by the government.

"The British net register is less than the American owing to a different basis of calculation. The British measurement does not include every available space that might be used for cargo such as extended bridge compartments, etc., but exempts those spaces when they are not used for cargo. The American measurement charges for those spaces whether used or not. It is an important technical point that should a vessel at any time go through the Suez Canal with merchandise of any kind, or lumber, coal, or stores of any description, the whole of that space is added to the net tonnage and can never more be exempted from measurement.

"The consumption of coal and the use of temporary or permanent bunker space are important items in the calculation, and shipowners using the canal for their boats will probably have to allow for permanent bunkers, as they will wish to make use of every foot of space for the cargo the ship can carry."

Another New York shipowning firm gave as a specific instance the case of a steamer having a measurement capacity of 392,958 cubic feet. Allowing 100 cubic feet as the arbitrary unit for a register ton the amount of the toll to be paid, at the rate of $1.20 a ton, would be $4,716.

Professor Emory Johnson, in his evidence, January 30, 1912, before the House Committee on Interstate and Foreign Commerce, printed in Volume II. of the Hearings, gave this rule for determining the net register tonnage of a vessel:

"There is deducted from the entire capacity of the hull the space occupied by the crew, master's cabin, steering and anchor gear below deck, boatswain's stores, chart house, and spaces occupied by propelling power (engines, boilers, shaft, tunnel, fixed coal bunkers). These deductions having been made, the net registered tonnage is ascertained by dividing the number of cubic feet in the remaining space by 100. In an up-to-date freight steamer, as measured by British, American or German rules, the net register is somewhat less than two-thirds the gross register. In the case of a high speed passenger vessel, so much of the ship is taken up with propelling machinery, fixed coal bunkers, crew space, etc., that the net register tonnage may be less than half, sometimes not more than one-third of the gross register."

To this evidence of Professor Johnson, it may be added, were appended exhibits showing tables of distances via the Panama Canal and alternative routes, number of days saved from various ports, Suez Canal data, comparative data of a ship, the Santa Rosalia, built in 1911, showing net tonnage on all three systems, viz.: British, 3,488; American, 4,392; Suez, 4,452; average price of coal at Panama and detailed statements on the relation of tolls to the volume of Panama Canal traffic.

RAILWAY RECEIPTS AND EXPENSES FOR SEPTEMBER.

The business of the railways for September while showing a considerable improvement over that of September, 1911, does not maintain the rate of increase set by the record-breaking month of August. The total net operating revenue of 90 per cent. of the steam railways increased $5,896,840 for September, while the increase for August was $13,865,622. This increase in net operating revenue was at the rate of $21 per mile of line for the month or at the rate of 70 cents per mile of line per day.

The total operating revenues per mile of line for the month increased 6.5 per cent., the operating expenses 7.3 per cent. and the net operating revenue 5.1 per cent.

The foregoing statistics are from the summary made by the Bureau of Railway Economics from the reports of the railways to the Interstate Commerce Commission. A special committee of the railways having headquarters in Chicago reports that bills now pending in the Federal Congress providing for an increase in the number of employees of the railways and for the rapid substitution of steel for wooden equipment will, if enacted, place the railways under an additional expense of approximately $12,000,000 per annum for the former, and a total expense of $632,746,000 for the latter purpose. Without compulsion, the railways in the course of three years have increased their steel equipment 750 per cent. and their steel underframe equipment 256 per cent.

UNIT COSTS OF FILTERING WATER IN FOUR SLOW SAND PLANTS AT PHILADELPHIA.

The data here given with reference to the unit costs of filtering water in four slow sand plants at Philadelphia are abstracted from the annual report of the Bureau of Water for 1911. The Queen Lane plant was not put in service until the first of December, so no results are here given for that plant. The costs and other operation data follow for the four plants in service in 1911:

Upper Roxborough Filters.—This plant comprises a storage reservoir giving a sedimentation period of 9.71 days, eight covered filter beds, and a covered clear water basin. The average rate of filtration throughout the year was 238,000,000 gals. per acre per day. The average cost of filtration was $2.98 per 1,000,000 gals., which included 65 cts. per 1,000,000 gals. for the laboratory cost. The average cost given includes all items connected with the operation of the station, but does not include the cost of pumping water from the storage reservoir to the filters. The average number of cleanings for the year was five for each filter. The average amount filtered between cleanings was 159,320,000 gals. per acre. The filters were washed for the entire year by the Brooklyn method. The cost of labor and wash water was 57 cts. per 1,000,000 gals. of water filtered, and 1,870 gals. of wash water were required per 1,000,000 gals. filtered. The results of the preliminary sedimentation in the storage reservoir are very good, the turbidity being reduced from 45 to 17 by the sedimentation. The filter removed 99.9 per cent. of the bacteria in the raw water drawn from the Schuylkill River.

Lower Roxborough Filters.—This plant consists of a storage reservoir which gives a sedimentation period of 1.29 days, five covered filter beds, eleven preliminary filter tanks, and a covered clear water basin. The average rate of filtration was 3,800,000 gals. per acre per day. The filters were operated at a rate of 508,000,000 gals. per acre per 24 hours. The cost of operation, including the preliminary filters, but not including the cost of the wash water, was $5.55 per 1,000,000 gals. filtered. This figure includes 85.4 cts. for laboratory expense. The preliminary filters were operated at an average cost of $2 per 1,000,000 gals. of water filtered by the sand filters. The sand filters were washed for the entire year by the Brooklyn method, the number of washings averaging 12.8 per filter. The average time between scrapings was 26.2 days, and the average amount filtered between cleanings was 107,550,000 gals. per acre. The average reduction of the bacteria in the raw water was 99.73 per cent. The corresponding figure for reduction of turbidity was 99.82 per cent. These figures refer to the complete treatment.

Belmont Filters.—This station is composed of a sedimentation basin giving 1.69 days' sedimentation, preliminary filters consisting of 9 filter tanks having a capacity of 40,000 gals. per 24 hours, 18 covered sand filters, and a covered clear water basin. The filters were operated at an average rate of 293,000,000 gals. per acre per 24 hours. The preliminary filters were started on October 23, 1907. They were operated at a rate of 75,000,000 gals. per acre per 24 hours this year, and have materially increased the length of runs or time between scrapings of the slow sand filters without any decrease in efficiency.

The cost of operation was $2.90 per 1,000,000 gals. filtered, which included a charge for operation of the preliminary filters and for laboratory expenses, the cost of preliminary filtration being 52 cts. per 1,000,000 gals. and the laboratory charge 33 cts. per 1,000,000 gals. The reduction in turbidity and bacteria by the action of the preliminary filters was 44.4 per cent. and 48.0 per cent., respectively.

There were 151 runs or cleanings during the year; 142 of these runs were on filters cleaned by the Brooklyn method and nine by the other methods. The average length of runs was 40.18 days, the amount filtered between runs being 94,146,000 gals., or 125,194,000 gals. per acre. While the length of runs and quantity filtered with the Brooklyn method was not so large as with the usual method, it proved economical on account of the short time it was necessary to have the bed out of service, the low labor cost of cleaning and the saving in not having to replace the sand.

Seventeen filters were operated for the entire year by the Brooklyn method. The items of cost, etc., in the process of cleaning were as follows.

Number of runs	142.
Average length of runs, days	40.4
Average m. g. filtered per run	94.53
Average m. g. filtered per acre per run	125.71
Average cost of water to wash per m. g. filtered	0.05
Average cost of labor to wash and spade per m. g. filtered	0.55
Total cost of washing and spading sand in place (water and labor) per m. g. filtered	0.60
Average gallons water used to wash sand in place per m. g. filtered	4,109

One filter yas operated during the year by the "Nichols Separators" method.

Number of runs	9.
Average length of runs, days	37.38
Average m. g. filtered per run	88.02
Average m. g. filtered per acre per run	117.05
Average cost of labor, scraping, raking and spading per m. g.	0.262
Average cost of labor washing per m. g. filtered	0.266
Average cost of water per m. g. filtered	0.02
Average cost per m. g. labor, spading, scraping, washing, water, etc.	0.55
Average gallons of water used to wash per m. g. filtered	1.336
Depth of sand scraped per run, inches	1.42
Cu. yds. sand scraped per m. g. filtered	1.590
Daily average turbidity of applied water	14.0
Daily average bacteria in applied water	21.630

Comparing the effluent from the Belmont filters with the applied water, the reductions were as follows:

	Per cent.
Average reduction, turbidity	99.34
Average reduction, bacteria	99.19

Comparing the efficient from the plain sand filters and the water from the Schuylkill River, the reductions were as follows:

	Per cent.
Average reduction, turbidity	99.74
Average reduction, bacteria	99.66

A Blaisdell Filter Washing Machine installed in 1909 for cleaning the preliminary filters has been in operation for the entire year, and has been of great benefit to the filters.

Torresdale Filters.—The Torresdale Filter Station consists of 65 0.75 acre covered beds, a covered clear water basin, preliminary filter plant consisting of 120 concrete tanks, approximately 60 x 20 ft. each, containing 1,140 sq. ft. of filtering surface, with a capacity of 240,000,000 gals. of water per 24 hours; a low lift pumping station, containing eight 40,000,000 gal. centrifugal pumps; three 150 kw. generators and four sand washing pumps, with full complement of boilers, economizers, mechanical stokers, etc.

The amount of water filtered during the year was equivalent to an average rate of 4,270,000 gals. per acre per day. The entire cost of operation, not including the expenses of the low lift pumping station, or the cost of the wash water, which are included in the expenses of the pumping station, and which amounted to $2.17 per 1,000,000 gals. of water filtered, was $1.66 per 1,000,000 gals. of water filtered, making the total expense of pumping the water from the river and filtering it, $3.83 per 1,000,000 gals. filtered, a reduction of 16 cts. over 1910. Of this amount 28 cts. was for operating the preliminary filters, and 16.8 cts. the cost of the laboratory. The filters are operated at rates approximating 6,000,000 gals. per day per acre.

The number of runs or cleanings was less than ten per filter per year, and the average length between cleanings was 35.33 days.

The standard method of cleaning adopted for 1911 was washing the sand in the filters by ejectors and Nichols Separators, the cost of which was as follows:

Number of cleanings by Nichols method	613.
Average lengths of runs, days	35.31
Average m. g. filtered per run	121.21
Average m. g. filtered per acre per run	161.61
Cost of water to wash per m. g.	0.01
Cost to rake, scrape and wash per m. g., labor	0.62
Total cost to clean	0.63
Average gallons water used to wash per m. g.	1,924.
Cubic yards scraped per m. g. filtered	1.62
Average turbidity of applied water	5.
Average bacteria in applied water	2,610.

The resanding was done during the year by Bureau labor, using Nichols Separators. There were replaced 11,017 cu. yds. in filters, at a cost of 30.6 cts. per cu. yd.

Comparing the effluent from the Torresdale final filters with the water taken from the Delaware River, the reductions were as follows:

	Per cent.
Average reduction, turbidity	99.58
Average reduction, bacteria	99.67

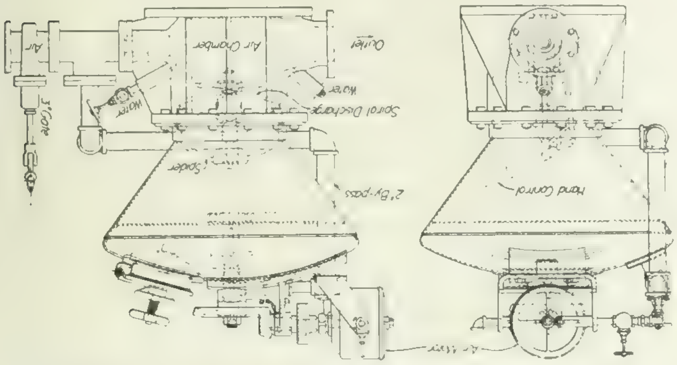
The Torresdale preliminary filters were placed in service on January 21, 1909, and since this date all water filtered by the sand filters has passed through these filters. They normally filter at the rate of 80,000,000 gals. per acre per day, but have given satisfactory results from rates of 100,000,000 gals. per acre per day. The daily average reductions in turbidity and bacteria for the year were 66.98 and 65.45 per cent. respectively. The average turbidity of the applied water to the pre-filters was 16 and the maximum 97. The per cent. of wash water used for the year averaged 0.57 per cent. of the amount filtered. The number of cleanings for the pre-filters was an average of 190 cleanings to each filter, or about 1.9 days between cleanings for the year.

GRAND TRUNK AND NEW HAVEN RAILWAYS.

In connection with the proposed traffic agreement between the Grand Trunk and the New York, New Haven & Hartford, it is stated that the final settlement of the points at issue is remote. The agreement is still in the hands of Mr. E. J. Chamberlin, president of the Grand Trunk, and his officials, and any changes which they may consider necessary will have to be submitted to the directors of the New Haven and approved by them. When all interested parties in Montreal and New York are in accord, the agreement must then be sent to London for ratification by the Grand Trunk board of directors. It is felt that all difficulties will be overcome in time since some kind of arrangement between the two roads is desirable for both.

IMPROVED DEVICE FOR DELIVERING CONCRETE.

The management of the firm of W. Van Whitall, New York, are the perfectors of a new system for concrete distribution by means of compressed air furnished by a blower as illustrated in the accompanying illustration. The blower consists of a steel drum or receiving hopper bolted to a cast steel discharging pan. A shaft, passing through the drum, is connected by suitable gears and bevel to an Ingersoll-Rand four-piston air motor. The air is admitted through a hand-controlled valve to a flanged pipe leading directly to the air chamber. A 2-in. by-pass leading to the air motor is placed in this pipe in front of the air chamber. In this way the operation of the machine starts simultaneously with the admission of air to the line. Globe valves are placed on this by-pass line to permit of proper control of the pressure. Water is admitted through two connections at the front and back of the air chamber. The concreting materials are spread in alternate layers of stone, cement and sand and shoveled directly into the drum. As they pass from the latter into the air chamber the water spray is encountered and the combination of air and water results in a thorough mixing.



Blower for Transporting Concrete by Compressed Air.

◆

CROSS-WISE BENDING TESTS OF RAIL FLANGES.

The failure of the rail which caused the wreck on the Wabash Railroad near West Lebanon, Indiana (U.S.A.), on March 7th, seems to have been caused by the seaminess of the metal in the base of the rail. Mr. James E. Howard, engineer-physicist of the United States Bureau of Standards, in a report of his investigation issued by the Interstate Commerce Commission, writes: "The steel was seamy, and the initial line of rupture occurred along the line of a seamy streak. Herein is exhibited a structural defect which is prevalent, to a marked degree, in many rails. It is a defect, the presence of which is well recognized and admitted. Notwithstanding these circumstances, rails are accepted under specifications and tests in which this, the most comman cause of breakage, is not guarded against." Mr. Howard mentions the fact that this seaminess of the metal can be revealed by cross-wise bending of the flanges. About 27 per cent. of the head of the rail in question was worn down, and careful track inspection should have revealed this, but the seamy streak in the base, which, no doubt, caused its rupture, could not have been detected by inspection. As the author states, this was a defect of manufacture which current specifications and tests are not adequate to discover, though not less than 80 per cent. of broken rails reported, covering certain periods, are of the type here encountered.

COMPRESSED-AIR SEWAGE DISPOSAL.

Some interesting details concerning the compressed-air plant for removing the sewage of the small town of Allenstein, in Eastern Prussia, are given by R. Luckhardt, the director of the municipal gas and waterworks of the town, on the strength of thirteen years' experience. The town of Allenstein, though still a small country place of not more than 35,000 inhabitants, has rapidly grown in the last four decades; in 1870 the population barely amounted to 6,000 people. The River Alle, on which the town is situated, runs through a hilly country, and there are level differences of more than 100 ft. in the main streets. The Shone system of canalization having been shown at the Berlin Trade Exhibition of 1896, its municipality sent a committee over to England to study this system, and the contract was entrusted to the Gesellschaft Hydow, of Berlin. The plant was completed in 1899. There were difficulties at first, but on the whole the system has answered, and, as little has been published on the subject, Luckhardt's report in the "Zeitschrift des Vereines Deutscher Ingenieure" of November 2nd, 1912, will be found of interest. The working expenses amount to 0.67 mark per head per year, and the annual cost of the whole plant, including interest and depreciation and settling-tanks is estimated at 2.66 marks (58 cents) per head.

◆

LARGE GAS ENGINE ORDERS.

The Mesta Machine Company, Pittsburg, Pa., have received two orders for gas engines in the past month which are worthy of particular mention on account of some features not usually encountered in this class of work.

The first order comprises three single tandem, horizontal double-acting, four-cycle engines, having cylinders 28-inch diameter by 36-inch stroke, to operate at a speed of 150 r.p.m., each arranged to drive direct connected a 500-kw., 60-cycle, 3-phase, 600-volt, alternating current generator. These engines are to be installed by the Canadian Car and Foundry Company, at their new Fort William, Ontario Province, plant, and will be the largest producer gas engine plant in Canada.

The main gas plant consists of four double bituminous coal generator sets furnished by the R. D. Wood & Company,, Philadelphia, Pa. The gas plant was originally intended for fuel gas purposes, but as it is necessary to intermittently change from water gas operation to producer gas it was decided to utilize the waste, or producer gas, for power purpose. This gas will contain more than 10 per cent. hydrogen by volume, and is particularly suitable for use in gas engines.

The fuel gas which will be used for furnace work will have a heat value of 300 B.t.u. per cubic foot, and will contain 50 per cent. H and 30 per cent. CO. The operation of the producers will be such that it will be practically impossible to mix the gases, that is to say, the regulation of the gas will be automatic, eliminating any liability of water gas being carried to the engines. In the use of double generator sets the gas is drawn off the top of one generator and down through the incandescent mass of the other, the tar being consumed and converted into gas, thereby increasing the efficiency of the plant. Soot, of course, will be the resulting deposit. This soot will be disposed of through Thiesen washers.

The other order comprises three engines of exactly the same size for the Alpha Portland Cement Company, Easton, Pa. The engine will be located at Cementon, N.Y., near Catskill, and will operate in parallel with four producer gas engines now in service. Gas is generated through R. D. Wood & Company's superimposed pressure type producers, using bituminous coal as fuel.

COAST TO COAST.

Montreal, Que.—The Montreal harbor revenue for the past season was $461,396.43, an increase of $30,000 over those of 1911.

Calgary, Alta.—Payment of a small fee as rental to the city for the use of the street while building operations are being carried on is being considered by the commissioners.

Brantford, Ont.—Slush and ice clogged the intake of the power house supplying this municipality with light, and as a consequence the town was in darkness during the nights of December 11th and 12th.

Sydney, C.B., N.S.—The output for the Dominion Iron and Steel Company for the month of November was as follows: Coke, 46,660; pig iron, 28,670; steel ingots, 28,010; blooms, 27,060; rails, 15,385; rods, 7,250. Total shipments, 26,520 tons.

Toronto, Ont.—The steady advance in the mineral production of Ontario is strikingly shown by the annual report of the Bureau of Mines for 1911. The total production had a value of $41,976,797, an increase of 6.7 per cent. compared with the previous year. From 1906 to 1911, Ontario's output of minerals increased in value by 87 per cent.

Welland County.—Engineer C. Gardner, who has had charge of the work on the good roads throughout the county, submitted his report to the county council at their last meeting. Five and a half miles of good roads have been built in the county during the past year at a cost of $2,700 per mile. In Bertie township thirty-five days' work was done, in Thorold one hundred and forty-seven days, and in Stamford one hundred and forty-five days.

Dauphin, Man.—The members of the Board of Trade met in session last week, President R. Lilly presiding. The various items of work accomplished, and in hand, were explained, showing much time and labor having been spent in obtaining all particulars for the erection and operation of a hydro-electric power plant at Meadow Portage, where it is estimated 25,000 h.p. can be obtained. Government engineers have interviewed the board and reported favorably, and the city council have now the project in hand with a view of having it installed at the earliest moment. The installation of such a plant will give cheap light and power for manufacturing purposes.

Dauphin, Man.—At the last meeting of the city council a report was brought up by the Fire, Light and Power Committee. It was explained that owing to the rapid growth of the city, the power plant was being worked to its capacity, and it was impossible to undertake any more installations. Various suggestions were made for temporarily relieving the pressure. It was the unanimous opinion of the council that a new plant should be built with three times the capacity of the present outfit, and so arrange that a heating plant be connected for the purpose of supplying heat to the business and residential blocks from the exhaust steam The contractors of the sewerage and water plant were granted an extension of time to complete the few outlaying points that are necessary to finish their contract. Building permits for the month ending November 31st total $135,425, as against $58,255 for the same time last year.

Victoria, B.C.—To raise the status of the logging engineer and to provide for the training of more men for the industry is the object of Mr. G. M. Cornwall, a well-known lumberman, of Portland, Ore., and proprietor of the "Timberman." With such a purpose, Mr. Cornwall called on Mr. F. L. Carter-Cotton, chancellor of the new British Columbia University, recently, to urge upon him the necessity of establishing a course in logging engineering in connection with the university. Mr. Cornwall pointed out that the Pacific Logging Congress was doing its utmost to raise the occupation of logging engineer to the status of a profession, and that the inclusion of a course designed to turn out qualified men from the university would be a great advance.

Toronto, Ont.—On a report by the engineer, Mr. E. L. Cousins, the consulting engineer, Mr. J. G. Sing, and the secretary, Mr. Alex. C. Lewis, regarding the separation of grades along the waterfront, the Toronto Harbor Commissioners unanimously decided that the property of the commissioners would be irretrievably damaged by any of the proposed solutions of the problem other than the viaduct order of the Dominion Board of Railway Commissioners, or by any deviation from the viaduct plans as approved by the board. The chairman, Mr. L. H. Clarke, was given authority to take whatever action he thought necessary to safeguard the interests of the commissioners.

Stratford, Ont.—At a special session the city council, by a unanimous vote, gave the street railway by-law its second reading, and it will go to the ratepayers on January 6th. The by-law grants the Stratford Railway Company a twenty-five-year franchise, and leaves the builders free to obtain their power elsewhere than from the Hydro-Electric Commission if cheaper. It provides for construction to begin by June 1st, 1913, if the by-law is confirmed by the Legislature. The power clause was explained by the city solicitor as requiring the consent of both council and ratepayers before the company can sell of lease electric power in the city. The Canadian Northern Railway, through Sir Wm. Mackenzie, has pledged itself to build the railway.

Toronto, Ont.—The Toronto Railway Company will be asked by the city to place in service 150 new motor cars of approved modern type, as recommended by the transportation experts, Mr. Bion J. Arnold, of Chicago, and Mr. J W. Moyes, of Toronto, in their report, as well as to construct the lines in the older portion of the city suggested by the experts. They state that 150 modern motor cars are required at present to give a reasonable service on the lines. They also recommend that the company be asked to undertake to add new motors as fast as it builds new lines. The experts recommended the extension of Victoria Street north to Bloor Street "at any reasonable cost." They say: "This would prevent the crowding of traffic on either Yonge or Teraulay Street, these three streets offering sufficient transportation facilities for many years to come." The company will be asked to construct and put into operation at once a number of other lines.

GOVERNMENT SHIP RETURNS FROM ARCTICS.

The Canadian Government's ship "Arctic," which left Quebec on June 29th last, under the command of Commander Jackson, returned to Quebec on Saturday, November 16. All on board were well, and there were no complaints made by the members of the crew. The commander said he had been employed most of the time taking surveys in Hudson's Bay Straits, and as a result of the work there would be considerable changes in magnetic variations. He also took soundings and observations for ice conditions. He refused to express an opinion as to the practicability of the Straits as a route for grain.

◆

Fort William's new industrial plants are making much progress toward completion. Additional elevator capacity and harbor facilities are being planned. When these various developments are completed the citizens will be claiming largest manufacturing city of the west.

PERSONAL.

JOHN McGILL has been appointed assistant manager by the Berg Machinery Manufacturing Company, Toronto.

A. S. GOING has been appointed engineer of construction for the Grand Trunk Railway System, with headquarters at Montreal, Que.

GORDON KRIBS, B.A.Sc., graduate of the University of Toronto, formerly assistant to the chief engineer of the Pacific Power & Light Company, Portland, Ore., is now assistant to the chief engineer of the Texas Power & Light Company, Dallas, Texas.

SUPERINTENDENT WHITE, of the Eastern Canada Power and Pulp Company's ground wood mill at Murray Bay, Quebec, has been appointed superintendent of the new one-hundred-ton ground wood mill, which will be erected by the Abitibi Pulp and Paper Mills.

T. R. DEACON, O.L.S., M.Can.Soc.C.E., has just been elected mayor of Winnipeg. Mr. Deacon is a graduate of the University of Toronto in civil engineering of the class of '91, and is president and general manager of the Manitoba Bridge and Iron Works, Limited.

G. SYLVESTER, of Calgary, Alta., has been elected one of the executive of five officers representing the various divisions of the American Association of Manufacturers of Sand Lime Products, the annual convention of which was held at the King Edward Hotel, Toronto, December 3rd and 4th.

ALFRED E. ROSEVEAR, recently appointed assistant to vice-president of the Grand Trunk, with headquarters at Montreal, Que., was born on February 20, 1863, at Montreal, and was educated at Montreal Academy. He began railway work on May 1, 1879, as a clerk in the motive power department of the Grand Trunk. The following year he was made clerk in the general superintendent's office, and from 1885 to 1890 was stenographer in the general manager's office. From 1890 to 1892 he was with the West Shore Fast Freight Line at Chicago and at Detroit, Mich., and then for six years was in the accounting department of the Reading Despatch at Detroit, becoming acting manager of the same line in September, 1898. He was appointed freight claim agent of the Grand Trunk in October, 1898, and in April, 1908, was promoted to assistant general freight agent of the same road, which position he held at the time of his recent appointment as assistant to vice-president.

RICHARD COLCLOUGH, recently appointed assistant to the general superintendent of the Intercolonial Railway and the Prince Edward Island Railway, with headquarters at Moncton, N.B., was born on February 24, 1871, at Bic, Que. After leaving the common schools he attended Rimouski College, and in 1888 graduated with the degree of B.A. from Laval University, Quebec. He began railway work on December 9, 1889, with the International Railway as a clerk in the superintendent's office at Moncton, and has been in the continuous service of that company ever since. From 1892 to November, 1901, he was private secretary to the chief superintendent, then to the general manager, and later to the general superintendent and manager. He was subsequently chief clerk in the manager's office until October, 1902, when he was appointed clerk in the general manager's office and in the office of the managing board. From June, 1911, until the following May he was chief clerk in the general superintendent's office, and in May, 1912, was appointed assistant superintendent of the Halifax & St. John division, which position he held at the time of his recent appointment as assistant to the general superintendent.

S. B. WILLIAMSON, since 1908 division engineer of the Pacific Division of Panama Canal Construction, has resigned his position to enter the service of J. G. White & Co., Limited, international engineers and contractors, of London and New York. Mr. Williamson was called to the canal service by Col. Goethals in May, 1907, as division engineer of the Pacific locks and dams. In his later position he had charge of the construction of the gigantic locks at Pedro Miguel and Miraflores, involving the placing of vast quantities of concrete, extensive dry excavating and dredging; the construction of terminal docks at the Pacific entrance, and municipal work in Panama City, and the Canal Zone south of Culebra. Previous to his work in Panama, Mr. Williamson was engaged in railroad and general construction work in various parts of the United States. He was also in the service of the United States government for some time, and in 1900 was in charge of the fortification work at Newport, R.I. In his new field of work, with J. G. White & Co., Limited, he will be associated with their London office in the capacity of principal assistant engineer, directing construction in all parts of the world excepting the United States and its possessions.

DEATH OF NOTED SCIENTIST.

The death is reported of Sir George Howard Darwin, second son of the famous Charles Robert Darwin, who won notoriety through his lectures and publications along the lines of nature and evolution. Sir George Howard Darwin was professor of astronomy and experimental philosophy at Cambridge University, he was 67 years of age.

FIRE LOSS OF THE UNITED STATES AND CANADA.

The fire loss of the United States and Canada during the month of October, as compiled by the Journal of Commerce, shows an aggregate of $13,651,650, as compared with $13,945,000 for the same month of 1911, and with $37,188,300 in October, 1910, when climatic conditions resulted in serious losses from forest fires. The fire losses for the first ten months of 1912 reach the sum of $191,181,600, as against $192,933,800 for the same time in 1911,

	1910.	1911.	1912.
January	$15,175,400	$21,922,450	$35,653,450
February	15,489,350	16,415,000	28,601,650
March	18,465,500	31,569,800	16,650,850
April	18,091,800	17,670,550	16,349,400
May	18,823,200	21,422,000	21,013,950
June	13,183,600	20,691,950	16,103,450
July	26,847,900	25,301,150	15,219,100
August	21,570,550	12,662,650	14,158,800
September	11,700,000	11,333,250	13,779,300
October	37,188,300	13,945,000	13,651,650
Total, for 10 months.	$196,535,600	$192,933,800	$191,181,600
November	10,407,000	18,680,600	....
December	21,528,000	22,722,850	....
Total year	$234,470,600	$234,337,250	....

MEETING OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The monthly meeting of the society was held on Thursday, December 19th, in the society rooms, 413 Dorchester Street West, Montreal. Mr. H. H. Vaughan, assistant to the vice-president of the Canadian Pacific Railway, read a paper on "Rotary Snow Plows."

MEETING OF ENGINEERING ALUMNI, UNIVERSITY OF TORONTO.

At a dinner of the Engineering Alumni Association of the Faculty of Applied Science, University of Toronto, held on December 17th in Toronto, at which 125 were present, and over which the president, Mr. J. C. Armer, presided, there was a discussion of the research scholarships which the association is founding, and the announcement was made that next year research work would be done by Messrs. W. P. Dobson and M. R. Shaw. Mr. Dobson's work will be that of studying the electrical surges in transmission systems, due to the switching of loads on and off. The University of Toronto and the Ontario Hydro-Electric Commission are working in conjunction to give Mr. Dobson the necessary equipment and assistance. Amongst those who spoke at the dinner were Dean Galbraith, of the University of Toronto; Mr. J. E. Ritchie, president of the University Engineering Society; Mr. C. H. Mitchell, consulting engineer, and Prof. H. W. Price, of the University of Toronto.

COMING MEETINGS.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annua Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McG University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr, G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O, Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close	Noted in issue of
1-18—Trunk Sewer Extension, Edmonton, Alta. ....(P. & S.)	12-19

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page
Aylmer, Ont., public building	Dec. 30.	Dec. 12.	65
Hamilton, Ont., harbor improvements	Dec. 30.	Dec. 12.	74
Halifax, N.S., work on new Herald building	Dec. 23.	Dec. 12.	65
Kamloops, B.C., power house equipment	Dec. 19.	Dec. 5.	65
Kerrisdale, B.C., valves, special castings and hydrants	Jan. 6.	Dec. 12.	74
Kelowna, B.C., school building	Jan. 3.	Dec. 12.	65
Montreal, P.Q., railway ties	Dec. 20.	Nov. 14.	65
Ottawa, Ont., machinery for dredge	Dec. 30.	Dec. 5.	65
Quebec, P.Q., alterations to post office	Dec. 23.	Dec. 5.	65
Orillia, Ont., drill hall	Dec. 19.	Dec. 12.	65
Ottawa, Ont., Indian supplies	Jan. 7.	Dec. 12.	65
Ottawa, Ont., re-erection of a Lobnitz rock breaker	Dec. 23.	Dec. 12.	65
St. Joseph, N.B., extension of college	Dec. 31.	Nov. 28.	65
Sarcee Indian Reserve, school buildings	Jan. 3.	Dec. 12.	65
St. John, N.B., post office building	Dec. 30.	Dec. 12.	65
Toronto, Ont., four steel bridges	Dec. 20.	Nov. 28.	65
Toronto, Ont., erection of school	Jan. 7.	Nov. 28.	65
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68
Vancouver, B.C., Y.M.C.A., building	Dec. 23.	Dec. 12.	66
Ville-Marie, P.Q., wharf	Jan. 7.	Dec. 12.	66
Victoria, B.C., motor launches	Dec. 23.	Dec. 12.	66

◆

TENDERS.

Calgary, Alta.—John Stocks, Deputy Minister of Public Works, Edmonton, Alta., will receive sealed tenders for "electric wiring, Court House, Calgary, Alta.", up to noon December 23rd. Specifications, forms of tender may be had at the office of the Department of Public Works, Calgary, or at the office of the Provincial Architect, Department of Public Works, Edmonton.

Calgary, Alta.—J. M. Miller, City Clerk, will receive sealed tenders up to noon December 24th for the supply of lap-welded steel pipe as required by the city commissioners. Specifications, etc., may be obtained from the above.

Edmonton, Alta.—Tenders for trunk sewer extensions, addressed to the City Commissioners, Edmonton, will be received until January 18th, 1912. Plans and specifications may be seen at the offices of the City Engineer, Edmonton; "The Canadian Engineer," Toronto, and "Engineering Record," New York. (For full particulars see advt. elsewhere in The Canadian Engineer). City Commissioners.

Kamloops, B.C.—J. J. Carment, city clerk, will receive tenders up to December 26th for 150 electric lights. Particulars may be obtained from the above.

Ottawa, Ont.—Tenders for the construction of six 300 cubic yards' capacity steel hopper scows, will be received at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until January 7th, 1913. Plans, specifications and form of contract can be seen and forms of tender obtained at Mr. Desrochers' office, and at the offices of T. H. Schwitzer, Esq., Mechanical Superintendent, Birks Building, Ottawa; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto; C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S.; and H. H. Donnelly, Esq., Superintendent of Dredges, St. John, N.B.

Quaco, N.B.—Sealed Tenders addressed to R. C. Desrochers, secretary, Department of Public Works, Ottawa, and endorsed "Tender for wharf at Quaco, N.B.," will be received at this office until 4.00 p.m. on Monday, December 30, 1912, for the construction of a wharf at Quaco, St. John County, N.B. Plans, specification and form of contract can be seen and forms of tender obtained at this department, and at the offices of F. G. Goodspeed, Esq., district engineer, St. John, N.B.; Geoffrey Stead, Esq., district engineer, Chatham, N.B.; and on application to the postmaster at Quaco, N.B. Each tender must be accompanied with a marked check on a chartered bank for a sum equal to 10% of the tender price, payable to the Honorable the Minister of Public Works.

Regina, Sask.—Tenders for the supply and erection of a five million gallon turbine pump and compound condensing vertical engine, will be received by the City Commissioners up to noon of January 29th, 1913. Copy of specifications and conditions may be obtained from R. O. Wynne-Roberts, consulting engineer. (See advt. elsewhere in The Canadian Engineer).

St. John, P.Q.—Tenders for the construction of a steel bridge with reinforced concrete flooring, between the towns of St. John and Iberville, P.Q., will be received by J. A. Raymond, secretary-treasurer of the town of St. John, until December 23rd. Plans and specifications may be seen at the office of Baulne and Mercier, consulting engineers, 503 Power Building, Montreal.

◆

CONTRACTS AWARDED.

Brantford, Ont.—Messrs. Schultz Bros. have been awarded the contract for the erection of a vaudeville theatre for Mr. James O'Reilly. Messrs. Stewart and Whitton are the architects.

Calgary, Alta.—The following tenders have been recommended to the council for acceptance:—The Ottawa Car Company for:

12 41 ft. 6 in. car bodies, $3,420 each, $41,040.
12 46 ft. 6 in. car bodies, $3,615 each, $43,380.
6 44 ft. 6 in. trainers, $3,467 each, $20,002.
30 Set Brill, 22 G 1 truck, $925 each, $27,690.
Total: $132,912.

The Canadian Westinghouse Company for:—

24 complete quadruple motor equipments, $2,350 each; $56,400.

24 complete air brake equipments, $236.90 each, $6,864. Total, $63,264.

Cap a l'Aigle, P.Q.—The contract for an extension to the wharf of this municipality has been awarded to Nap. Trudel of St. Irenie, P.Q.

Edmonton, Alta.—The contract for the supply and erection of a sub-structure for a bridge, to be on 5th Street, has been awarded to Messrs. Lyall-Mitchell Company, of Edmonton, at a cost of $79,898.18. Five other offers were considered; they ranged in price as high as $133,000.

Grimsby, Ont.—Public building: Contractor, E. A. Bleakney, Esq., of Gananoque, Ont.

Longueuil, P.Q.—Dredging: Contractors, The W. J. Poupore Co., Ltd., of Montreal, Que.

Preston, Ont.—Contracts for work on the new factory to be erected by the Anchor Bedding Company have been awarded as follows:—Mason work, Wirsching Bros.; carpenter work, James Eagle. The architect is H. Gale Legg.

Quebec, P.Q.—The Harbor Commissioners of Quebec have ordered 3 six-wheel switching locomotives from the Montreal Locomotive Works. The dimensions of the cylinders will be 19 in. x 26 in.; the diameter of the driving wheels will be 50 in., and the total weight in working order will be 120,000 lbs.

South Vancouver, B.C.—Mr. S. D. Rogers has been awarded a contract to erect two annexes to schools in this municipality at a cost of $1,475 each.

Stratford, Ont.—The contract for the building of the new Bank of Toronto has been awarded to Mr. Wm. Bradshaw of the city.

Victoria, B.C.—The management of the Sound Construction Company have been awarded the contract for the erection of the superstructure of the building to build for the British Columbia Permanent Loan Company; it is to be a ten story structure and will cost about $200,000.

RAILWAYS—STEAM AND ELECTRIC.

Brantford, Ont.—There will be much railway work in the vicinity of this town according to the present plans. Among the lines proposed are the Brantford and Hamilton Electric Railway, The Imperial Traction Company, The Huron and Ontario and the Niagara, St. Catharines and Toronto.

Hamilton, Ont.—The management of the Hamilton Street Railway Company are negotiating with the civic council regarding certain proposed extensions to the present system.

Ottawa, Ont.—The Grand Trunk Pacific Railway officials are negotiating with the federal government for an extension of time for the completion of all western lines of this company.

New Brunswick.—The Intercolonial Railway has finished work on 8.3 miles of new line in the province of New Brunswick from Nelson to a point two miles east of Chatham to replace the old line between these two places. Work is now under way between Georges River and Sydney Mines on nine miles.

Province of Quebec.—Work is now under way on a 30-mile extension of the Quebec and Lake St. John Railway from Roberval, north. Mr. J. P. Mullarky, Montreal, is the contractor.

Vancouver, B.C.—The Canadian Northern Railway have called for public tenders for the construction of its proposed Lulu Island branch from a point at the upper end of the island to a point adjacent to the Y of the British Columbia Electric Railway on the west boundary of section twelve, block three, north, adjacent to Steveston, a distance of 10.2 miles.

Western Canada.—The double tracking programme of the Canadian Pacific Railway for the year 1913 calls for 1,100 miles of new track.

LIGHT, HEAT AND POWER

Brandon, Man.—The civic power committee are considering the erection of a power plant at a point eight miles east of the city. City Engineer Speakman is a member of the committee.

Galt, Ont.—The Town Council has passed a by-law providing for placing the control of the local hydro-electric department in the hands of a commission, to consist of two members and the mayor.

Prince Albert, Sask.—It is probable that an expenditure of about $200,000 will be made during the coming year to erect a first-class power and light station.

Sarnia, Ont.—The municipal council are making a preliminary investigation into the possibilities of installing hydro-electric current into this municipality.

GARBAGE, SEWAGE AND WATER.

Brantford, Ont.—The municipal council will ask the ratepayers to endorse a by-law allowing an issue of debentures for the sum of $15,000 to be used for the construction of works to prevent damage from floods which occur in the spring by reason of the Grand River overflowing the bank.

Montreal, P.Q.—The following firms have tendered on the installation of a water heater as required by the city engineer:—Messrs. Laurie and Lamb, H. L. Peiler and Co., H. W. Petrie, of Montreal, Ltd., and Larling Bros., Ltd., each tender is on the same price basis, namely, $2,500.

Montreal, P.Q.—The following five firms have tendered on the installation and manufacture of a 12,000,000-gallon pump; they all submitted the same price of $80,000. Messrs. Heap & Gardners, Ltd., Escher, Wyss & Co., the John McDougall Caledonia Iron Works, the Canada General Electric Company, and Drummond McCall an dCo.

Victoria, B.C.—City Engineer Rust has presenter a report to the council which shows the expenditure of the $700,000 will be requested from the ratepayers for drainage works. The report allows an expenditure of $519,330 for north-east and north-west sewer extensions, and $78,900 for surface drainage extensions.

Victoria, B.C.—Engineers of the municipal water department are preparing a report on their examination of all waters in the districts of Golden, Cranbrook, Fernie, Grand Forks, Similkameen, Kelowna, Vernon, Ashcroft and Lytton.

BUILDINGS AND INDUSTRIAL WORKS.

Province of British Columbia.—There is a likelihood that the Dominion Tar and Chemical Company may establish a plant in British Columbia for the manufacture of creosote and other by-products of coal. Mr. Harold Boulton, London, England, a director of the company, is at present investigating the prospects.

Calgary, Alta.—It is reported that Col. James Walker will erect a $500,000 theatre in this city.

Calgary, Alta.—The management of the Riverside Sash and Door Company will erect a large factory in this city.

Fredericton, N.B.—Mr. David Richards is negotiating for a site in this city suitable for the erection of a theatre.

Haileybury, Ont.—M. J. O'Brien, Cobalt, Ont., is interested in a projected paper mill which in all probability will be erected at this point in the near future. It is planned to commence with 750 employes.

Kingston, Ont.—The management of the American Creosote Wood Block Preserving Company are negotiating with the municipal council regarding the location of a branch factory in this city. The ratepayers will be asked to provide a suitable site.

London, Ont.—If the ratepayers endorse a by-law to raise $250,000 for a Federal Square the McCormick Manufacturing Company will erect a new building in the eastern part of the city.

Port Arthur, Ont.—The Board of Education have decided to erect two new schools during the summer of 1913.

Saskatoon, Sask.—It is reported that certain members of the Slav colony will invest the sum of $50,000 in a plant for the manufacture of all varieties of iron, contracting work, and sheet steel articles. Mr. C. J. Alexander is interested in this project, which is to be known as the Toil Corporation, Ltd.

Seaforth, Ont. Mr. William J. Duncan is negotiating for freedom from taxation, and if the same is obtained will convert the old Grip Hotel into a factory.

Barrett Specification Roofs

A Mile of Barrett Specification Roofs

The wonderful Bush Terminal in Brooklyn, New York, illustrated below, includes 181 buildings, comprising tremendous warehouses, enormous pier sheds for docking ocean steamers, huge factory buildings, a large modern power house and an enormous freight structure. These buildings stretch for a mile along New York harbor. Their total roof area is 3,100,000 square feet—more than seventy acres.

The entire area was covered with Barrett Specification type of roofs, for the following reasons:

1. Low first cost.
2. No maintenance expense, such as painting, etc.
3. They are not injured by steam, gases and acid fumes.
4. They are fire retardent and take the base rate of insurance.
5. The net unit cost, that is, the cost per foot per year of service, is lower than that of any other type.

Although some of the buildings are fifteen years old, the roofing contractor states that the expense for maintenance of this entire roof area has been less than $10.00. He estimates that if metal or ready roofings had been used, it would have been impossible to keep the buildings free from leaks and that the painting bill alone up to date would probably have amounted to at least $50,000.00.

We wrote to the Bush Terminal Company, asking what they thought about Barrett Specification Roofs. The Vice-President replied:

> "We use this kind of roofing because our experience has shown it to be the best and cheapest. Our analysis of first cost of application and cost of maintenance entitles us to speak with some measure of authority."

We shall be pleased to mail architects, engineers or owners of buildings copy of our Barrett Specifications with diagrams from which blue prints can be made. Address the nearest office

Special Note

We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.

Victoria, B.C.—It is expected that the Department of Public Works will soon be in a position to invite tenders for the erection of the new Provincial Normal School in this city.

Winnipeg, Man.—The congregation of the Central Congregational Church have $70,000 toward the erection of a new church building. Doctor J. L. Gordon is the pastor.

BRIDGES, ROADS AND PAVEMENTS.

Calgary, Alta.—The ratepayers will be asked to provide sufficient money to cover the cost of an additional unit to the paving plant.

St. John, N.B.—Word comes from this point that a number of ratepayers around Loch Lomond are considering the matter of road improvement. Mr. Fred. Watters acted as chairman at a recently-held good roads meeting.

Welland, Ont.—The actual cost of county road construction has been found to be $3,222.87 per mile as against the estimate of $2,690.

West Point Grey.—A committee has been appointed to secure the assistance of the provincial government and the municipal council in the construction of a concrete archway bridge to be erected over a ravine near this point. Those appointed to act are Messrs. W. R. Arnold, A. G. McKennie, D. Morrison, John Weeks and Dr. Tanner.

FIRES.

Cobalt, Ont.—The plants of the Jajola 20th Century mines were damaged by fire to the extent of $3,500,000. Mr. S. Sager is interested in these workings.

Hespeler, Ont.—The moulding shop of the Canada Machinery Corporation was damaged by fire to the extent of $20,000.

Stratford, Ont.—The plant of the Stratford Mill Building Company was destroyed by fire with a loss of $75,000.

Vancouver, B.C.—The works of the Hoffar Motor Boat Works were damaged by fire to the extent of $14,000.

Watson, Sask.—The store of Messrs. Schinkler Bros., builders' supplies, was destroyed by fire.

CURRENT NEWS.

Berlin, Ont.—The ratepayers will be asked to vote the expenditure of $30,000, to be used in the construction of an abattoir.

Montreal, P.Q.—The Williams Manufacturing Company, manufacturers of sewing machines and typewriters, has been re-organized and now has a capital of $1,000,000. It is the intention of the directors to expand the buildings and allow of a heavier output. Montreal men on the directorate include Messrs. C. W. Davis, B. McLennan, James Rodger, and William Yuile.

Montreal, P.Q.—Messrs. Price, Waterhouse and Company have made an investigation into the public service commission on the Montreal Harbor Commission, and report this department in a fair shape. Several recommendations are made, one of which provides that all the accounting and cost records of every department be placed in charge of a chief accountant or comptroller, who should have the entire responsibility for all accounting.

Vancouver, B.C.—The following firms tendered on the supply of 4-inch, 6-inch, 8-inch, 12-inch iron pipe and 2-inch galvanized pipe as required by the engineering department. The tenders were put in as follows: Messrs. Gerald Lomer & Co., $300,000; Messrs. Frank Darling & Co., about $220,000; Messrs. Wilkinson & Co., $280,000; Messrs. Balfour, Guthrie & Co., $288,580; Messrs. Robertson, Godson & Co., about $320,000; Evans, Coieman & Evans, Ltd., $160,750, and (alternative) $164,000.

Victoria, B.C.—Messrs. Sharpe and Thompson, architects, Vancouver, B.C., have been awarded the prize for the design and plans of the building for the proposed university of British Columbia.

It is reported that the officials of the Canadian Northern Railway are considering the erection of a line of hotels along their right-of-way from Halifax to Vancouver.

Victoria, B.C.—The Board of Education are planning to spend $150,000 on new school buildings in the near future.

Windsor, Ont.—The ratepayers voted the usual tax exemption to the Tudhope Motor Company and the Canadian Roofing Company, both of which are to locate factories here.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending December 2nd, 1912:—

A London correspondent desires to get into communication with Canadian manufacturers of wire and wire nails.

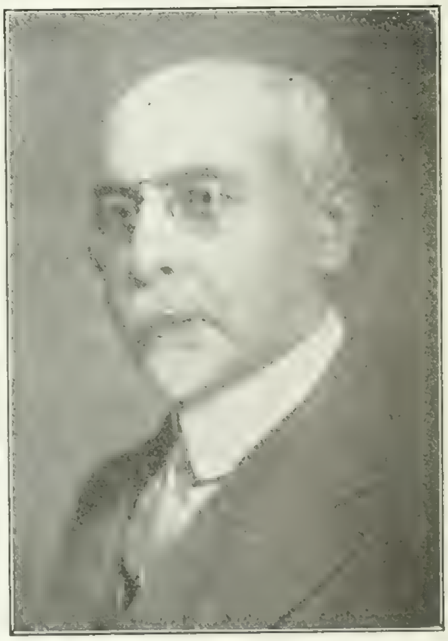
A Sheffield firm manufacturing razors, clasp knives, desk knives, and all classes of table knives, butchers' knives, cooks' knives, kitchen knives, and forks, desire to do Canadian business.

A Belgian manufacturing and export company desire to enter the Canadian market for tissues, laces and embroideries; also paper, chemicals and pharmaceutical products.

A German firm of automobile manufacturers desire to appoint high-class agents in Canada.

NEW DIRECTOR OF BANK OF TORONTO.

Mr. J. L. Englehart has been elected a director of the Bank of Toronto in place of Mr. W. H. Beatty, deceased. Mr. Englehart is best known perhaps as chairman of the Temiskaming and Northern Ontario Railway Commission. In that capacity he has not only shown an excellent grasp of railroad problems and affairs but has maintained also an unmatched enthusiasm respecting the prospects and development of Northern Ontario, backing his opinions with hard work.



J. L. Englehart.

Mr. Englehart was born at Cleveland, Ohio, in November, 1847. Since 1866 he has been the head of the firm of Messrs. J. L. Englehart and Company, engaged in the refining, producing and exportation of Canadian petroleum and its products, with works in London, Ontario, and offices in New York. He was one of the pioneers in the trade. In 1881, he removed to Petrolea, Ont., where he became second vice-president of the Imperial Oil Company. He is also vice-president of the Crown Savings and Loan Association, Petrolea, and vice-president of the London and Western Trust Company, London, Ont. He has been a governor of Toronto University.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of
Galvanized Wire
Machine Banded
WOOD
STAVE PIPE
CONTINUOUS
STAVE PIPE
RESERVOIR
TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

INSTALLATION OF **"PULSATOR RAM"** SYSTEM AT TANDRIDGE, SURREY.

The Engineer, T. C. Barrallet, Esq., writes "The fixed spray nozzles and pulsating rams supplied by you at Tandridge works last winter gave a very efficient distribution over the surface of the filter."

THE
"PULSATOR-RAM"
SYSTEM
OF DISTRIBUTING SEWAGE
BY FIXED SPRAYS.

KEEPS THE JETS CLEAR.
INCREASES AREA COVERED.
THE NEAREST APPROACH TO PERFECTION IN UNIFORMITY OF DISTRIBUTION YET ATTAINED.

TUKE AND BELL
LIMITED
69 LEADENHALL STREET,
LONDON, E.C.

3

AGENTS FOR CANADA:

LAURIE AND LAMB
211 BOARD OF TRADE BUILDINGS,
MONTREAL.

THE GUTTA PERCHA AND RUBBER MANUFACTURING CO., OF TORONTO, LIMITED, TO BE REORGANIZED.

There is to be a reorganization of The Gutta Percha & Rubber Manufacturing Company, of Toronto, Limited. whose factories are located in Toronto (Parkdale). The reorganization will take effect as of January 1st, 1913. The company has carried on an extensive business throughout Canada and by export to various parts of the world for over a quarter of a century, having been incorporated as a purely Canadian industry under the Ontario Joint Stock Companies Act in 1887.

As the business of the company grew, it became necessary to open branches in many places. At some points these branches were operated under the name of "The Gutta Percha & Rubber Mfg. Co., of Toronto, Ltd.", but in the prairie provinces the business has been conducted at Winnipeg and Calgary through a subsidiary company, The Winnipeg Rubber Company, Ltd., and in British Columbia through another subsidiary company, the Vancouver Rubber Company, Ltd. The directors and shareholders of the company have now decided that its interests and convenience and the interests and convenience of its customers will be better served by a reorganization which will enable it to operate in all its branches under one name and at the same time adequately care for and develop its very large and constantly increasing business. To this end, application has been made for a Dominion charter under the name "Gutta Percha & Rubber, Limited," with an authorized capital of $6,000,000. The new company will be controlled by the same interests and be under the same management as the old. It will acquire all the trademarks, patents, properties and good will of the old company and, as heretofore, will be an entirely independent concern without connection or affiliation with any other company in or out of Canada.

◆

PAVING CONTRACT.

The Dolarway Paving Company, 95 Liberty Street, New York, have recently been awarded a contract to supply 15,968 square yards of Dolarway Pavement to Roselle Park, N.J., contractors.

◆

NEW INCORPORATIONS.

Calgary, Alta.—Concrete Products, $25,000.

Prince Albert, Sask.—Fuel Supply Co., $20,000.

Moose Jaw, Sask.—Cordova Building Co., $300,000.

Estevan, Sask.—Great West Brick and Coal Co., $250,000.

Redcliffe, Alta.—Redcliffe Pressed [illegible] $150,000.

Regina, Sask.—Crystal Ice Co., $25,000. Rutley Lumber Co., $200,000.

Nanaimo, B.C.—Builders Supply Co., $25,000. Pacific Coast Packing Co., $50,000.

Caledonia, Ont.—Roper Drug Co., $20,000. C. E. Donaghy, J. M. Forbes, J. T. Arrell.

Medicine Hat, Alta.—Medicine Hat Pump and Brass Manufacturing Company, $50,000.

Fort William, Ont.—Eureka Match Co., $500,000. G. W Pepper, O. A. Winter, A. Greengrove.

Minaki, Ont.—Crossing Lumber Co., $200,000. A Stewart, H. R. Patriarche, D. H. Cooper, Winnipeg.

Hamilton.—Hamilton Malleable Iron Co., $610,000. S. [illegible], R. H. Parmenter, A. [illegible]

Louisville, Que.—United Refining Company, $150,000. A. Moisan, A. Lavergne, C. Smith, Quebec.

Trenton, Ont.—Trent Manufacturing Co., $40,000. C. F. Duquette, H. Despardins, C. M. Richardson

Quebec, Que.—Canadian Morris Iron Company, $50,000. J. H. [illegible], J. M. [illegible], F. G. [illegible]

Winnipeg, Man.—Lac Seul Development Co. (mining) $75,000. J. W. Morrison, G. Lennox, W. H. Sullivan.

St. Thomas, Ont.—St. Thomas Metallic Vault Co., $40,000. A. J. Stough, W. K. Cameron, Miss M. Ronan.

Windsor, Ont.—Essex County Light & Power Co., $500,000. W. A. J. Case, J. B. Taylor, C. G. Lynch, Toronto.

Edmonton, Alta.—Alberta Plumbing and Heating Company, $30,000. Buck-Eye Construction Company, $50,000.

London.—Canadian Handle Manufacturing Co., $600,000. W. C. Crawford, F. W. Hees, Tilbury; F. G. Rumball, London.

St. Jerome, Que.—Compagnie Manufacturiere St. Jerome du Lac St. Jean, $20,000. J. B. Simard, T. Bolly, P. Deschene.

Kingston, Ont.—Kingston Sand and Gravel Co., $25,000. R. H. Fair, Kingston Township; W. McCartney, J. W. Litton, Kingston.

Peterborough, Ont.—Peterborough Machine and Lubricator Co., $60,000. E. R. Wilson, A. Gillespie, Peterborough; J. A. Davidson, Smith Township.

Vancouver, B.C.—Cariboo Power Company, $250,000. Forest Mills of British Columbia, $500,000. Great West Lithograph Co., $300,000. Lamb Lumber Co., $200,000.

Niagara Falls, Ont.—Good Manufacturing Company of Canada, $3,000. J. S. Lovell, W. Bain, R. Gowans. Pure Ice and Cold Storage Co., $40,000. F. W. Griffiths, W. B. Masters, H. Schumacher.

Vancouver, B.C.—Mayne Island Shale Brick Company $500,000. Lacey Rerigerator Systems, $75,000. Legal Tender Gold Mining Company, $100,000. Mt. Stephens Mines, $1,000,000. Modern Glass Company, $50,000.

Ottawa.—Lecky and Collis, $50,000. W. S. Lecky, W. R. Rowatt, C. J. R. Bethune. Inventor's Machinery Co., $40,000. M. Alexander, D. Burley-Smith, A. Labelle. Aluminum Castings, $40,000. T. H. Sedley, R. M. Kirby, R. G. Code. Carleton Drug Co., $40,000. W. F. Garland, A. R. Legg, H. P. Hill.

Toronto.—Canadian Fritchle Electric Automobile and Battery Co., $1,000,000. G. H. Sedgewick, A. G. Ross, A. E. Langman. A. B. Ormsby Co., $500,000. A. B. Ormsby, T. A. Rowan, J. E. Jones. Ellis, Jackson Hat Co., $40,000. W. G. Ellis, W. R. Ellis, J. A. Coakwell. Canadian Multipost Co., $50,000. D. J. Lynch, T. Williamson, W. J. Tubman.

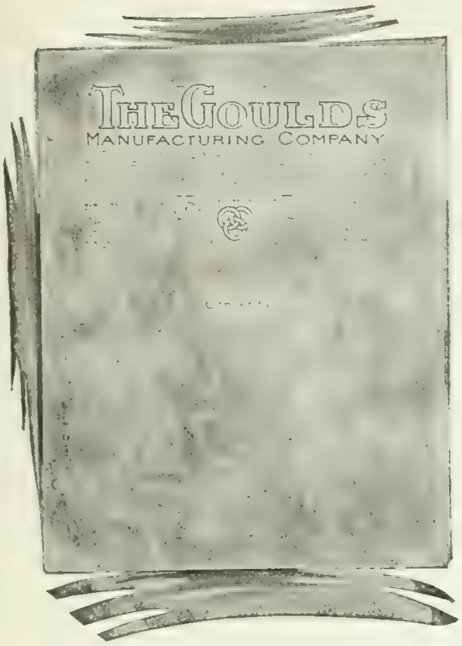
Montreal.—Railway Signal Company of Canada, $1,100,000. H. Gerin-Lajoie, A. Lacoste, T. J. Shallow. Quinlan Cut Stone, $400,000. J. A. Mann, C. G. MacKinnon, T. B. Gould. Union Rubber Company, $50,000. W. Bovey, R. Fleet, J. A. L'Heureux. Consolidated Milk Company, $1,000,000. J. J. Meagher, R. Burnett, C. A. McNee. Glass and China Decorators, $20,000. J. M. Gelz, E. F. Stearns, W. F. Wood.

Winnipeg, Man.—Canadian Heer Engine Co., $100,000. H. Armstrong, R. McLennan, G. Bull. Western Lumber Company, $40,000. W. C. Large, Hudson Bay Junction; C. E. Graham, Winnipeg; R. P. Large, Hudson Bay Junction. Economy Foundry Co., $100,000. W. Richardson, Portage la Prairie; H. V. Hudson, W. J. McMartin, Winnipeg. Winnipeg Smallwares Co., $40,000. H. Adilman, E. Goldstein, F. Droxelman.

Montreal, Que.—Laurentide Brick and Sand Co., $250,000. H. J. Elliot, L. A. David, B. C. Macfarlane. Lauzon Engineering Co., $100,000. J. H. Dillon, A. Perrault, H. Perdriau, A. Lafontaine. Magnesia Products, $800,000. A. R. McMaster, Westmount; T. M. Papineau, A. Angers. Abitibi Pulp and Paper Co., $5,000,000. V. E. Mitchell, E. M. McDougall, J. J. Creelman. Williams Manufacturing Co., $1,000,000. C. W. Davis, B. McLennan, W. Yuile. National Wire Products, $1,500,000. G. V. Cousins, P. F. Brown, W. R. Ford. Mountain Creek Gold Fields, $40,000. E. W. Barlow, J. B. H. Mongenais. Motor Transport, $300,000. A. Perrault, T. A. W. P. Mercier, J. H. Dillon.

Toronto.—Venezuela Electric Light Co., $1,5[illegible]. W. Bain, J. S. Lovell, R. Gowans. Ferranti Electrical Co., of Canada, $250,000. A. Gilmour, C. H. Watson, E. B. Henderson. [illegible] (stoves, furnaces, etc.) [illegible] Carroll, J. C. Wilson, R. H. Parmenter. Gutta Percha and Rubber, $6,000,000. J. S. Lovell, S. G. Crowell, S. S. Mills. Canadian Eg-Save Co. (food products), $40,000. G. A. Jarvis, H. H. Grubbe, A. H. Martens. Zip Co., $500,000. G. C. Loveys, J. B. Taylor, W. A, J. Case. Nyberg Auto Sales Co., $40,000. W. K. Fraser, R. H. G. Ivey, D. D. McLead. Dominion Rubber Co., $1,000,000. R. F. Segsworth, J. J. Main, E. M. Carleton. Canadian Inventions, $40,000. A. G. Robertson, J. J. [illegible]. [illegible] Creek and Seymour River Lumber Company, $250,000. B. H. L. Symmes, C. J. Ballantine, G. O. [illegible]. Alco Manufacturing Company, $40,000. J. H. Cohen, B .A. Sutin, A. Kingensmith.

A Data Book that Every Engineer will Appreciate



For the convenience of engineers, contractors and others who have to specify pumping equipment, we have collected all the data and tables needed in pumping calculations.

This data has been published in bulletin form. A copy of this bulletin will be sent on request.

THE FOLLOWING IS SOME OF THE INFORMATION IT CONTAINS—

Instructions for Installing and Operating Power Pumps, Rate of Suction and Discharge, Capacities of Pumps, Dimensions of Wrought Iron Pipe and Well Casing, Table for Equalizing Pipes, Rules for Determining the Size of Pulleys and Gears, Diameter of Pulleys with Belt Speeds and Horse Power Belting will Transmit, Horse Power Shafting will Transmit, Sizes of Triplex Pumps for Feeding Boilers of Various Sizes, General Information on Hydraulics, Friction of Water in Pipes, Discharge of Water, Table of Effective Fire Streams, Weights and Measures, Data Required in Selecting Pumps for Various Services, etc.

WRITE FOR A COPY.

SALES AGENTS—

The Canadian Fairbanks-Morse Company, Limited

MONTREAL ST. JOHN OTTAWA TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

18163—November 28—Authorizing C.P.R. to construct spur for the D. E. Adams Coal Company, Limited, Winnipeg, Manitoba.

18164—November 28—Approving proposed location C.P.R. station at Dorion, Ontario.

18165—November 29—Authorizing Esquimalt and Nanaimo Railway to construct bridge 39.9 on its Comox Extension over Trent River, B.C.

18166—November 28—Authorizing Qu'Appelle, Long Lake and Saskatchewan Railway to construct spur for Cushing Bros. Company, Limited, Regina, Sask.

18167—November 28—Authorizing G.T.R. to construct siding for the Atlas Glass Works, Ltd., on Part Lot No. 130, town of St. Pierre, Parish Montreal.

18168—November 28—Authorizing G.T.R. to reconstruct bridge No. 10, at mileage 8.72, over public road between Cons. 7 and 8, Tp. North Dumfries.

18169—November 29—Approving location G.T.P. Ry. proposed station at Pocahontas, Sec. 6, Tp. 49, R. 27, W. 5 M., Alberta.

18170—November 29—Extending, for a period of one year form Dec. 1st, 1912, Order No. 12723, dated December 6th, 1912.

18171—November 29—Authorizing C.N.R. to divert public road between Secs. 35 and 36, Tp. 41, R. 28, W. 2. M. on its Vonda Northerly Line.

18172—November 28—Authorizing C.N.R. to construct across Twenty (20) highways on its Goose Lake Extension, mileage 281.5 to mileage 301.5.

18173—November 29—Directing C.P.R. to construct a highway crossing over tracks of its Arrow Lake Branch at city Boundary of Revelstoke, British Columbia.

18174—November 28—Approving plan and specifications of Toronto Eastern Railway Co.'s Standard Pile and Frame Trestle.

18175—December 2—Authorizing the town of Bonfield, Dist. Nipissing, Ontario, to construct a highway across C.P.R. on Lot 9, Con. 8, Tp. Bonfield.

18176—November 30—Authorizing C.N.R. to construct across and divert public road between Secs. 21 and 22, Tp. 31, R. 15, W. 4 M., on its Goose Lake Extension.

18177—November 30—Approving location C.N. Montreal Tunnel and Terminal Company, Limited, Railway and Tunnel in city of Montreal, from Lagauchetiere St. Station 13.79.7 to Station 447.17.9.

18178—November 30—Permitting C.P.R., G.T.R., C.N.R., and M.C.R.R. Companies to increase from December 15th, 1912, to March 31st, 1913, both inclusive, the Car Service or Demurrage toll from $1 to $2 a day for first 24 hours, and $3 a day for each succeeding 24 hours, beyond free time allowed by Order No. 906, dated January 25th, 1906, for loading and unloading cars.

18179—November 30—Relieveing C.N.R. from providing further protection at highway about 7 telegraph poles north of mileage 58, Parry Sound Subdivision.

18180—December 2—Recommending the Indenture of Lease, dated October 2nd, 1912, between St. Mary's and Western Ontario Railway and the C.P.R. to the Governor in Council for sanction.

18181—November 30—Authorizing C.P.R. to construct two (2) spurs for the [illegible] Supply Co., Ltd., Winnipeg, Man.

18182—November 30—Authorizing Esquimalt & Nanaimo Ry. Co. to construct spur for the Canada Mosaic Tile Co., Ltd., at mileage 1.7, Victoria West, Esquimalt District, Vancouver Island, B.C.

18183—December 2—Amending Order No. 18024, dated Friday, November 15th, 1912, by changing its date to Saturday, the 16th day of November, A.D. 1912.

18184—November 30—Authorizing G.T.R. to construct sidings for the Dyment Mickle Lumber Co., on Lot 23, Con. 9, Tp. of Fenelon, Co. Victoria, Ont.

18185—December 2—Relieving G.T.R. from providing further protection at crossing of forced road about 1 mile north of Golden Lake, on Lot 5, Con. [illegible], Tp. North Algoma, Ont.

18186—December 2—Directing G.T.R. to construct siding extending southerly from termination of existing siding in road allowance between Lots 4 and 5, Tp. Humberstone, Co. Welland, for Carroll Bros., Buffalo, N.Y., and Sherkston, in Co. of Welland, Ont.

18187—December 2—Authorizing [illegible] Limestone Co., Ltd., to construct [illegible] under the siding of Carroll Bros., on Lot 5, Con. 1, Tp. Humberstone, Co. Welland, Ont.; and repealing Order No. 17007, dated July 12th, 1912.

18188—December 2—Relieving Central Ontario Ry. from providing further protection at highway, short distance south of Wellington, Ontario.

18189—December 2—Appointing and directing Mr. Arthur Sullivan, of Winnipeg, barrister, to make inquiry and take evidence necessary to show whether or not the portion of the Winnipeg Electric Ry., to the C.P.R. shops is profitable.

18190—November 30—Extending, until June 1st, 1913, the time limited by Sec. 4, Chap. 61, of the Acts 7-8, Ed. VII., for approval of White Pass & Yukon Route tolls for telegraph messages between all points in Canada; and allowing tolls authorized to be charged under Acts 7-8, Ed. VII., Chap. 61.

18191—November 30—Extending the tariff of telephone tolls of the North American Telegraph Co., until June 1st, 1913.

18192—November 30—Extending, until June 1st, 1913, the time limited by Sec. 4, Chap. 61, of the Acts 7-8, Ed. VII., for approval of Can. Nor. Telegraph Co.'s messages between points in Canada; and allowing tolls authorized to be charged under said Acts 7-8, Ed. VII., Chap. 61.

18193—November 30—Extending, until June 1st, 1913, time limited by Sec. 4, Chap. 61, of Acts 7-8, Ed. VII., for approval of G.T.P. Telegraph Co.'s tolls between points in Canada, with exception of tolls between local offices, on Ottawa Division, in Ontario and Quebec, and between them and Swanton, Vt., approved by Order 11153, dated July 12th, 1910; and allowing tolls authorized to be charged under Acts 7-8, Ed. VII., Chap. 61.

18194—December 2— Directing G.T.R. to keep all cars away from crossing, just east of Jordan Station, Ont., in both directions for a distance of 100 feet.

18195—November 30—Extending the tariff of telephone tolls of the Bell Telephone Co., until June 1st, 1913.

18196—December 3—Approving location C.N.R. through Tp. 26, R. 7, W. 3 M., Sask., mileage 51.5 to mileage 61.32.

18197—December 3—Approving location G.T.P. Branch Lines Co.'s Moose Jaw Northwest Branch from east line of Sec. 25, Tp. 22, R. 7, to north line of Sec. 31, Tp. 22, R. 7, W. 3 M., mileage 67.86 to mileage 79.02, Dist. Moose Jaw, Sask.

18198—November 30—Extending, until June 1st, 1913, time limited by Sec. 4, Chap. 61, of said Acts 7-8, Ed. VII., for approval of G.N.W. Telegraph Co.'s tolls between points in Canada west of North Bay, also to and from points west of North Bay and to points east thereof, and east of and including Windsor, Ont., and allowing tolls which it was authorized to charge under said Acts 7-8, Ed. VII., Chap. 61.

18199—November 12—Permitting the Winnipeg Electric Ry. Co. to lay and maintain tracks through subway under tracks of C.P.R., on McPhillips Street, Winnipeg, Man.

18200—December 3—Directing C.P.R. to provide a farm crossing in east ½ of Lot 23, Con. 11, Tp. Beckwith.

18201—December 2—Authorizing C.L.O. & W. (C.P.R.) to construct its Glen Tay to Cobourg Line across C.N.O.R., in Lot 28, Con. B, Tp. Brighton, mileage 95.1 from Glen Tay, by overhead structure.

18202—December 3—Certifying that correction, to show station grounds at Bayside, mileage 82.5, in plan of C.L.O. & W., Glen Tay to Cobourg Line, is allowed.

18203—December 3—Authorizing C.L.O. & W. (C.P.R.) to construct across road allowance between Lots 30 and 31, Con. 1, Tp. Hope, mileage 133.38 from Glen Tay.

18204—December 2—Authorizing G.T.R. to construct siding for the Empire Cotton Mills Co., Ltd., on Lot 24, Con. 5, Tp. Crowland, Ontario.

18205—December 2—Authorizing G.T.P. Saskatchewan Ry., to connect its Weyburn Branch with G.T.P. Branch Lines Co.'s Regina-Boundary Branch, in Sec. 35, Tp. 9, R. 13, W. 2 M., at Talmage, Saskatchewan.

18206—December 2—Approving proposed location G.T.P. Branch Lines Co.'s station in Sec. 24, Tp. 1, R. 3, W. 2 M., Sask.

18207—December 3—Authorizing G.T.P. to operate trains over portion of railway between mileage 164 and mileage 176.8, east of Prince Rupert, and amending Order No. 17769, dated Oct. 14th, 1912.

18208—December 2—Temporarily approving G.T.P. Standard Freight Mileage Tariff, C.R.C., No. 12, to apply between stations between Thornton, Alta., and Tete Jaune, B.C., inclusive.

18209—December 3—Authorizing C.L.O. & W. (C.P.R.) to construct across road allowance between Twps. of Haldimand and Cramahe, Co. Northumberland, Ont., mileage 106.17 from Glen Tay; and eliminating Item No. 10 of Order No. 17361, dated August 29th, 1912.

18210—December 3—Suspending, pending a hearing of the application, the rate of 40 cents per net ton, on coal, from Detroit, Mich., to Windsor, Ont., as published in M.C.R.R. Supplement No. 14 to Tariff C.R.C., No. 1288.

18211—November 6—Approving location C.N.O.R., through Twps. York and Scarboro, Co. York, Ont., from mileage 0 to mileage 7.60, from Yonge Street.

18212—November 6—Directing T. H. & B. Ry. to cut down hill immediately east of and south of railway at Gorrie's Crossing.

18213—November 6—Authorizing the London Street Rly. Co. to cross tracks of C.P.R., at Adelaide Street, London, Ont.

18214—November 22—Authorizing G.T.P. to open for traffic its line between Fitzhugh (mile 1027.8) and Tate Jaune (mile 1095.3).

18215—December 4—Authorizing Local Improvement Dist. 18-W. 4 to construct road across Calgary and Edmonton Ry., in east ½ Sec. 20, Tp. 25, R. 28, W. 4 M.

18216—December 4—Relieving B.C. Electric Rly., (Lu Lu Island Branch) from providing further protection at Townsend Road, Mun. of Point Grey, B.C.

18217—December 4—Approving location C.N.R. through Tps. 20-21, Rgs. 21-20, W. 2 M., Sask., mileage 0.00 to mileage 8.79, Craven North-easterly Line.

18218—December 4—Authorizing C.N.O.R. to connect with C.P.R. in Tps. Westmeath and Pembroke, Co. Renfrew, Ont., mileage 82.02 to mileage 82.61.

18219—December 4—Authorizing Can. Nor. Alberta Ry. to operate trains over crossing of G.T.P., in S.E. ¼ Sec. 31, Tp. 53, R. 10, W. 5 M., Alta., for construction purposes only.

18220—December 4—Authorizing G.T.R. to construct siding and spurs for Dominion Wood and Lumber Company, Limited, Lot No. 25, Con. 1, Tp. of Himsworth, Dist. Parry Sound, Ontario.

18221—December 4—Authorizing G.T.R. to construct siding for Kirkfield Portland Cement Company, Limited, at Raven Lake, Ontario.

18222—December 4—Authorizing G.T.R. to construct siding and spur for Canada Grip Nut Company, Limited, St. Johns, Quebec.

18223—November 21—Authorizing C.P.R. to open up Thirteenth Avenue across its tracks and station grounds, town of Estevan, Sask.

18224—December 4—Authorizing C.P.R. to construct spur for Standard Chemical Iron and Lumber Company, of Canada, Limited, Montreal, P.Q.

General Order No. 98—December 6—Directing Railway Companies operating in Eastern Canada, to furnish, according to their respective powers, heated refrigerator cars, during cold weather, for carriage of fruit, vegetables and eggs.

18225—December 4—Directing C.P.R. to install a 12-inch pipe for drainage under its tracks in town of Vaudreuil, Que.

Volume 23. Toronto, Dec. 26, 1912

Contents of this issue on page 923

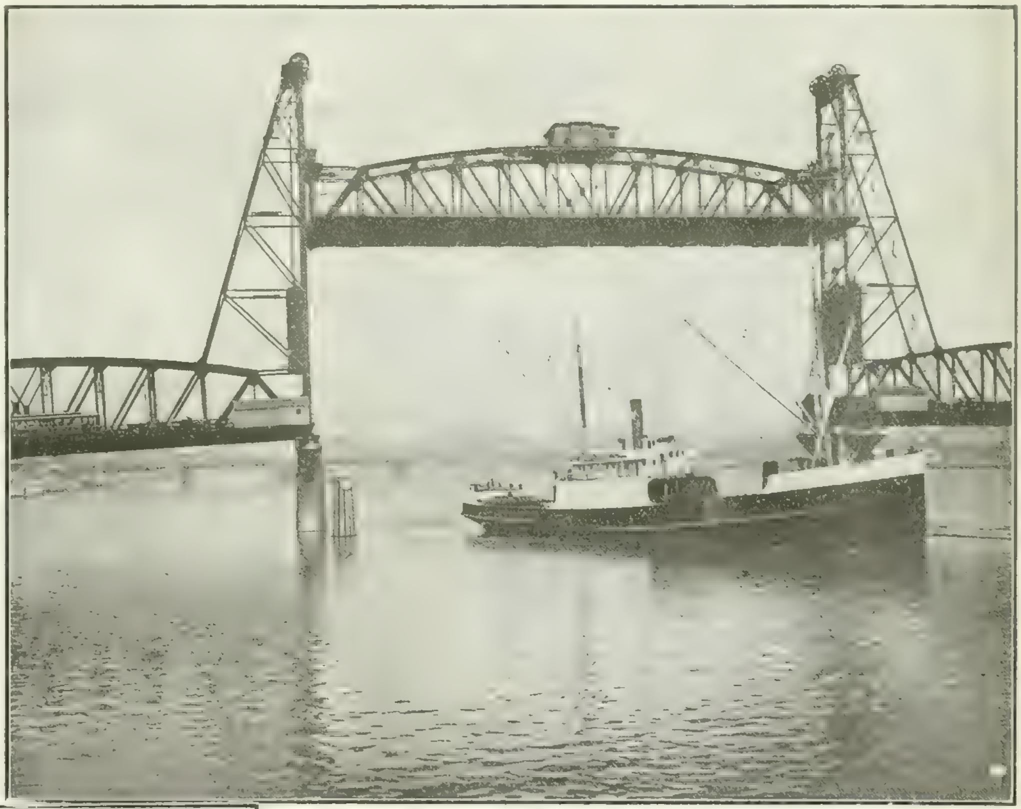
The Canadian Engineer

An Engineering Weekly

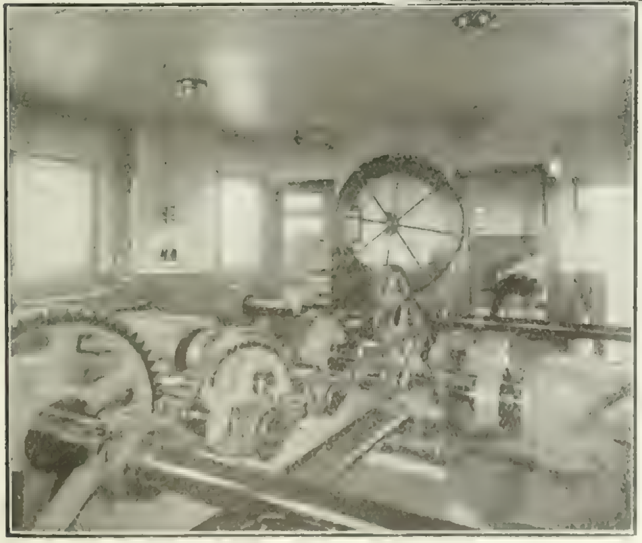
THE ELECTRICAL EQUIPMENT OF THE HAWTHORNE AVENUE BRIDGE, PORTLAND, OREGON.

In laying plans for the installation of a draw bridge for Hawthorne Avenue, Portland, Oregon, the city officials endeavored to eliminate the many vexatious delays that were due to the constant opening and closing of the old draw span type Madison Street bridge, which formerly occupied approximately the same location as the present structure.

After looking over the various types offered, they finally decided on the lift span type as being the one which would most effectively alleviate these conditions. This has proven a very wise selection on the part of the city officials, as the time required to raise the bridge to the top of the span and lower it is less than that required to swing open the draw span type. The lift span type, however, possesses an additional advantage in that it is unnecessary in most cases to raise the span more than a few feet to accommodate the greater bulk of the river traffic, and consequently the delays to traffic across this bridge have been reduced to a minimum.



View of Hawthorne Avenue Bridge, Portland, Oregon,
with draw raised showing boat going through



Interior view of motor house
showing motors and operating gears.

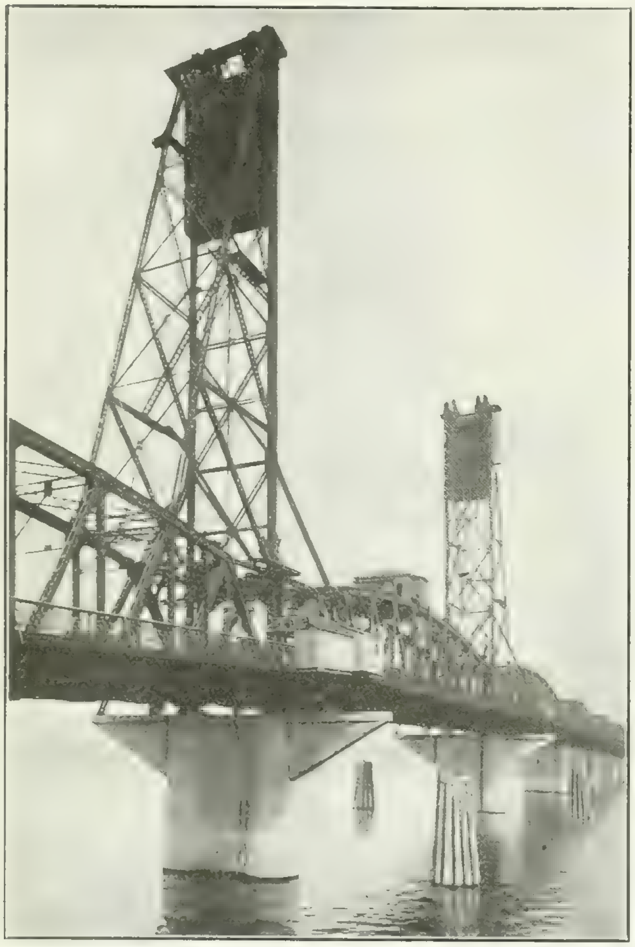
This type of span resolves itself, from an operating standpoint, into practically an elevator proposition, the weight of the span being balanced by means of large concrete counter weights connected to the span by means of steel cables operating over sheaves located at the top of the towers on either side of the span. These counter weights are clearly shown in their position in the photographs.

The bridge is operated by means of two No. 160 Westinghouse 125 horse-power, 550-volt, direct current railway crane type motors, which are directly coupled to a train of gears located in the machinery house on the top of the span; this reduction gearing, in turn, operates the bridge by means of steel cables. The lift span is guided in raising or lowering by means of steel roller bearings operating in the guides located in the vertical uprights of the towers. Besides the advantage of greater speed in operation, and consequently less delay to the traffic, this type of bridge also presents three great advantages from an engineering standpoint.

There is no unequal expansion or contraction, due to the effect of the sun's rays, as would be the case with the draw span type pivoted in the centre.

2nd. The wind friction is practically negligible.

3rd. It offers the use of the entire channel.



View of bridge with draw in position.

The bridge was designed by Waddell & Harrington, consulting engineers, Kansas City, Mo., and was erected under the supervision of Mr. Leon Clarke, engineer in charge. The electrical equipment, including the motors and control equipment, was furnished by Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

◆

BRITISH INVENTION FOR UTILIZATION OF PEAT.

A new process for the utilization of peat, invented by F. H. Nixon, of London, consists of cutting the turf, after it has been air dried, into corrugated blocks, which are sprayed with petroleum so as to form firelighters. The blocks are subsequently given a coating of highly inflammable material which also strengthens them and prevents them from breaking easily. It is claimed that this process overcomes the obstacles associated hitherto with the combination of peat and petroleum which have been connected mainly with the employment of a briquetting machine that is not only difficult to work, but also expresses too much of the petroleum from the finished blocks. It is stated that the process enables the firelighters to be produced at a cost which has not been approached before. It is proposed also to employ the method for the production of fuel on a larger scale.

POWER PLANT TESTS.

A valuable contribution to the literature on power station operations is contained in the report of the committee on power tests presented December 5 at the annual meeting of the American Society of Mechanical Engineers. Aside from its importance in establishing standards, the report is a collection of all the information necessary for making a test upon any kind of power-producing machinery, and notwithstanding the vast extent of the field, the report is in most surprisingly condensed form.

The subject matter is divided into three parts, of which the first is a set of general instructions for testing operations. This includes a series of brief descriptions covering the apparatus and instruments recommended for different operations, together with instructions for their use. As an example of the completeness of the report, among the methods described for measuring steam flow is included a table showing the weights of steam discharged through a given orifice with various pressure drops. There are, however, no positive recommendations for smoke determination, although the Ringleman smoke charts and several other methods are briefly described.

Another part of this section is devoted to a statement of the standard units recommended as a basis upon which to express capacities and efficiencies of power generating apparatus. Although the committee recognizes the recently proposed "myriawatt" at a unit for steam boilers by mentioning it in a footnote, in the body of the report the measurement of the boiler capacity is expressed only in terms of the weight of water evaporated from and at 212 deg. per hour. The expression "boiler horse-power" is sanctioned for stationary boilers, but also only by mention in a footnote. Steam turbines delivering mechanical power have been distinguished from turbo-generators in the list of standards by the use of the brake horse-power at the shaft as the unit of capacity for the former and of the kilowatt-hour for the latter. Engine-driven generators are included with turbo-generators, and in both cases the exciter output is excluded from that of the machine.

An interesting recommendation in this part of the report is that covering reserve capacity for power plant apparatus, or, in other words, the excess capacity which it should have over and above the commercial or manufacturer's rating. These reserve capacities are recommended to be 33 per cent. for boilers using standard fuel and 25 per cent. for steam engines and turbines with normal boiler pressure, together with the ability to deliver rated capacity at a boiler pressure 15 per cent. below normal. For pumping engines a reserve power of 20 per cent. is advocated, and the same percentage applies to gas producers and gas and oil engines. Water-wheels, however, are required only to have a reserve of 10 per cent. at the specified head of water.

The second section of the report includes standard codes of rules for different classes of apparatus, each of which is elaborated sufficiently with instructions to enable a test to be carried out in all necessary detail. The individual codes are, of course, revisions of the older standard codes, which are in this report brought up to date and, in consequence, differ but little from the previous form.

The report concludes with a series of appendices giving more elaborate descriptions of instruments and methods that are covered by the first section on general instructions. Among these are several devoted to the analysis of heat losses of the reciprocating steam engine, and a reference is made to the British standard of engine economy, the use of which is, however, made optional in the complete standard code and omitted altogether in the short form.

TOWN PLANNING AND CIVIC IMPROVEMENT.

By C. H. Mitchell, C.E.*

That the towns and smaller cities of Ontario are awakening to the importance and advantages of town planning and improvement is a most encouraging sign of the times. The larger cities of Canada and America generally have already become active in this respect, in practice as well as in the planning itself. They have realized within the past few years that if they are to escape the mistakes of older cities, and if they are to avoid the conditions which make possible these mistakes, brought about by the ever changing modern methods of life and work, they will require to meet the new situation by a rapid change of policy as to transportation, housing and sanitation.

It has become plainly evident that the time is here for national and provincial effort and for concerted civic activity in each community. One does not need to tell the citizens of any town or city in this young country that this movement is vital, in some manner or other, to each community because in this wonderful progressive Canada of ours every month sees the commencement of some little new settlement or hamlet, or the sudden rise of a village to cityhood. And how many of us in the years past, looking each at his own small town, has in his mind, seen it grow to a larger town and then to a city and to a great commercial and industrial community? And how many of the older ones amongst us have seen the dream come true, even in a few decades? And who will foretell for the next few years, and what will he prophesy for that busy part of Ontario which lies between the lakes?

In the larger Canadian and American cities the growth and congestion arising from a rapid development heedless of provision for the future has been recently marked by a sudden realization of the situation and the civic spirit has been aroused. In most large cities nearly everyone—even though he be styled public spirited—has been bent on money-making, an essentially necessary and a practical occupation but a community which is thus absorbed can hardly be expected to give serious thought to the welfare of future generations or to the benefits which might arise from efforts to make the home city attractive to work and live in. Now, however, a change is taking place, and this is evidenced by the fact that over fifty Canadian and American cities have adopted in some degree a course for improvement of existing conditions and systematic plans for the future. In order to provide wide and continuous business thoroughfares, convenient groupings of public buildings, rapid transit, adequate street traffic circulation, parks and squares, parkways and boulevards, children's playgrounds and gardens, clean and attractive streets, pure water supply and efficient sewage disposal, prohibition of sign and noise nuisances, enforcement of laws for structural building and fire safety and for tenement regulation and the encouragement of housing schemes—for all these, enormous financial undertakings are being projected.

Civic effort toward future planning and improvement, while it may be encouraged ever so much in each community, cannot in itself succeed sufficiently to meet the present-day conditions. Such effort must have encouragement from higher up and from the mutual assistance of sister towns and cities, in educating the people and in impressing upon the Provincial and Dominion authorities the great desirability of legislation designed to encourage, if not assist, various kinds of civic improvement which otherwise might not be rendered possible. This, I take it, is the spirit which brings together at this spontaneous and self-appointed inaugural congress, the many officials and citizens of the cities and towns of Ontario, and it is with such an object that, doubtless out of this meeting, some permanent organization will arise to inquire into the present situation and carry the movement to some conclusion.

Toronto, the "Queen City" of the province is becoming more and more interested each year in practical civic improvement and planning according to the general acceptation of the term. While many of the civic authorities are fully aware of the importance and necessity of changes and provision in anticipation of the future, it has been found that the most effective means of obtaining real action and conclusive legislation by the city government has been through the medium of citizens' organizations such at the "Civic Guild," the "Board of Trade" and the various Ratepayers' Associations which are spread over the city. These bodies have been enabled to study various civic problems without the distorting vision of the prospective candidate for municipal honors at the coming January election, and have brought to bear pressure from the outside, toward improvements either for the immediate present or the future which otherwise would have been overlooked or been incapable of realization owing to local or fractional opposition in various parts of the city. The Civic Guild, which has an active executive committee including prominent business and professional citizens meeting weekly, has been especially making a study of the needs of the city in this respect and has succeeded in inaugurating and in bringing about a great many improvements which all thinking citizens united in approving and supporting. Out of the efforts of the Guild grew the Civic Improvement Committee, appointed by the mayor in 1911, for specially studying and outlining a comprehensive system of civic planning; this report recommends and the Guild strongly urges a permanent commission for the city "clothed with the necessary powers for carrying out a broad, sane and comprehensive scheme of civic improvement."

The general subject of civic planning, which is really as old as the hills and not a recent development, embraces all of those allied subjects such as street routes and widths, depths of blocks and lots, buildings, street circulation and transportation, housing with its light and air problems, sanitation and cleanliness, railroad locations, distribution of factory areas, parks, playgrounds, boulevards and in general all those matters which influence the lives of the people in the community. The ideal, therefore, of city planning is that in which all these branches are harmonized to secure for the people of the city such conditions as will obtain a maximum of efficiency in work of health of body and of enjoyment of life; in other words, to make the city a good place to work and live in.

It has been a common idea in American cities until quite recently that city planning has been almost exclusively identified with city beautifying. This view is not fair to the whole subject because it loses sight of the practical sides of the question, which are very many and complex, as can be readily seen. City planning should mean the acquiring of a city convenient, useful, economical and healthful, as well as a city beautiful

Civic planning may be divided into three general divisions as affecting the city or town within its boundaries, with perhaps a fourth as affecting it from the outside. These are as follows:—

I. The first division is concerned with the circulation and transportation problem within the city, and embraces roads, railways, waterways and all means of communication.

---

* Vice-president, Toronto Civic Guild, member Civic Improvement Committee, of Toronto.

II. The second division concerns all other public areas and buildings not devoted primarily for circulation, and would embrace firstly, such institutions as municipal buildings, schools, post offices and government buildings, hospitals, libraries, museums, churches, public halls, theatres, all of which have more or less land space surrounding them, and secondly, parks, gardens, highways, boulevards, playgrounds, amusement parks, cemeteries, etc.

III. The third division relates to all of the remaining or privately owned lands within the city, and concerns more particularly the character of their development in so far as the community can control, especially as to buildings, sanitation, fire risk, density of population, adornment as to trees, gardens, etc.

IV. A fourth division may very rightly be added to the foregoing, which concerns those areas and features of development lying outside the boundaries of a city in which the city is vitally interested, but over which it probably has no control, except through some higher authority such as the province.

It is not the purpose here to describe in detail the features of the various branches of civic improvement enumerated, but rather to draw to your attention the outstanding problems which are confronting our municipalities, large and small, and more especially those which now, or may in the near future, concern the cities and larger towns of Ontario. Following out these divisions we have:—

I. Division—Circulation and Transportation.

Street Planning.—Street planning in the full sense is the key of the whole subject, whether considered from the strictly practical or the artistic standpoint. After all, the primary principle, and the principle which is the very basis for the existence of cities is the facility of communication, and a city is probably more dependent upon this facility for its prosperity than upon any other physical factor under its control. This can be fully realized when it is considered that three-quarters of a city's traffic is either to or from its general centre.

The area allowed for streets in most cities aggregates at least 25 per cent., but there has been a pronounced tendency of late, even in Ontario, I am sorry to say, to reduce this in outlying portions by sub-divisions in residential districts which are placed on the market by proprietors and agents interested only in the selfish business of selling the lots. These proprietors—still absorbed in money-getting like their predecessors—have in most cases no interested desire to promote the common welfare of the citizens, and do not interest themselves in easy communication, but rather adopt any haphazard layout suitable to the plot of land they happen to have which may appeal to the temporary convenience or fancy of the prospective inhabitants.

Probably the worst fault with our early planning for cities has been the adherence to the "grid-iron" layout. There was a time when this was boasted of as the ideal system and even to-day it is being blindly followed in some of our western cities. It may have done in the days of the Romans and during last century in America, but this is the century of rapid transit and present-day automobile and motor truck transportation demands rapid circulation with the fewest corners and the fewest delays in traffic. Interesting examples of the avoidance of the "grid-iron" are the radial and fan-like systems which have been employed in the great European capitals, such as London, Paris, Berlin and Vienna, in America in Washington, and now in Australia, where the plan for the new Federal capital, about to be built, embraces several hub-like centres with radiating streets.

The obvious remedy for the "grid-iron" system after having been once established is the introduction of through diagonals, superimposed upon the "grid-iron" in order to facilitate rapid transit to the four corners of the city in addition to the four sides. This is the course proposed and in some cases being followed in various cities where the "grid-iron" routes zig-zagging back and forth on the two sides of the triangle have become intolerable under modern conditions. It is the proposal of the Civic Improvement Committee for Toronto to open diagonal streets northeast and northwest from Queen Street, near Yonge Street; these would rapidly serve the growing population in these corners of the city and their suburbs, and would carry traffic beyond the upper Don on the one side and the upper Humber on the other.

Street Widening.—Closely allied with the actual layout arrangement of streets is the question of their width. In the early days in Ontario nearly all streets, without regard to their probable uses, were laid out a uniform width of 66 feet, probably for no other reason than because it was convenient, being the length of a surveyor's chain. You who lived with this system know how it has worked out. Hardly ever can it be said to be too wide, because if in residential quarters the space not actually occupied in roadway can be profitably laid out with grass and trees. On the other hand, how often nowadays is it not found too narrow, even in our towns on the main business streets where traffic, moving and stationary, accumulates and congests and consequently delays the free course of business. In a recent report on an American city an eminent town planning expert states that "every delay in traffic adds to the expense of manufacturers, the cost borne by wholesale merchants and the prices charged consumers by retail merchants; in short, inadequate traffic facilities add to the cost of doing business and of living."

Three factors may be said to enter into the determination of street widths on business thoroughfares: Pedestrian traffic, vehicular traffic and street car traffic. On a main business thoroughfare in a large busy city it has come to be an accepted principle from the necessity of modern traffic that there should be sufficient space between the centre line and the curb for a street car line and three lines of traffic, one standing at the curb, one slow-moving and one fast-moving. If, in a busy retail store district, four lines of pedestrian traffic are provided for in each direction on each side a 16-foot sidewalk would be required. This brings the total width of such a street to 104 feet. If one of the three vehicular traffic lines were dispensed with on each side the width could be reduced to 86 feet, which is the absolute minimum sufficient under present conditions for down-town business streets having two lines of street cars and streets crowded with vehicles and pedestrians. So apparent and acutely has this been brought home to Toronto citizens, where the space for vehicular traffic is so narrow, that an automobile and street car cannot simultaneously pass a standing vehicle, that the civic authorities have been compelled to pass a by-law prohibiting automobiles passing a standing street car whilst loading its passengers. It has also been necessary to prevent vehicles of all kinds standing an undue length of time at the curb.

What is the result? Cities which are now feeling the pinch of narrow 66-foot business streets, and those cities ambitious to have attractive and convenient business streets in the future are quickly and seriously considering how they may widen their busy thoroughfares by at least an additional 20 feet either on one side or both. How this can best be done on streets already built up with stores and fine buildings is engaging the attention of town planners and civic authorities throughout the continent. Two methods have presented themselves. One, the establishment of a new line called the "homologated line," to which all new buildings as built will be moved back, and the second the establishment of such a line to which, at some future date many years distant, all buildings must be moved back. In the former case the cure is unsatisfactory, as has happened in Montreal, because new buildings built to the new line become "pocketted" between adjoining old ones, and thus, if they are stores, may temporily lose trade. The latter method is the one recommended by the Civic Improvement Committee of Toronto, and provides that after the new street line and a date, say, 20 years hence, are fixed, new buildings may proceed on the understanding that at the stated date the added strip will be purchased by the city at the price obtaining at the date of enactment for, say, only two or three stories of the building which must be torn away from the front. Such an arrangement makes easy construction and automatic land purchase by the city at a reasonable price, the owner having the use of it in the meantime.

Rapid Transit.—It is not the purpose here to enlarge upon the conditions brought about in civic matters by the introduction of rapid transit, either within the city and its suburbs, or outside the city in interurban traffic. The great tendency for people to live in the suburbs and country is to be noted, however, and the effect of this daily migration more than ever intensifies the traffic congestion within the city. It is a question, too, whether it does not increase the cost of living if there are not convenient and adequate facilities through the city streets for delivery of goods and supplies.

Railways and Waterways.—In olden days, when cities were walled about, the entrance was through elaborate and artistic gates which gave to the incoming visitor his first impression of the town. Nowadays, our gates are our railway stations and our harbors. These are the entrances, and from these our visitors receive their first impressions and judge of us. Too often do the railways approach our towns through dirty back streets, ill kept and unattractive, if not repellant. How many of our railway stations are situated in unattractive quarters of the town amongst surroundings which, with some attention from the civic authorities and public-spirited citizens, can be made to look inviting and cheerful to the incoming visitor. The railway companies are beginning to do their part by the beautifying of their own station grounds by gardens and lawns. It is the duty of the citizens to help.

The same holds true for our docks on our lake and navigable river gateways—perhaps the possibilities are not so apparent because each town has its own specific problems. The outstanding instance of this movement is the truly magnificent scheme which the harbor commissioners have outlined for the development of Toronto harbor which, when completed, will without doubt be at the same time one of the most attractive as well as serviceable harbors in the world.

Street Improvement.—Amongst the many things which can be accomplished by civic authorities in making a city attractive is by clearing the streets of various obstructions on business streets and by preserving the trees in residential streets.

The removal of electric wires and their forests of poles can be accomplished by placing them either on alleys or side streets of by meeting the question squarely and putting them underground, on the principal streets at any rate. This would then help to preserve the trees in fine residential streets where too often the tops and centres of fine trees are brutally cut away by linemen. The removal of unsightly signs overhanging or prominently situated on or near streets is possible, if concerted action is taken by determined citizens. The encouragement of planting trees and flowers and of sodding on residential streets commends itself, as does also the placing of fountains and watering places. Artistic bridges in the suburbs as well as in the centre of the city are just as easily and as cheaply built as heavy formal structures, and make a street more attractive, particularly if finished with neat balustrades and lamps. Street lighting, especially where the hydro-electric power system throughout the province provides such a cheap and convenient source of electricity, lends itself, as hardly anything else can, to the ready adornment of streets, either business or residential, if the individual lighting scheme by using lamp posts is carried out artistically. And one might go on to all the various street features, such as walks, curbs and pavements and make a plea for clean-cut, well-planned improvements, all of which are just as possible in the smaller cities as in the larger. And, after all this is done no community can have any excuse for permitting its streets to become unsightly with flying papers or other rubbish, and all citizens will have sufficient civic pride to see that their streets are kept looking attractive.

II. Division—Open Spaces and Parks.

When we think of city parks and open spaces we must think of them as utilitarian as well as beautiful—for we must have parks and recreation spaces and breathing places if we are to have happy, healthy and contented citizens. It is not necessary to dwell on the various attractions or valuable features desirable within the parks themselves, but the great question which is interesting all civic authorities nowadays is how to make the parks more accessible to the people; how to get them properly located, and whether it is possible to get them connected up one with the other by an elongated park or parkway, or by a combination of street and park termed a boulevard. This is the day of the electric street railway and of the automobile, so that the total distance to be travelled is not so much a matter as the advantage of getting quickly amongst trees and flowers and greenery as a relief from the hot and dusty working city. The parkway and tree-planted boulevard meet this demand and are to be commended as linking up several parks or open spaces as they bring the parks, so to speak, nearer the people's doors.

But all do not travel or have not the time or opportunity to travel in street car or automobile. For these and for down-town uses there must be small street corner parks or rest places with trees, shrubs and flowers.

All the principal public buildings, such as have already been enumerated, should be set, if possible, in fine, open spaces, not only to show them off to advantage architecturally, but in order to provide a suitable park and garden setting.

This brings us to the question of a grouping of public buildings in a convenient central location which has been called "The Civic Centre," and which is an ideal to which many large cities are aspiring. This, after all, is nothing much more than the old town square or market place of the early days, but now on a gigantic scale. The civic centre idea is being adopted in many American cities as being not only of utilitarian convenience, but best calculated to centralize civic activities and foster civic spirit. This is the scheme which has been proposed in Toronto by the Civic Improvement Committee for a grouping of municipal, county, provincial and federal buildings in one locality north of Queen Street and between Yonge Street and University Avenue. Within the heart of many of the Ontario cities there is a space which, it appears, has been going through a period of neglect the past few years—the market. It may be because of the changed transportation methods, or because of the roads leading in from the country, or the changed methods of marketing, but if a market is to be maintained duty still remains with the city authorities to make the market and its appurtenances and the streets leading to and about it attractive and convenient for carrying on trade under the new conditions. In these days of inquiry as to "The High Cost of Living," it appears to be of vital importance that farm produce and the other necessities can be marketed directly from the producer to the consumer in the easiest and quickest manner possible.

Other open places, such as playgrounds, gardens, recreation and amusement grounds are quite as necessary for our young and old as are schools, churches and hospitals, and the value, for instance, of supervised playgrounds and children's gardens to the rising generation, cannot be over estimated. In this respect the education of the young generation, and the old, for that matter, is of vital importance toward the preservation of trees, grass and flowers in public places.

There are doubtless many other miscellaneous areas and spaces within our home cities which, though now neglected and unattractive, might readily lend themselves to artistic and useful development. Such spaces may be peculiar to the natural situation of the city. It may be a creek or a river; it can be cleaned, old tumble-down buildings removed, the sides banked up and the shores planted with trees and grass. It may be a wooded valley; it can be cleaned of its refuse heaps, the wooded slopes preserved, the underbrush and stumps removed and the whole brought cheaply into a new park. It may even be an unsightly abandoned quarry; a little money spent on earth filling, walks and gardening might make it into an attractive garden. Or, it might be a winding sylvan roadway on a hillside; it can at least be kept clear of weeds and loose stones.

A picturesque valley can, at small expense, be utilized for a parkway and its drives terminate in terraced parks or connect various garden centres of the town. In some of the Ontario towns there are rivers which, on account of their annual freshets, discourage an attractive treatment of their banks—this is all the greater reason for these towns uniting to bring about conservation methods to prevent these floods; the banks within the towns could then be trimmed up with walls and the buildings upon them reconstructed in a permanent artistic manner. If factories must be on the river bank, they can, by the utilization of electric power, avoid, or at any rate, mask the unsightly ash and refuse dumps which are so common. To carry this idea still further, how much more attractive a river could be if it had a water-front space, its outer walk forming, wherever possible, a tree-shaded promenade provided with benches and other features of recreation?

III. Division—Privately Owned Lands.

At first glance it might seem that in a new democratic country like ours the municipality would have but small control over privately owned lands and their buildings and occupants. In a measure this is true, but as time goes on and we work out our various problems of civic government, be they in large or small communities, we have found that many measures must be framed by the people themselves in self-defence and the common interest.

The most important of such measures are, of course, with reference to health and sanitation, a discussion of which is not intended here except to draw attention to the necessity of regulations against overcrowding of houses and factories. The housing question is quickly becoming acute in large densely populated cities where industrial workers are crowded into areas and buildings in proximity to their work. While this question perhaps does not concern the younger and smaller cities in general, it has an interest in particular to those cities which have a proportionately large industrial population, such as have many of the Ontario towns in the hydro-electric power area. In these towns the municipalities can at least encourage in every manner possible the making of attractive, healthy and comfortable homes by the working people. This, as everyone knows, should be encouraged in every possible way by the employers—the manufacturers themselves—to ensure their work-people being contented and efficient. "Garden Suburbs" for working men can be readily organized and should be attractive and worth while for these smaller cities whose population is largely industrial.

On residential streets much attractiveness can be added by placing restrictions to keep the houses back a definite distance from the street and by encouraging tree planting and sodding the space both on and off the streets. Window gardening should be encouraged, especially on those streets where the houses are close to the sidewalk. Legislation is already provided for keeping houses back of the street.

The municipality can very much improve the city in its attractiveness by passing and enforcing regulations for smoke prevention and for removing noise nuisances—such as train whistling—and by discouraging unsightly sign boards on private property.

Reference has already been made to the selfish methods of many landowners in opening up their new sub-divisions. They should be prevented, if possible, from dividing residential property into individual lots too small or of unsuitable form for gardening and planting as is frequently the case, and they should be encouraged to place restrictions upon the locations of houses on their lots. It would not be amiss here to draw attention to the frequent misrepresentation of the location and features of sub-divisions placed before the public which has become so common of late, not so much in Ontario as in the West. While everyone admits that the speculative holding of land within a city is a detriment to its growth, no effective or equitable legislative measure to prevent it is yet apparent, unless it be by the whole reconstruction of our taxation system.

IV. Division—Land Outside the City.

Under modern conditions of transportation and the inevitable expansion of suburban areas outside of the small as well as the large cities, we must at once become interested in the development of the country surrounding the city.

There are two vital points which arise. The city authorities—as distince from the township—have under our present laws, no control over the layout of sub-divisions immediately adjoining or outside the city limits; they cannot, therefore, co-ordinate street planning or street widths with those inside the city, which is an absolute necessity. The city, moreover, does not exercise any control over such questions as park and open space allowances in such sub-divisions.

The arrangement and improvement of township and county roads not only to make them easy and convenient for transportation, but attractive as interurban drives and parkways, is of special interest to a city or group of cities, providing, as it would, a ready means of bringing farm products into town as well as convenient interconnection between towns. This would have a direct bearing on the cost of living and the attractiveness of a group of towns, and of the intervening country as places for residence and business. A noteworthy example of this development on a large scale is the Essex County park system in New Jersey.

Conclusions and Recommendations.

The cities and towns of Ontario, and especially those in the area between the Great Lakes, stand unique in Canada as being so grouped and favored by location as to benefit from hydro-electric power for industrial purposes. They become, in addition to their former activities, each a special industrial centre and their future depends much on this ability to expand while retaining attractive homes for their workers.

In this review of the subject of civic improvement many of the illustrations and the motives have been drawn from the experience and activity of the larger cities but, as has been pointed out, there are very many openings for the adoption of similar improvements and projects in the smaller towns and cities of Ontario. These cities can still be unique by leading in town planning and improvement as well as by leading in industrial activity.

Each city has its own specific outstanding feature. It may be its geographic situation or its transportation facilities, or its contiguous country. It may be some physical feature of landscape—a hill, a valley, a river, lake or waterfall. Whatever these features may be they can all lend themselves to practical utilization, combined with artistic and pleasing attractive treatment.

You who live in these towns and cities can, by taking thought, suggest lines along which your particular civic improvement might follow. Your civic officials, energetic and able though they may be in their proposals for improvements, probably have their hands tied by lack of public support and certainly they are powerless through inadequate laws. The civic authorities require more power and the citizens more understanding and education as to the benefits to be derived.

Much of the momentum for a movement of this character must come from the citizens themselves and from a sympathetic press which fully grasps the significance and advantages of the movement.

In order to inform and educate all our citizens it would appear that in each city, as a neucleus, a small committee or commission should be formed for the purpose of making a study—a stocktaking as it were—of the possibilities which present themselves. They might be improved, if it was thought expedient, to call in an expert to advise either on a comprehensive scheme or upon some particular detail. Any schemes arising from this preliminary study might then be discussed by the civic authorities and the citizens and some improvement programme laid out either in detail or in a comprehensive manner which might be spread over a number of years, but always conforming to a prearranged systematic plan which, when complete, will stand the city for all time.

It will, of course, be asked how such projects could be financed. The municipality may devote a definite portion of its tax rate each year for the purpose, in which each year's levy would be used for the upkeep and improvement of existing works, and for the purchase of new lands and for the construction of new works. Toronto has adopted this principle for its parks.

If it was possible to capitalize a yearly sum or a portion of it, and suitable legislation could be obtained, a capital sum might be raised by debentures and the proceeds devoted to a new work and purchases of lands, the whole managed and controlled by a special commission apart from the city council, which would be a body of a more permanent personnel. One of the great advantages of such a commission would be that it could enter into real estate transactions without publicity, and thus save money which could be put into actual improvements. Such a commission would require to be invested with special powers by the Legislature to enable it to carry on the financing of such projects; the relations of such a commission to the Ontario Railway and Municipal Board would require to be clearly defined.

For the purpose of giving effect to any proposals which might be made as a result of this and other conferences of representatives of the various municipalities of the province in seeking necessary legislation and outlining a course of action, it would seem advantageous to appoint a committee sufficiently representative to embrace the various phases to be considered.

In view of the experience acquired in the study of these questions in Toronto, and in view of the situation existing throughout Ontario it would appear opportune for the municipalities to seek, through their committee, such legislation as would facilitate those civic improvements which may be desirable. This legislation might include amongst other enactments:—

Provision for civic improvement commissions in the smaller cities.

Provision, applicable to cities smaller than already provided for in the Ontario Act, for the purchase by municipalities of lands required for opening streets, not only sufficient for the streets themselves, but for an adequate margin on each side which, after the opening has been completed, can be resold as lots, thus producing a revenue to help meet the cost of the improvement.

Provision for municipalities to secure streets wider than 66 feet on new subdivisions when necessary to conform to a town planning scheme.

A practical method for any necessary widening of business streets already built up.

An adequate control over new subdivisions so that the layout will conform to modern requirements and so that misrepresentation cannot be practiced. The embodiment of ininformation such as contours and elevations is to be recommended.

Provision for the control, through the Ontario Railway and Municipal Board, by the municipality of the layout and street planning features of subdivisions outside the city limits for a stated distance.

With respect to the two last proposals the act passed by the Legislature at the last session provide for control by the board of street planning and the size and form of the lots in subdivisions, both within and for five miles outside, of cities "of not less than 50,000" population.

◆

TESTING A CONCRETE BRIDGE.

On a bridge recently completed in England, a rather unique test was carried out. The bridge was loaded with water. The floor system of the bridge is carried by columns on three reinforced concrete arches. The clear span is 57 feet, and the rise 8 feet 3 inches. The parapets are solid concrete with sunken panels. In preparing for the test, a clay dam 3 feet thick at the base, and 1 foot thick at the top, was built at either end, and the water was conveyed through a 2½-inch hose. The load was applied in 8 hours, and although it exceeded the required loading of 250 lbs. per sq. ft., the deflection at centre was only 1/16 inch. The water test load was rapidly and easily applied and removed, at a very low cost. It would be a very easy matter in situations where water service is not available to pump water from the stream which the bridge spans.

STRUCTURAL-STEEL TOWERS AND POLES.*

By R. Fleming.†

Wood, Concrete and Tubular Poles.—According to the United States Census there were 3,870,000 wooden poles purchased during 1910. Of these 62% were cedar, 18% chestnut, 7% oak, the remaining 13% being pine, cypress and other woods. Classified according to length 17% were under 20 ft., 56% were 20 to 30 ft. (this being the length most commonly used by telegraph and telephone companies), 21% were from 30 to 40 ft., 5% were from 40 to 50 ft. and 1% over 50 ft. The bulletin from which the above statistics are quoted gives the number of poles purchased in 1909 as 3,738,000; in 1908, 3,249,000; in 1907, 3,283,000. Of the poles purchased in 1910 about 21% received some kind of preservative treatment before being set in place.

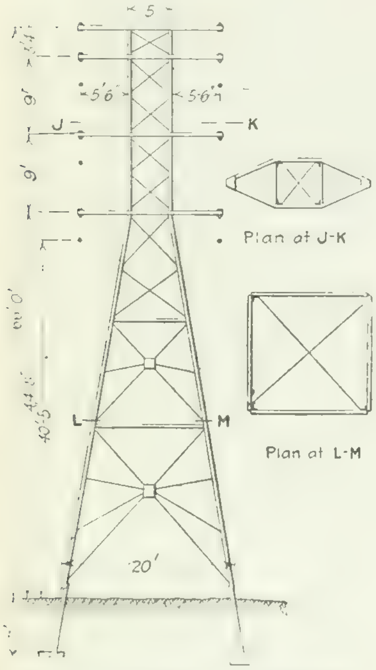


Fig. 1.—Standard Transmission-Line Tower, Connecticut River Power Co.

For 1909 the average first cost of wooden poles purchased was but $1.89. So, from the financial standpoint nothing has been found to take the place of wood for the ordinary telegraph or telephone line pole. The cost of renewals and maintenance is not great enough to warrant the additional first cost of either concrete, iron, or steel poles, and wood will continue to be largely used for some years to come.

Wood is increasing and fabricated steel is lessening in price. Fewer poles or towers are required if made of steel than of wood as they can be placed farther apart; this means fewer foundations, crossarms and insulators. In many cases, as for distribution systems in the yards of shops, wooden poles are not strong enough to carry the loads that will come upon them. Municipal authority has sometimes required the wooden pole on the city street be replaced by the steel pole. The fire risk is eliminated with the steel support, and this is important. A substitute for wood is therefore in many cases not only desirable, but necessary.

Reinforced concrete is being used to some extent for distribution lines of electric-light and power companies, and also for overhead construction of street railways. The general tendency seems to be in the direction of a more extended application.

Tubular poles, made of successive lengths of iron pipe, take up little room, present a round resisting surface to external loads, show excellent results when tested, and can easily be repainted when necessary. Their limitations as to size restrict their use to light loads.

Structural-Steel Towers.—This paper will be restricted to structural-steel supports—either poles or towers. The treatment of reinforced-concrete poles, tubular poles, or the different patented poles on the market will be left to others. The literature on steel towers is extensive—that on steel poles is limited.

We have yet no form of either pole or tower that can be called "standard." Present-day practice for poles is crystallizing about the latticed four-angle type. Towers are being built mostly of the square wind-mill type. An exception is the 140,000-volt line put in operation this year in Michigan, where the towers, of which there are 10 to the mile, are of the braced-tripod type, composed entirely of galvanized-steel angles. This line, at present 125 miles long, is being extended a hundred miles farther and carries the highest voltage yet undertaken, the previous maximum being 110,000 volts.

While the electrical features of a transmission line have received careful attention by the electrical engineer, the structural features have often been taken care of in a crude way, or left largely to chance. The electrical engineer fails sometimes to realize there are other problems to be solved besides those of a purely electrical nature. He should work with his brother, the structural engineer, as the chief item of cost in a transmission line is the structural-steel supports.

Loads.—In designing either a pole or tower the first question for determination is the loads to be carried. These loads are of three kinds: (1) Vertical or dead loads; (2) loads at right angles to the direction of line, due to lateral wind pressure; (3) unbalanced loading in the direction of the line, due to breaking wires. The forces of these three loadings are at right angles each to the other.

(1) The vertical or dead loads are: (a) the weight of the structure itself; (b) the weight of the wires supported by the structure; (c) the weight of the snow or ice coating, if any, on the wires. In sleet regions, ice is generally assumed to accumulate ½ in. thick around the wire. These vertical loads are easily determined, but are seldom a governing feature in the design of the structure, except for the crossarms. The crossarms should be designed for a minimum load of 1,000 lb. at each end. They carry not only the insulators and wires but at times a man or two to adjust them.

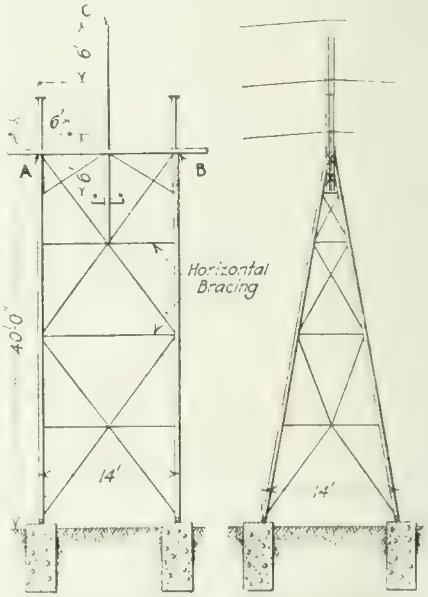


Fig. 2.—Standard Structural-Steel Tower, Georgia Power Co.

(2) The lateral wind pressure on transmission lines has been much discussed. Well known engineers have arrived at widely different conclusions. The author of the article on "Electrical Power Transmission in the Encyclopedia Britannica" writes:

> The actual possibility of wind pressure is very generally over-estimated, and has resulted in much needlessly costly construction.

---

* From a paper presented at the annual convention of the Association of Iron and Steel Electrical Engineers, Milwaukee, Wis., September 30 to October 5, 1912.

† American Bridge Co., 30 Church St., New York City.

Another writer (Joseph Mayer, Engineering News, Jan. 4, 1906), says:

Such lines should, therefore, be built strong enough to resist not only the commonly occurring, but also the exceptionally violent local storms.

From a mass of data, the writer recommends the use of the following wind loads: (a) On the structure itself, 30 lb. per sq. ft. of exposed surface; (b) on bare wires, 15 lb. per sq. ft. of projected area (length multiplied by diameter); (c) on wires covered with ½-in. coat of ice, 10 lb. per sq. ft. of projected area. In a sleet region (c) should be followed as it is the more severe.

It is noted at once that the requirements given for (1) and (2) do not in themselves determine the loads on the towers or poles unless their distance apart is known. In laying out a transmission line the first thing to find is the most economical span. This is both an electrical and a structural problem. The voltage, size and kind of wires, are to be decided. With these given, the spacing of towers can be determined. The foundations also enter in the calculations. Empirical formulas have been given for the most economical span, but so many variables enter into the question, that they can only be regarded as approximate. Each line is a problem by itself and must be solved independent of all other lines.

(3) The assumptions regarding unbalanced loading in the direction of the line will often determine the design of the tower. Practice as well as theory varies widely in this respect. The following is recommended: A tower having three line conductors or three conductors and one ground wire should be designed to withstand the unbalanced load due to any single wire breaking; a tower, having six line conductors or six conductors and a ground wire should be designed to withstand the unbalanced load due to any two wires breaking. The breaking of a wire throws upon the wire in the adjacent span and thence to the tower a load equal to that which caused the wire to break. For the smaller sizes of wire, No. 4 and under, this load should be taken as the ultimate strength of the wire itself. For No. 3, 90%; No. 2, 80%; No. 1, 70%; No. 0, 60%; and for No. 00 and larger wires it is recommended that 50% of the ultimate strength of the wire be used. The reason for the larger wires being given an advantage is that a break is not liable to occur in them until there has been a reduction of cross-section from burning due to a short-circuit from any cause. The smaller sizes will not permit any reduction of section without breaking.

For line conductors hard-drawn copper wire is generally used. The American Steel & Wire Co. find, from tests, the elastic limit of their copper wire to be 34,500 lb. per sq. in. and more and the tensile limit from 50,000 to 65,000 lb. per sq. in. For No. 00 copper wire, a size often used, the longitudinal pull due to one wire breaking will be 2,500 lb.; for No. 0000 copper wire 4,000 lb. will answer. Care must be taken to provide for torsional stresses caused by unbalanced loading.

In designing the standard towers of the line, the material is to be proportioned for maximum stresses due to any combination of loads (1), (2) and (3).

Unit Stresses.—Equally important with assumed loadings are assumed unit stresses. It might be well to divide proposed towers into three classes—(A), (B) and (C), and assume unit stresses in accordance with the classification of the tower. Two prominent features to be considered regarding any line are the importance of uninterrupted service and the probability of loss of life, due to accident of wires or towers giving way. If the purchaser of power insists upon service at all times under heavy penalty, the tower would come under (A). If interruptions under certain limitations are allowed, (B) may answer. From the standpoint of loss of life due to accident, a line over a thinly settled mountain country would come in (B), while the thickly settled zone about a town or city would require (A). Using open-hearth steel with an ultimate tensile strength of 55,000 to 65,000 lb. per sq. in. and an elastic limit of 55% of the ultimate strength, the working unit stress of steel in tension may be taken at 22,500 lb. per sq. in. for (A) and 27,000 lb. per sq. in. for (B). For steel in compression the recommended formula is:

$$\frac{22{,}500 \text{ or } 27{,}000}{1 + \dfrac{l^2}{18{,}000\, r^2}}$$

To (C) is consigned poles and towers where the primary feature to be considered is the cost. The question then too often becomes, not what the structure should be, but what are the least requirements that can be exacted and the line probably do its work. A common method of reducing material is to consider loadings (2) and (3) not acting at the same time, and increasing the unit stress to 30,000 lb. per sq. in. Some engineers think a high wind will not occur when the wires are covered with sleet.

Even admitting this to be true, arcing sometimes happens between wires when there is a high wind on the bare wires. Owing to lightning discharges, accompanied with wind, it may happen over insulators. This is certainly a combination of (2) modified, and (3) which should not be neglected. For wires covered with ½ in. coat of ice, 8 lb per sq. ft. of projected area for wind load is considered allowable by some good authorities. To this there is not the objection as to the use of 30,000 lb. per sq. in. for unit stresses. The latter comes too near the elastic limit of the steel likely to be used.

It may be said here that comparatively few existing towers are of classes (A) or (B). The engineer often finds it a commercial impossibility to have the towers built as he would like to design them. The situation is similar to that of the highway bridges 30 or 40 years ago. The bridges of that day would not be tolerated now. The towers of to-day will not be tolerated a generation or two hence.

Tests.—Specifications often require that towers withstand certain artificial tests. This means the minimum amount of material that will meet these tests will be used regardless of other considerations. The conclusions from artificial tests are often misleading. The material is new and in good order, and there is the friction of pieces bolted or riveted close together. The workmanship for the test pieces has at least not been slighted. The structure is assembled at the shop under more favorable conditions than will exist in the field. The loads are applied gradually and in one direction, quite different from those that will come after erection. The test generally takes but an hour or two, while the structure is built to last for years, during which it is subject to a continued test.

What is wanted in steel work is durability. This cannot be assured by a structure simply meeting an artificial test. It may be noted that almost every bridge that has failed or had to be replaced was "tested" before acceptance. This does not mean that a mechanical test has no value. The contention is that an artificial test alone does not give the true value.

For poles which are composed of few pieces and are of simple construction, a greater value may be placed upon the test than for towers which are made up of a multitude of pieces and are complicated in their structure, but for both poles and towers conditions should be imposed regarding thickness of material, relation of unsupported length of column to radius of gyration, and details—the last being considered especially important.

Special Cases.—A careful study should be made of special cases of loading. Generally when a pole or tower fails it is under conditions for which it was not designed. Horizontal and vertical angles in the line should be considered. Some English specifications allow the standard tower to be used without further calculation when a horizontal angle in the line does not exceed 8 deg. American specifications often allow this angle to be 10 deg., though there is no uniformity of practice in this respect. Frequently standard towers are used and the approach spans are decreased. In one large system, where the average cable span length on tangents for level country is 550 ft., the approach spans to angles in the centre line vary from 400 ft. on angles up to 8 deg. to 100 ft. on angles of 45 deg., the maximum angle turned on one tower. Sometimes a standard tower is used and guyed. This is generally objectionable. The most satisfactory practice is to use a tower calculated to withstand the increased loads due to the deviation in the direction of the line. Poles or towers adjoining railroads should be designed to meet special requirements. The specifications issued by some railroad companies for lines crossing their right-of-way are quite severe. The National Electric Light Association's "Specifications for Overhead Crossing of Electric Light and Power Lines" are less stringent. Poles used about manufacturing plants will be mentioned later.

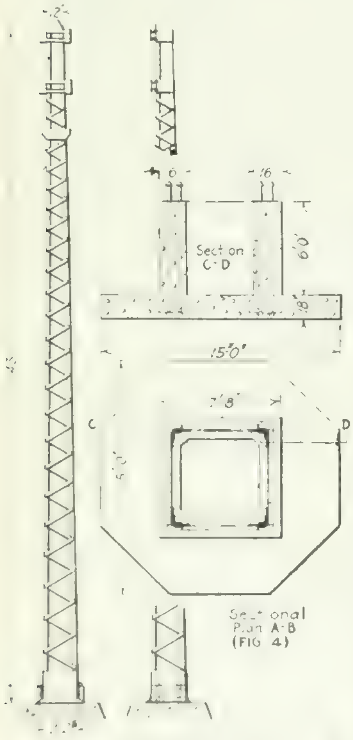


Fig. 3.—Standard 40-ft. Two-Arm Steel Pole, Indiana Steel Co.

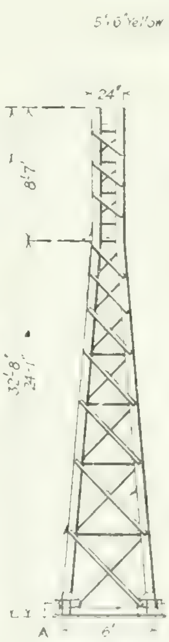


Fig. 4. Typical Electric-Line Pole for Railway Yards, Westinghouse, Church, Kerr & Co.

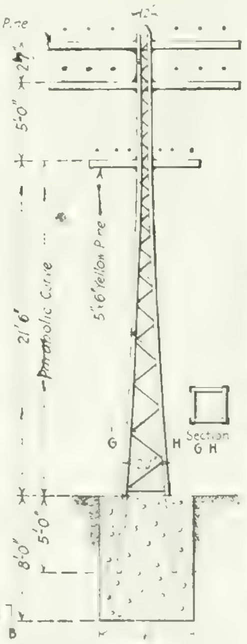


Fig. 5. Standard Transmission-Line Pole, N. Y. C. & H. R.

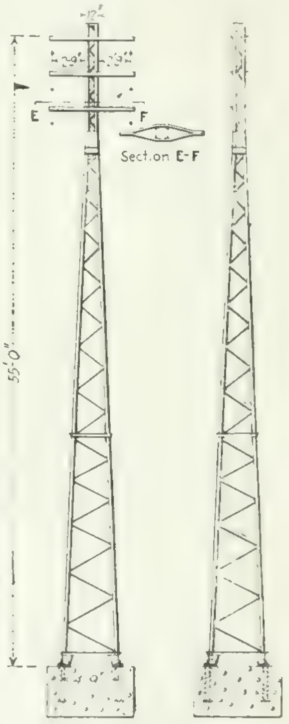


Fig. 6. Standard Steel Pole of the Tri-City Railway & Light Co., Davenport, Iowa; J. G. White & Co.

"Flexible" Towers.—What are known as "flexible" towers originated in Italy a few years ago, and are being used to some extent in this country. Semenza, an Italian engineer, conceived the idea of caring for the longitudinal forces in a line through a flexible system rather than by a single rigid tower. By this method an occasional tower, about one in ten, is "dead-ended" or made perfectly rigid to take longitudinal stresses, the intervening towers being made to withstand only the dead weigth and transverse wind loads. If a wire breaks there is a drop in the catenary and the shock is absorbed into the series of poles by each yielding at the top. The "dead-end" tower being designed for all the wires breaking, prevents the longitudinal pull extending farther along the line. The intermediate or standard towers are generally made A-shape of two channels latticed together with angles. The advocates of this method are enthusiastic over the saving they claim in steel material and foundations.

A point generally overlooked in making a comparison between the flexible and the rigid towers is that if flexible towers are used either heavier wire or higher towers are required. With the rigid type, if a wire breaks, the tower at each end will take up the unbalanced loading. In the flexible type, say with three line conductors and a ground wire, if a wire breaks the tops of the towers on either side of the break will be pulled over by the four cables in the next span until the total tension in them would be just balanced by that in the remaining conductors of the damaged span. That is, the three cables remaining would do the work of the four in the adjoining spans, showing the need of heavier wire. Of course, this unbalanced loading can be taken up by a greater sag and less tension in the cables, but this necessitates higher towers to maintain the required clearance underneath the wire. It is an open question just how far flexible towers are to be commended. Does the reduced cost overbalance the lessened reliability? For low voltages with towers or poles comparatively short distances apart, they may sometimes be used to advantage. Where high voltages are used with but eight or ten towers to the mile, rigid towers should be used. The city of Winnipeg in its municipal line from Pointe du Bois on the Winnipeg River to the city, a distance of 72 miles, compromises on the choice of towers. Rigid towers are spaced 1,200 ft. apart with a flexible tower midway between. Towers are 43 ft. to the crossarm and carry a double circuit or six wires.

Foundations.—It matters little how near perfect the superstructure may be, if it rests on insufficient foundation. It will then fail in the hour of stress. The theoretical considerations governing the design of foundations are well known, but it is folly to design these foundations in an office, unless it is known the assumptions made fit the actual conditions of the soil at the site. The attempt to do this will probably result in a footing with an undue margin of stability, causing unnecessary expense, or a footing of insufficient strength, liable to cause trouble ever after. Especially to be condemned is a prevalent practice of placing the steel anchorage without any thought of surrounding conditions. Some towers recently built showed excellent results when tested at the shop in the usual way by firmly fastening the foot of each leg to a heavy steel frame. In the field they were pulled over without any difficulty. The soil yielded and the steel anchorages pulled out. Such designing, or lack of designing, is foolish.

The usual method of anchoring is to run an angle stub 5 to 8 ft. in the ground. This stub extends a foot or so above the ground level, and at the top are open holes for bolts to take the corner legs of the tower. At the bottom of the stub is a cross piece 3 or four ft. long of either channels or angles. This anchorage is placed in a hole dug in the ground and the hole refilled. For light lines with short spans and good soil, this may be sufficient for a time. For the usual long-span transmission line, the overturning moment due to the side wind pressure becomes much larger. A platform at the bottom of the angle stub can easily be designed to withstand the uplift, if the soil conditions are known.

Without any protection save a coat of galvanizing, corrosion is bound to set in at or near the ground level. The writer, a year ago, saw some towers in a cultivated field against the corner angles of which the soil had been turned in plowing. The galvanizing had nearly disappeared, though the towers had been erected but two years. There is trouble at no distant future for those towers. The anchorage should extend not less than a foot above the ground line and should be entirely encased in concrete; though a sleeve of concrete extending from the top to two or three feet below the ground line is sometimes used. Here at once a practical objection is raised. To get water and material at the site of the various towers of a transmission line, make concrete and properly set it, is difficult and expensive. Unless a strict supervision is exercised the work is sure to be slighted.

Thicker steel sections used for the anchorage will delay, but not prevent, failure from corrosion. It has been suggested that the anchor stubs be designed in two lengths, the upper length to be removable and thus replaced without tearing down the tower. A large line installed last year used a preservative paint instead of galvanizing their anchorages.

Life.—The life of a wooden pole is given, if of cedar, as from 15 to 20 years, and longer if preservatives are used. The life of a steel pole or tower cannot yet be definitely stated. It is only as far back as 1903 that the first high-tension transmission line was built in which steel towers were used exclusively. This was a line 101 miles long in Mexico, with towers about 450 ft. apart. The present practice of a multiplicity of light sections will not be conducive to long life. Sections ⅛ in. thick are very common—more of this thickness than of any other are used in the average tower. Towers made of such material, galvanized at the shop, bolted together in the field, and then left alone cannot last for a long term of years.

The use of unusually thin metal for compression values calculated in accordance with accepted formulas is to be criticized. In a number of tower tests, under the writer's observation, the failure was always in the 4 x 4 x ¼-in. corner-angle leg. They were not good for their calculated value. This confirms Talbot & Moore in "An Investigation of Built-up Columns Under Load"[*] in which they write:

> It would seem quite probable that, for columns of the same length and containing the same amount of metal, one which is of stocky form and in which the metal is distributed so as to resist local flexural and torsional action will be much stronger and more satisfactory than a column of more flimsy form, which has its metal spread in thinner sections, even though the slenderness ratio l/r of the former may be considerably more than that of the latter.

Important changes will take place in the direction of thicker material after some of the present lines fail, and the present policy of purchasing only what will answer for the immediate present is abandoned. There is no reason why a tower properly designed, inspected at regular intervals, painted when necessary, should not last 50 years, perhaps longer.

Examples of Towers.

Connecticut River Power Co.—The 917 towers for the line of the Connecticut River Power Co. were designed and built by the American Bridge Co. Of these towers, 862 are the standard, shown in Fig. 1. The specifications, drawn up by J. G. White & Co., call for the strength of these towers to be as follows:

> The towers shall be designed for, and shall be guaranteed to stand, the following test loads without stressing any member beyond its elastic limit:
>
> Insulator pins and grounded wire cap:
>
> (1) At top of insulators for line conductors, 1,600 lb. in any direction perpendicular to pin axis. (2) At top of iron cap support for grounded wire, 1,400 lb. in any direction perpendicular to axis of support.
>
> Supports for pins and cap.
>
> (3) 1,400 lb. load in any direction on grounded wire cap and 1,600-lb. loads in any direction on line conductor insulators to be applied singly or in any combination to produce maximum stress in the supports.
>
> Main tower structure:
>
> (4) A load of 4,800 lb. in any direction at point A (Fig. 1), and no load at B and C.
>
> (5) A load of 4,800 lb. in any direction at points A and B, together with a load of 1,400 lb. in any direction at point C.
>
> In proportioning material the unit stresses were taken at 24,000 lb. per sq. in. net for tension and for compression.
>
> $$\frac{24,000}{1 + \frac{l^2}{13,500\, r^2}}$$

Georgia Power Co.—Some towers designed and built by the American Bridge Co. for the Georgia Power Co. are shown in Fig. 2. Suspension insulators are used. There are 735 towers of the dimensions shown in cut carrying six line conductors of No. 0000 copper wire, and two 7/16-in. galvanized-steel-strand ground wires. The data drawn up for the Georgia Power Co. by the Northern Contracting Co., C. O. Lenz, chief engineer, from which the towers are designed follow:

> The test load shall be: (1) A longitudinal pull of 4,300 lb. at right angles to the end of any one cross-arm. (2) A vertical load of 1,500 lb. at the ends of any or all cross-arms. (3) A load of 1,500 lb. pulling in any direction at the top of tower. (4) A load of 10,000 lb. pulling at right angles to the line or parallel to the cross-arms, that is, 2,500 lb. at each cross-arm. At the same time a pull parallel to the line or at right angles to the cross-arms of 8,000 lb., that is, 4,000 lb. in the same or opposite directions at each end of any single cross-arm or at one end of any two cross-arms.
>
> Cross-arms are proportioned for combined loading (see section on "Loads" under "Towers" above) of Case 1, Case 2, and 1,250 lb. horizontal thrust at end of arm. The tower is proportioned for maximum combination of Cases (2) and (3), or (2) and (4). Unit stresses used are 25,000 lb. per sq. in. net for tension and for compression.

---

[*] Bulletin No. 44. University of Illinois Engineering Experiment Station.

$$\frac{25{,}000}{1 + \dfrac{l^2}{18{,}000\ r^2}}$$

There are also 816 standard towers carrying six line conductors of No. 00 copper wire and two ⅜-in. galvanized-steel-strand ground wires, the towers being 16 ft. square at the base and 70 ft. to the upper cross-arm. The loads for which they are designed are: (1) A longitudinal pull of 3,000 lb. at right angles to the end of any one cross-arm. (2) A vertical load of 1,200 lb. at the ends of any or all cross-arms. (3) A load of 1,200 lb. pulling in any direction at the top of the tower. (4) A load of 8,000 lb. pulling at right angles to the line or parallel to the cross-arms, that is, 2,000 lb. at each cross-arm. At the same time a pull parallel to the line or at right angles to the cross-arms of 5,000 lb., that is, 2,500 lb. in the same or opposite directions at each end of any single cross-arm or at one end of any two cross-arms.

The combination of loadings and unit stresses is the same as for the towers with No. 0000 wires.

In addition to the above standard towers there are 200 towers designed to meet special conditions.

Structural-Steel Poles.

It has been requested that structural-steel poles be given a prominent place in this paper. Much of what has been written is intended to be applicable to either poles or towers, though for transmission and distribution systems about the yards of manufacturing plants some of the conditions are quite different from lines through great stretches of open country. The size of base is restricted to as small an area as possible. This necessitates a pole instead of a tower.

The loads to be carried and the desired permanency demand a steel instead of a wooden pole. An interruption of service, even for a short time, means inconvenience and loss. Accidents to life and property, if any occur, are liable to be disastrous and must be guarded against. The seriousness of failure on such lines will justify heavy construction. For this reason it is recommended that each pole be designed to withstand, in addition to the dead and wind loads, the unbalanced load due to a majority of the wires coming upon it being broken. All conditions such as the probability of wires being added in the future, the deviation of the line from a tangent, or special loadings, should be considered. A unit stress of not more than 16,000 lb. per sq. in. net for tension and the same reduced by previous formula for compression should be used.

The foundations shall be of concrete and shall be designed in accordance with local conditions. These local conditions should be thoroughly understood. A clause from the specifications of New York Central & Hudson River R.R. for lines crossing railroads is applicable here:

> The foundations shall be of concrete ond shall be designed so as to be able to resist the greatest tendency to overturn due to any combination of the loads specified. No steel shall be carried below the surface of the ground unless encased in concrete. The tops of foundations or tops of the concrete casing shall not be less than 12 in. above the ground and always above flood water.

Indiana Steel Co.—The latest word in the various departments of steel manufacturing may be found at Gary, Ind., in the plant of the Indiana Steel Co. Attention is called to a paper in the Transactions of the American Institute of Electrical Engineers for 1909 entitled, "The Industrial Application of the Electric Motor, as Illustrated in the Gary Plant of the Indiana Steel Company," by R. R. Shover It is valuable on account of the detail with which the writer has gone into so many phases of his subject.

The standard 40-ft. two-arm pole is shown in Fig. 3. The poles and towers throughout are designed to carry the dead load of the construction, including a coating of ice on the wires equal in thickness to the radius of the wire, together with an overturning load of 20 lb. per sq. ft. on the towers, and 10 lb. per sq. ft. on the projected area of the wires; also a torsional stress in any pole produced by an unbalanced load resulting from the cutting of 25% of the wires in the adjacent span. The unit stresses used are those of the American Railway Engineering and Maintenance of Way Association. No material less than 5/16 in. thick is used.

Westinghouse, Church, Kerr & Co.—R. A. Marshall, structural engineer, has designed and built a number of poles for the yards of railroad shops. Fig. 4 shows a typical pole and its foundation.

Each pole is carefully worked out by itself. The dead loads are the structural steel and the wires with a covering of ice ¼ in. thick. The wind load is figured at 13½ lb. per sq. ft. on projected diameter of wire with ¼-in. ice coating. The tension in wire is figured on a basis of 100 ft. span with 3% sag at centre. A number of these poles take pulls at right angles to the main line which adds materially to the stresses. This is not an uncommon feature in the yards of railroad shops and manufacturing plants.

The steel is designed for two-thirds of the computed loadings with a unit stress of 16,000 lb. per sq. in. net in tension and 16,000 lb. reduced by the formula for compression. No material less than ¼ in. thick is used. Observe that the foundation is of ample proportions.

Pennsylvania R.R.—Among the interesting features of the New York tunnel extension of the Pennsylvania R.R. are the poles through the Meadows section in New Jersey. There are two lines, one for telegraph and telephone purposes, and one for power transmission; they were designed by R. D. Coombs. The poles of the telegraph lines are of concrete, 25 to 50 ft. high and spaced 70 to 135 ft. apart. The poles of the high-tension transmission line are of latticed steel, parabolic outline, square in cross-section, with one angle at each corner and single angle bracing. They are designed not only for present requirements but a liberal provision is made for future needs. The Hackensack River is crossed midway in the Meadows section. The adjoining poles, at the time they were built, were the highest in this country.

These poles (or tower-poles) are 765 ft. apart. Each one is 15 ft. square at the base and 3 ft. square at the top. The tops of foundations are 6 ft. above high water, and from the top of the foundation to the ground line is 188 ft. 4 in. Special features are: Large number of heavy wires, of voltage requiring some separation, carried at a minimum clear height above high water of 133 ft. No strain insulators were available of sufficient electrical or mechanical strength, therefore nests of pin insulators carrying saddles were used to support the wires on the poles. The poles present a graceful appearance. The base is small in area—a greater spread would further obstruct the river and increase cost of foundation. On account of the importance of the line in operating the terminal division of a great trunk-line railroad, conservative data were used for calculations. These data are as follows:

Wires—

River Span: One 250,000-circ. mils, hard-drawn stranded copper ground wire; twenty-four 250,000-circ. mils, hard-drawn stranded copper line wires; four 250,000 circ. mils, hard-drawn stranded copper signal wires; two 2,000,000-circ. mils, hard-drawn stranded copper feeder wires.

Adjoining span same as river span.

Second adjoining span, same as river span except for signal wires—four No. 00 hard-drawn solid copper.

Loading—

One-half-inch ice on all wires with 8 lb. per sq. ft. wind pressure on diameter multiplied by length.

Thirteen pounds per square foot of wind on 1½ times the pole area.

Normal sag 31.8 ft.

Transverse pull 24,900 lb.

Longitudinal pull 22,135 lb.

Unit stresses: Steel in net tension 15,500 lb. per sq. in.; steel in compression 17,600 lb. per sq. in. reduced by formula.

New York Central.—The poles near New York City for the electric-transmission lines of the New York Central & Hudson River R.R. are often quoted as good practice. Fig. 5 shows the standard pole carrying 12 high-tension conductors.

It is made of four corner 3½ x 3½ x ⅜-in. angles laced with 2½ x 2 x ¼-in. angles. Poles on a tangent are 150 ft. apart with a wire sag of 30 in., those on a 6 deg. curve are 107 ft. apart with wire sag of 15 in. The dead loads are the structure itself with the wires covered with ½-in. coating of ice. Wind pressure is taken at 30 lb. per sq. ft. on the surface of the pole and on all wires covered with ½-in. coating of ice. The unit stresses used are 30,000 lb. per sq. in. net for tension and for compression

$$\frac{30{,}000}{1 + \dfrac{l^2}{125\, r^2}}.$$

While these unit stresses seem high, the loadings are large. The foundation is a solid block of concrete. The cross-arms are of wood, probably to secure greater insulation.

Long Island R.R.—A similar substantial sonstruction is used by the Long Island R.R. for their steel poles on Long Island. The parabolic outline is abandoned. For the high-tension wires the wind is figured on the bare wire; for the low-tension wires it is figured on the wire covered with sleet ½ in. thick. Wind pressure is figured according to results of German high-speed railway tests, where pressure per square foot = $0.0027\ V^2$. With a velocity (V) of 100 miles per hour, wind pressure = 27 lb. per sq. ft. on flat surfaces and 13½ lb. per sq. ft. on projected areas of conductors. Side pull on pole is figured for a centre deflection of 6 ft. with poles on 150-ft. centres.

N. Y., N. H. & H. R.R.—The 40-ft. yard poles of the New York, New Haven & Hartford R.R. used in the electrification of the Harlem River Branch, are rectangular in cross-section of four 5 x 3½ x ⅜-in. angles, double latticed on all four sides with 2¼ x ⅜ and 2¼ x ½ in. flat bars. The poles, back to back of angles, are 2 x 3 ft. at base and 2 ft. by 2 ft. 2 in. at top. The base of each pole is made specially strong From this base, four anchor rods of 1¾ to 2⅝ in. diameter and upset at ends run down 8 to 10 ft. in a concrete foundation.

J. G. White & Co.—Some poles designed by S. R. Jones, structural engineer of J. G. White & Co., are simple in construction. They are for a transmission system in the Middle West and are shown in Fig. 6.

The data upon which design is based is:

Power wires: One circuit No. 1 stranded medium hard-drawn copper; one circuit No. 4 stranded medium hard-drawn copper.

Ground wire: No. 8 copper-clad steel.

Maximum allowable tension in wires: Fifty per cent. of breaking strength with ½-in. coating of ice and wind load of 8 lb. per sq. ft. on horizontal projection of increased diameter of wire.

Assumed loads on pole: Vertical loads: Crossarm = 600 lb. at end of crossarm; pole = weight of pole + weight of wires covered with ½-in. thickness of ice.

Horizontal loads: Total pull of 2,500 lb. applied at middle crossarm in direction of line, or at right angles to line plus wind load on pole at 20 lb. per sq. ft. on exposed surface (both sides of pole included in surface exposed to wind pressure).

Unit stresses in steel: 24,000 lb. per sq. in. net for tension; 24,000 lb. per sq. in. reduced by formula for compression.

The preceding poles may be taken as illustrating the best practice of to-day. It will be seen that they have much in common. In each case the pole is made of four angles latticed.

Various Poles.—A pole made of two channels laced has been used, but such a pole is limited to light loads and low heights. The same can be said of a pole made of one plate and four angles. Foster ("Electrical Engineer's Pocket-Book") gives the deflection of some poles 6 ft. in ground and 24 ft. above ground, made of 6-in. to 12-in. by 3/16-in. plate and four 2½ x 2 x ¼-in. angles, for loads of 500 to 2,500 lb. applied 3 ft. from the top, to be from 1 to 5 in. These poles were used for electric railway service. The plate-and-angle pole has the advantage of being a good shape for inspection and painting.

Patented poles, made of rolled-steel sections fastened together at intervals, are on the market, and are meeting with considerable sale. They show good results for vertical loads, but the sections being battened and not laced together are adapted to carry only light lateral loads to the base. It is the custom to guy these poles from the top if the lateral forces are large. This restricts their use.

Conclusion.—The use of steel poles and towers is on the increase. This paper is not intended to be a complete discussion for the field is too varied and too large to be thoroughly reviewed in a single paper. It is hoped, however, what has been written may not be without interest, and lead to further discussion on the subject.

THE DIESEL ENGINE FROM THE USER'S STANDPOINT.

The Diesel engine is coming into such general use for the purpose of the generation of electrical energy that a few notes on its advantages, cost of running, and maintenance, may be of interest. Mr. Wm. J. U. Sowter read a paper recently before the Dublin local section of the Institution of Electrical Engineers. A few abstracts of the paper which are of particular interest follow:—

Although several papers have been written on the subject, most of the conclusions arrived at are based on estimated results, and it is, therefore, the intention of the author to discuss the matter from the user's standpoint, quoting as far as possible results obtained in actual practice.

The following is a specification of a suitable oil which the author has adopted with satisfactory results:—

1. The oil shall be either crude, refined, or a residue of petroleum.

2. It shall be free from tar, bitumen, or solid hydro-carbons; it shall be also be free from sand, fibrous matter, or foreign solid impurities.

3. The oil shall not contain more than one-half of 1 per cent. of water, nor 1½ per cent. of sulphur, and shall be free from acid.

4. The viscosity shall be such that the oil will flow in a continuous stream with 1 ft. head through a ½-in. copper pipe 6 feet long without pre-heating.

5. The calorific values shall not be less than 18,000 B.t.u. per lb.

Many other liquid fuels may be used, such as residue shale oil, gasworks tar oil, or creosote oil

Running Costs.—Contrasted with steam plant, there is but little difference in fuel consumption per B.H.P.-hour between large and small Diesel engines, nor does the fuel consumption increase largely per unit of energy as the load is decreased on the engine. It is well known that a large steam engine running at light load is grossly inefficient, the fuel required to maintain steam pressure in the boilers and to run the engine light, together with the necessary auxiliaries, being out of all proportion to the work done; also, a small steam engine requires many more pounds of steam per h.p. to run it fully loaded than does a large one. In addition to these considerations there is the serious question of stand-by losses, which are very great indeed with steam plants, while they are absolutely non-existent where the Diesel engine is used.

It is apparent from the foregoing remarks that it is unnecessary from the point of view of fuel economy to install large engines when a greater number of small engines will suit the circumstances of any particular case better, desirable as the former procedure may be so far as capital cost per kilowatt of plant installed is concerned.

The following figures show the cost of fuel per unit generated with oil at the prices mentioned, and at various loads, for a 50-B.H.P. engine coupled to a 33-k.w. generator:

Load.	Dynamo Efficiency.	Price of Fuel per Ton.			
	Per Cent.	40s.	50s.	60s.	70s.
Full	88	0.161	0.201	0.242	0.281
Three-quarter	86	0.178	0.210	0.252	0.295
Half	83	0.208	0.261	0.314	0.365
Quarter	78	0.307	0.384	0.462	0.538

These figures are not merely manufacturer's "paper" figures, and the author is in a position to vouch for them personally, he having obtained similar results after repeated tests at irregular intervals. On larger plants the cost would be some 10 to 20 per cent. better, depending upon the size of the plant.

Figures such as the above clearly demonstrate the great advantages this type of plant offers for use in small generating stations.

Capital Cost.—The capital cost of a Diesel engine direct-coupled to a generator is considerably greater than a gas or steam-driven generator of similar capacity, but when the costs of complete plants, comprising either gas or steam, are compared, there is but little differences in the price per kilowatt. A Diesel station, however requires less land and building than similar stations employing steam or gas plant, so that the difference, if any, is in favor of the Diesel plant.

The following are approximate prices for small plants, delivered and erected on purchaser's foundations complete with all oil storage tanks, piping, etc., and may be taken as fairly representative:—

Size in Kilowatt.	Price.	Price per Kilowatt.	F.O.B. Works.	Weights.
100	1,950	19.5	1,340	19,450 lbs.
150	2,600	17.3	1,770	23,250 lbs.
200	3,260	16.3		
300	4,380	14.6		
400	5,300	13.3		

FILING SHOP DRAWINGS AND RECORDING PROGRESS OF WORK.

A very simple method of filing shop drawings and recording the progress of shop work has been adopted in the superintendent's office of the Dominion Bridge Company, at Lachine, Que., and is described in a recent issue of the Engineering Record. The drawings of all work in progress, amounting to fifty or more jobs, are uniformly filed in a very convenient and accessible manner and the main features are daily posted on to them in such a way that the condition of the work can be instantly determined by inspection. Each complete set of shop blueprints of standard size is clamped between two 2 x ¼-in. hardwood strips, 24 in. long, that are fastened across one end of the sheets. Attached to the centre of one of the strips is a U-shaped clamp of 2 x ⅛-in. iron with one leg about ¾ in. clear of the fixed strip. The ends of the drawings are placed between the fixed and loose strips, the latter being set inside the clamp and forced down to bearing by driving a thin steel wedge under the projecting leg of the clamp between it and the loose strip. This holds the blueprints tightly in position at the centre of the strip and prevents their slipping, while the edges of the sheets at the ends of the strips, although not held closely by the latter, cannot be displaced on account of the centre clamp and are protected by the wood strips which shield without clamping them.

The fixed strip has a frame for a title card close to the clamp and the clamp is provided with an eye by which it is suspended from the horizontal leg of a long hook having a vertical shank clamped between a small angle and a flat bar about 15 ft. long which are supported at the ends and intermediately. The hooks are set 3 or 4 in. apart at a height of about 5 ft. above the floor and provide for the very convenient and accessible filing of the drawing which can be selected or restored to the file independently.

Every day the number of pieces finished and inspected are checked off by red and yellow marks, respectively, on the blueprint, or as soon as any set of pieces is completed it is indicated by a circular check mark of the proper color. When all of the pieces on a sheet are finished large circles are drawn on the title to indicate it. The drawings are examined daily and when a job nears completion if scattering pieces are incomplete they are entered up in a "short-order" book which is posted daily and quickly shows any deficiency that may be made in shipment on an order.

OTTAWA LIGHT COMPANY'S CAPITAL INCREASE SANCTIONED.

The Dominion Government has sanctioned the proposed increase in the capital stock of the Ottawa Light, Heat and Power Company, Limited, from $2,000,000 to $5,000,000. This increase will be made by the issue of 30,000 new shares of $100 each. Of the present authorized capital of $2,000,000, at the end of 1911 $1,984,400 was subscribed and paid. This was an increase in paid-up capital of $404,000 over 1910. It represented 14,910 shares of the Ottawa Electric Company and 4,934 shares of the Ottawa Gas Company, which were exchanged at par for shares of the Ottawa Light, Heat and Power Company.

The Ottawa Light, Heat and Power Company this week declared a bonus of 1 per cent. with the usual quarterly distribution of 1¾ per cent. on the stock of the company. A similar bonus was paid last year with the dividend at the same rate as this year; a stock bonus of 25 per cent. was also paid in 1911. In 1910 the dividend rate was 6 per cent. with which a 2 per cent. bonus was paid, and in 1909 5 per cent. with a bonus of 1 per cent.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD,
MARINE AND MINING ENGINEER, THE SURVEYOR,
THE MANUFACTURER, AND THE
CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1 75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820 Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, DECEMBER 26, 1912. No. 26

CONTENTS OF THIS ISSUE.

Editorial:

PAGE
York County Good Roads 923
Toronto's Water By-law 923

Leading Articles:

The Electrical Equipment of the Hawthorne Avenue Bridge, Portland, Ore. 909
Power Plant Tests 910
Town Planning and Civic Improvement 911
Structural Steel Towers and Poles 916
The Diesel Engine from the User's Standpoint.... 921
The York County Highway Commissioners' Report 926

Engineers' Library 930
Coast to Coast 936
Personals 937
Coming Meetings 938
Engineering Societies 938
Market Conditions 24–26
Construction News 65
Railway Orders 72

YORK COUNTY GOOD ROADS.

A significant result of the improvement which has already been done on the roads throughout York County which lead into the city of Toronto is the falling off in the use of the elevators. This past fall the elevators within a radius of twenty miles and outside the city limits have only done about one-third of the regular business.

This has been due to the fact that the farmers are now able to draw their grain directly into the city, thereby securing better prices and increasing the business of the city elevators.

Good roads mean not only better prices for the farmer, but lower cost to the consumer. Increased facilities in marketing produce by the bettering and improvement of the highways always result in the forming of new business and the development of added sources of trade.

York County good roads have been vastly improved by the money already spent on them, but there is still much to be done. The by-law now before the ratepayers for the additional amount of $100,000 deserves the hearty support of the city.

◆

TORONTO'S WATER BY-LAW.

Are the citizens of Toronto satisfied that the by-law now being placed before them, to provide six million dollars for a duplicate water supply from Scarboro Heights will give them the best and most economical location for the future water supply of the city?

It is interesting to note the reasons on which the Water Commissioners based their choice of Scarboro Heights. The proposed location of the intake crib off Scarboro is twelve miles from the present intake, while the effluent from the Morley Avenue sewage disposal works, which will ultimately handle practically all of the city's sewerage, is discharged about half-way between.

The Commissioners are agreed in their report that Lake Ontario must remain the future source of supply. They state that from the evidence to hand the transporting lake currents are from the east to the west, and that there is a lesser probability of impure water to be met with off Scarboro than off Mimico. They add that there is no location within ten miles of the north shore lake from which water can be drawn which will at all times present a safe supply, unless such water be subject to some form of purification.

On page 6 of the report the following are given as the reasons for the choice of Scarboro:—

"That all the available evidence points to the necessity of increasing the water supply to meet the demands of one million population, and that it is not advisable to rely upon the present location for such increased supply. Taking into consideration the probable future growth of the city, it is reasonable that the present location of supply be considered only as a central unit, and that extra units be installed either east or west of the central unit.

"That, owing to the demonstrated fact that pure water is obtainable for longer intervals of time east of the harbor than to the west, and, owing to the high elevation of the plateau at Scarboro, a second unit be first installed at this location.

"That until Toronto can be assured of a second independent and reliable supply of water from the lake, what have been considered as exceptionable and unpreventable circumstances may again arise, to the discomfort of the citizens and consequent lack of confidence in the organization of the Water Works Department of the city."

Evidently, then, their decision is based on these facts:—

1. That the past troubles with the present location of the intake debar Centre Island as the main source of supply.

2. That the increase in the city's population demands units east and west of the present plant.

3. That there is greater probability of obtaining pure water for greater length of time at Scarboro.

4. That there is high ground at Scarboro for the location of a reservoir to provide gravity supply.

The Scarboro project provides for an intake tunnel ten feet in diameter and two miles long; pumping machinery of sixty million gallons capacity; a mechanical filtration system; covered reservoir, and gravity mains from the reservoir throughout the city. The total estimated cost is given as $5,320,000. As a matter of fact, we believe that this amount will be considerably exceeded if the plant is constructed, as the amount estimated for many of the items is too low.

The past troubles with the intake of the present plant on Centre Island have been due to faulty design and construction. The Commission proposes at Scarboro to spend $1,346,600 for intake purposes alone. It will cost to do this work at least a million and a half. If this same amount of money, or even half of it, were spent in installing an intake crip with intake tunnel at Centre Island, an independent and duplicate supply could be secured at that point.

That the increase in the city's population demands units east and west of the present plant sounds like a reasonable argument by the Commissioners, but we note in their report that they expect to supply West Toronto with water from Scarboro, a distance of fifteen miles. If the reason for the choice of Scarboro is the extension of the city's area and population eastwards, then why do the Commissioners contemplate the supply of West Toronto from Scarboro? Why not use the Centre Island plant, which is much nearer? With the city's population increased to one million, it is very doubtful whether the eastern and western limits of the city will be extended beyond what they are to-day. The central system to-day has no difficulty in supplying all parts of the city.

There is a greater probability of obtaining purer water for greater lengths of time east of the sewage disposal works at the Scarboro location. There is little difference, however, in the quality of the water at Centre Island and at Scarboro, and in any case, as the Commissioners note, continuous filtration is absolutely necessary.

Coming to the last point in the choice of Scarboro is the fact that there is high ground for the location of a reservoir. The distance from the Scarboro reservoir to the present High Level Pumping Station is a matter of twelve miles. To deliver the ordinary output of the Scarboro pumping station of sixty million gallons a day there will be a loss of about forty-five feet of head. At times of peak load this loss through friction will increase to one hundred and fifty feet of head. The High Level Pumping Station is at practically the centre of gravity of supply of the city. A comparison of the Centre Island supply with the Scarboro supply delivered at the High Level Pumping Station shows that it will be necessary to pump against a head of from forty to one hundred and fifty feet greater with the Scarboro scheme, and, in order to secure this privilege (if it may be so stated) it will be necessary to spend over $6,000,000.

A city of such size and growing importance as Toronto demands an absolutely continuous supply of pure water, and it is therefore quite necessary that there should be provided in the near future a duplicate supply of the present one. In reading over the Commissioners' report we have wondered whether they analysed the possibility of obtaining that duplicate supply from Centre Island. At an expenditure of not over $3,000,000 an intake crib and intake tunnel similar to that outlined for Scarboro, a filtration system, and a second tunnel under the bay could be built. This would furnish an absolutely independent supply of water to the city at the logical point for supply, the centre of population of the city. The water would be furnished to the consumer as it is at present, under a minimum amount of pumping.

If Scarboro were located, say, fifty miles east of Toronto on the lake front, the absurdity of choosing such a location simply because a high plateau existed there would be quite apparent, unless the quality of the water was so very much better as to justify the increased cost. Because a high plateau exists some twelve miles east of the city, which affords an excellent location for a reservoir, it does not follow that it will be economical to pump the water up to this plateau and then let it gravitate to the city. It must be remembered that the advantages of a gravity supply are sadly minimized when it is necessary to elevate the water to the upper level by pumping, and then lose this extra head by friction loss in the many miles of pipe necessary to convey the water to the city.

The facts against the Scarboro location are this—the quality of the water is very little better than that at Centre Island, and must be continuously filtered. There will be a continuous future loss of head due to the flow of the water through twelve miles of pipe in order to reach the centre of population of the city. It will cost at least $4,000,000 more to install a plant there than to build a duplicate plat at Centre Island; that is, greater first cost of construction, greater continuous cost of operation, no better water after filtration, are the arguments against the Scarboro scheme.

The citizens of Toronto are not justified in proceeding with the construction of a Scarboro plant on the evidence submitted in the report of the Commissioners.

EDITORIAL COMMENT.

The annual meeting of the Canadian Society of Civil Engineers will be held on the 28th, 29th, and 30th of January next. It is expected that the Society's new building at 176 Mansfield Street, Montreal, will be finished by that date, and the meeting will therefore be held there. All members should make an earnest effort to be present.

GENERAL NOTES.

Precipitation was decidedly deficient in the Western Provinces and in New Ontario and in excess of the average over a portion of Ontario lying between Lake Huron and the Ottawa Valley and also throughout the Province of Quebec, elsewhere departures from average were not pronounced. Snow occurred in all the provinces.

At the close of the month, snow to a greater or lesser depth, was on the ground in many parts of Canada. In northern districts of the West the depth was over 10 inches, this being also the depth in the Ottawa Valley and the Gaspé Peninsula. In southern districts of the Western Provinces, the ground was nearly bare of snow, a trace being reported from most localities. Nova Scotia and Prince Edward Island were snow covered to a depth of 3 to 7 inches.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for November, 1912:

	Depth in inches.	Departure from the average of twenty years
Calgary, Alta.	0.5	—0.22
Edmonton, Alta.	0.4	—0.44
Swift Current, Sask.	0.4	—0.25
Winnipeg, Man.	0.1	—0.98
Port Stanley, Ont.	2.3	—0.71
Toronto, Ont.	2.38	—0.15
Parry Sound, Ont.	4.5	+0.50
Ottawa, Ont.	6.7	+4.35
Kingston, Ont.	3.6	+1.01
Montreal, Que.	6.3	+2.86
Quebec, Que.	4.6	+1.53
Chatham, N.B.	4.6	+0.78
Halifax, N.S.	5.5	—0.38
Victoria, B.C.	5.0	—1.07
Kamloops, B.C.	..	....

LETTERS TO THE EDITOR.

LIGHT COMPRESSION MEMBER.

Sir,—I wish to thank Mr. C. R. Young, through The Canadian Engineer, for his pertinent comments upon my letter of November 23rd.

I can hardly agree, however, with his opinion that the assumption of an unequal distribution of stress across the sectional area of a compression member is poorly founded theoretically. Permit me to call attention to an article entitled "Elastic Equilibrium of Circular Cylinders Under Certain Practical Systems of Load," by L. N. G. Filon, and published in the Philosophical Transactions of the Royal Society of London, Series A, Vol. 198.

Quoting from this article for the benefit of those who may not have the article at hand; speaking of a circular cylinder in direct axial compression, Mr. Filon states: "The axial pressure deviates throughout from uniformity over the cross-section, the total variation in any section remaining tolerably constant over nearly two-thirds of the length of the cylinder." We notice, also, that near the centre of the cylinder the greatest pressures occur at the centre of the cross-section, whereas the reverse takes place at the ends, the pressure at the perimeter of the ends amounting to about 1⅓ times the mean pressure." Further on, speaking of cylinders under the same condition, except that the ends are prevented from expanding, he states: "It is thus not surprising that the greatest pressure should be at the perimeter, being in fact nearly 2½ times the pressure at the centre."

It seems to me that this shows the assumption of a varying distribution of stress is theoretically more reasonable than the uniform distribution. Furthermore, the case cited is for a circular cylinder, and the distribution of stress depends on the shape of the sectional area, so that the case of a "built-up" section may be even much worse than that of the cylinder.

Hence, I must still maintain that my suggestions, although perhaps not convenient for engineering practice, are not at all impossible theoretically.

The important point brought out by Mr. Young, that the position of the points of application of the load and the way in which the load is applied is an important factor in determining the distribution of stress over the sectional area, is certainly very important in specific cases where the method of loading is known, but a general theory of "built-up" compression members could not be made to take all possible cases into account.

Perhaps the most sensible way to apply the idea of an unequal distribution would be to reduce the allowable stress on the cover-plates of a "built-up" column in some proportion depending on the percentage of area included in the cover-plates.

Thanking you for the attention which you have given me in this matter.

Yours very truly,
I. F. MORRISON.
University of Alberta, Edmonton South, December 12th, 1912.

* * * *

CANADIAN ENGINEERS AND DRAUGHTSMEN.

Sir,—The remarks of Mr. F. Tissington in your issue of November 14th do not in any way demonstrate further the alleged need of more technical schools to make up for the lack of experienced draughtsmen. Technical classes do not make experienced engineers and draughtsmen. This year 545 engineering students entered at McGill, and yet technical men are being engaged direct from Britain or the States, who cannot be said to be experts in a particular line. There must be a gap somewhere. And that gap is inexperience. The degree of competition in Canada can be judged from the dismal failure to recruit men for the still-born Canadian navy. If a man considers he is not fairly treated in a drawing office, nothing is easier than to get another job. This frequent moving about militates against a draughtsman becoming thoroughly experienced in one branch of engineering. I strongly resent Mr. Tissington's unwarranted insinuation as to the treatment of draughtsmen in Great Britain, and can only suppose that he was extremely unfortunate with his employers there. Office hours in Canada, even in Ontario, are longer than in England, South Africa, or probably any other country in the Empire.

As to draughtsmen in Britain having all had shop experience, I referred particularly to mechanical engineering, and I rigidly adhere to this statement.

Yours faithfully,
C. O. Thomas.
Montreal, December 20th, 1912.

PRODUCTION OF METALS IN ONTARIO.

The total production of metals in Ontario, as given below, is subject to a slight deduction, due to its including not only iron ore but also pig iron, into which some portion of it was doubtless smelted, states Mr. T. W. Gibson, deputy minister of mines, in the twenty-first annual report of the Ontario Bureau of Mines, but, after making allowances of this sort, the aggregate value cannot be less than one hundred and eighty million dollars.

Product.	Quantity.	Value.
Gold ... oz.	165,521	$ 2,620,627
Silver ... oz.	130,371,791	79,504,371
Platinum and palladium . oz.	3,364	62,784
Cobalt ... tons	6,068	756,360
Nickel ... tons	136,114	36,276.303
Copper ... tons	108,064	15,655,221
Iron ore ... tons	3.356,287	6,485,501
Pig iron ... tons	3,182.715	49,191,732
Lead ore ... tons	3,351	20,000
Pig lead ... tons	1,143	96,000
Zinc ore ... tons	7,704	92,410
Total ...		$190,761,309

THE YORK COUNTY HIGHWAY COMMISSIONERS' REPORT

As an introduction to the second annual report dealing with the roads under control of the Board of Highway Commissioners, York County, the following facts concerning the early roads of York County may prove of interest.

The first survey of highways in what is now York County was made in 1791, by Augustus Jones, when he sub-divided what are known as the townships of Scarboro and York. In the following year York County was formed, although its area was many times its present size.

In the first Parliament of Upper Canada, which met at Newark (Niagara Falls), in 1793, the roads were placed under overseers who reported to the military authorities of the British Government, who provided the necessary money for construction and improvements.

The Parliament of Upper Canada granted in 1830, $512,000 for road construction throughout the Province, and in the same year the Statue Labor Act came into force.

By this Act every male resident of the Province between the age of 15 and 60 years were required to give two days' labor towards the building and repairing the highways of the Province.

The Act which united the Provinces of Upper and Lower Canada in 1841 also provided for municipal institutions and the road came more directly under the control of local officials.

In 1891 and each succeeding year efforts were made in the County Council of York to abolish the collection of tolls on York roads on condition that the City of Toronto cease to collect market fees other than cattle market fees.

In 1893, City of Toronto took over the Lake Shore Road and the tollgates on this road were abolished in 1896, under By-law 712, J. Slater being Warden. A by-law to abandon the York roads and transfer the same to the minor municipalities of York County was carried in 1896.

YORK HIGHWAY COMMISSION

Lewis Gardhouse, Warden, 1912 D. Sinclair, Tr[illegible] Dept. R. W. Phillips, Secretary. R. J. Bull, Warden 1911 Geo. S. Henry,
W. G. Trethewey, Commissioner. E. A. James, Chief Engineer. W. H. Pugsley, Vice-Chairman. J. J. Ward, Chairman.

In the following year, 1794, Yonge Street was surveyed and partly cleared, but as revenue for road work only amounted to $900.00 per annum, very little permanent construction could be undertaken.

The Don Mills Road was surveyed in 1799 and the following year an overseer was appointed, but it was not until 1821 that permanent improvements of an expensive character were undertaken.

The Danforth Road was commenced in the same year, and about 60 miles of the road was opened.

The Lake Shore Road was cleared in 1804.

The Dundas Street, the highway to the west, although partly opened in [illegible] was not [illegible] until after the War of 1812.

The Northwest Fur Co. offered the Government in 1815, $60,000 to improve Yonge Street, but only a small amount of this money was ever contributed and the road, although used as a military highway, was not put in good condition until 1835.

Following the assuming of the roads by the townships, efforts were made from time to time to again establish a County System, Mr. W. H. Pugsley, at the June session in 1899, moved a resolution which was seconded by Mr. James Ley, "that the Council, resolve itself into Committee of the Whole to consider the advisability of organizing and assuming a system of leading roads as county roads, and also as to petitioning the Provincial Legislature to assist in the maintenance of the same."

With instruction the committee arose and reported the following resolution: "Resolved, that the Clerk be and he is hereby directed to procure all the information possible with reference to a scheme whereby a system of county roads may be maintained by the County and Provincial assistance, for the use of this Council at its November session."

This resolution was received and adopted.

The committee thus appointed, realizing the magnitude and importance of the subject, in order to obtain as much information as possible and also to act in union with other counties of the Province, called a convention of municipal representatives of the Province, on December 12th and 13th of that year, to consider the question. The report of this convention was printed and distributed, and doubtless had much to do in bringing the necessity of improved roads and the advisability of an early start in that direction before the electors of the county.

In January, 1902, the following resolution was carried by the York County Council: "That the By-law and Legislative Committee be and they are hereby directed to prepare and have introduced in the Local House a petition asking that the clauses of the Act under which bonuses are granted to street railways be made to apply to the making of improved roads in townships, with a further provision that when any locality in a township vote to provide two-thirds of the costs of any such improved roads, the townships in which any such locality is situated shall pay the other one-third." No action, however, was taken by the Government.

In order to take advantage of the Act for the Improvement of Public Highways, passed in 1901, whereby the Provincial Government agreed to bear one-third the cost of the construction and improvement of County Highway Systems approved by the Government, the following resolution was passed by the County Council in June, 1903: "That this Council be now resolved into Committee of the Whole to discuss the advisability of taking over and maintaining certain roads in the County as County Roads, and thereby receive a portion of the amount set apart by the Government for making good roads." This Committee afterwards drafted a by-law which was submitted to the various township councils. More than one-third of the township councils disapproved of the by-law, and, under the provisions of the Act covering such cases, it was necessary to put the question to the ratepayers. This was done in January, 1904, the result being a majority against the proposal.

The matter then lay dormant till June, 1906, when Mr. W. H. Pugsley moved that the Council resolve itself into Committee of the Whole at the November session to discuss the advisability of again submitting the question of County Roads to the electors of the County for their approval or otherwise.

This Committee at the November meeting reported the following resolution: "Resolved, that the Council do at this session of the Council report a by-law setting apart certain roads as County Roads, and that the by-law be submitted to the various Township Councils for their approval as provided by the Act of 1901 and amendment thereto." This was defeated.

At the June session, 1907, the by-law to assume certain leading highways as a County Road System was defeated by a vote of 10 to 16.

During the sessions of 1908 the question of County Roads was again considered, but it was not until the December session of 1909 that substantial progress was made towards the present scheme by the passing of a resolution forming South York for County Road purposes and directing the Legislative Committee to meet the Council of the City of Toronto with a view to securing city aid for the improvement of leading highways.

At the June session of 1910, Mr. Geo. Henry moved, and Mr. W. H. Pugsley seconded, that Messrs. Annis, Nigh, Longhouse, Gardhouse, Bull, the mover and the seconder, be a committee empowered to draft a schedule of highways for a County Road System in the part of the county within the riding of East and West York.

This committee secured legislation authorizing the York County Council to adopt a County Road System for the portion of the County included in the Electoral Districts of East and West York and for issuing debentures assessable on that portion of the County, only exempting the municipalities that compose the Electoral District of North York. The Committee drafted a schedule of the leading roads in this section of the County, which roads now comprise the County Road System.

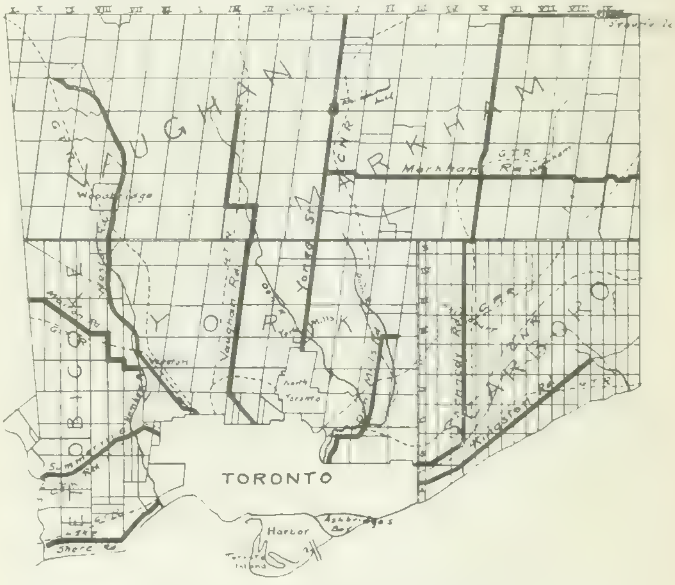
At a joint meeting of the above Committee and representatives of the City Council, Toronto Board of Trade, and the Ontario Motor League, the following resolutions were passed:

"Moved by Reeve Henry, seconded by W. J. Gage, that this joint Committee representing the City of Toronto, the County of York, the Board of Trade, and the Ontario Motor League recommend that the City of Toronto and the County of York each contribute one-third cost of constructing permanent roadways within the County of York, the remaining one-third to be contributed by the Provincial Government under the conditions of the Statutes in relation to the improvement of highways."

"Moved by Reeve Bull, seconded by W. G. Trethewey, that the City of Toronto and County of York strongly recommend the vote of a grant of $100,000 to be set apart for the purpose of improving the highways mentioned in the resolution so that the work can be commenced at the earliest possible date."

"Moved by W. J. Gage, seconded by Reeve Annis, that this joint Committee recommend that the County of York, the City of Toronto and the Provincial Government each appoint a representative who would practically constitute a commission to have charge and supervision of the expenditure of moneys given by the different municipalities and the Government in connection with the improvement of highways."

In January, 1911, a by-law was submitted to the electors of the City of Toronto to raise the $100,000 recommended as the city's share of the project, which by-law was carried by a substantial majority.



Good Roads Scheme, York County.

Showing Roads Under the York Highway Commission.

Early in 1911 the County Council passed by-laws: to designate the roads to be improved; to raise $100,000 as the County's share by the issuing of debentures; to confirm the agreement with the City of Toronto whereby the city and the county were each to bear one-third of the expense of construction, the remaining one-third to be borne by the Government; to relieve the municipalities lying in North York from liability for the cost of the new roads; and to appoint Commissioners to act with others appointed by the city and the Government.

According to the agreement with the city, the Board of Highway Commissioners was to consist of three persons appointed by the County, two by the City and one or more by the Government. The original personnel of the Board was as follows:

For the County—Messrs. R. J. Bull, Wm. H. Pugsley, and Geo. S. Henry.

For the City—Messrs. J. J. Ward, and L. H. Clarke.

For the Province—Mr. W. G. Trethewey.

The County By-law appointing Commissioners included the Warden of the County by virtue of his office, hence in January, 1912, Mr. Bull was succeeded on the Commission by Mr. John Gardhouse, Warden for 1912.

The following is the engineer's report:

My first report, which was presented to you in December, 1911, outlined generally the work we had undertaken, but as this report is our first printed report, I am incorporating in it part of the work undertaken during 1911, as well as dealing more particularly with the work of this year. When we commenced construction work in 1911 we had great difficulty in securing contractors who were experienced in road building, and where we undertook to do the work by day labor we had greater difficulty in securing men who had experience in the construction of waterbound macadam highways.

That the work might not be delayed and that the Commission might have in their possession information as to the cost of construction, it was decided that in 1911 to purchase two outfits. These outfits were so successful in 1911 that in the spring of 1912 three more were purchased. The five outfits purchased, together with the contractor's equipment, made it possible for the Commission to put in the field during 1912, fourteen outfits.

YONGE STREET.

Road No. 1., Div. 11 and 12.

This section was completed by day labor with Ben. Flook immediately in charge of the work.

Double Cylinder Waterous Roller, Working on Yonge Street.

In 1911, a Waterous double cylinder 12½-ton roller was used, and in 1912 a Kelly-Springfield double cylinder 12½-ton gasoline roller was used.

With the exception of a short section opposite lots 15 and 16, which was built of limestone, the road is constructed of 2-inch granite from Washago, waterbound with limestone screenings, and the road has an average width of 15 feet.

From an observation of the wear on the limestone and on the granite, it would appear that the granite will give much better service.

The granite on this road cost $1.75 per ton f.o.b. Metropolitan Railway sidings.

The limestone cost $1.95 per ton. The high price of limestone was due to the fact that there are no limestone quarries on the C.N.O. Ry. and that this stone had to come over three railways, thus making us liable for three freight rates.

The following tabulated statement will give at a glance the [illegible] and charge:

YONGE ST. DIV. 11 AND 12—MR. BEN. FLOOK.

	Total Cost 1911 & 1912	T't'l tons (1 ton $1.75)	T't'l c.yds. (2600 lbs. to c. yd.)	Cost per c. yd.
Grit, stone and granite..	$20,982.62	11,990	9,223	$2.27
Labor	5,412.26			58 3/5c.
Teams	3,066.43			33 2/10c.
[illegible]	457.96			4 9/10c.
Oil & accessories for roller	64.24			7/10c.

YONGE STREET.

Road No. 1, Divs. 13, 14 and 15.

These sections were completed by day labor with John Sheardown in immediate charge of the work.

In 1911, a small section was completed in the Village of Richmond, but it was not until 1912 that much progress was made.

These divisions were built of granite from Washago, waterbound with limestone screenings, and the road has an average width of 15 feet.

The remarks as to wear and cost given under Divisions 11 and 12 apply in Divisions 13, 14 and 15.

YONGE ST. DIVS. 13 AND 14—MR. J. SHEARDOWN.

	Total Cost 1911 & 1912	T't'l tons (1 ton $1.75)	T't'l c.yds. (2600 lbs. to c yd.)	Cost per c. yd.
Grit, stone & granite.	$18,139.82	10,365.6	7,973.5	$2.27
Labor	4,164.24			52 2/10c.
Teams	2,705.50			33 9/10c.
Coal & wood	327.82			4 1/10c.
Oil & acc. for roller..	52.88			66/100c.

KINGSTON ROAD.

Road No. 2, Divs. 21 and 22.

This road was built by contract.

Contractor, Morris Reid, Dunbarton, Ont.

In the construction of this road limestone from Dundas and Kirkfield was used. It was waterbound with limestone screenings.

Although this road had been previous a stone road, the road had been left without repair and the traffic had been so heavy that for most of the road we had to commence at the sand and build up again so that it made it an expensive road using much material.

The road is well crowned, and well bound, anl well drained, and is built with an average width of 14 feet from the east city limits to lot 21, Con. C., Scarboro.

KENNEDY ROAD.

Road No. 3, Divs. 31 and 32.

This road was built by contract.

Contractors:

ROUTLEY & SUMMERS, Haileybury, Ont.

In the construction of this road limestone from Dundas and Kirkfield was used; it was waterbound with limestone screenings.

On one section of this road just south of the C.N.O. Ry. tracks a short section was surfaced with trap rock from Cobalt. This road is much more expensive to lay than limestone, but its wearing qualities are much superior, and I anticipate that in future large quantities of trap rock will be used for macadam highway. Trap rock will cost from $1.85 to $1.95 per ton, f.o.b. sidings, in York County.

On this road 15 ft. of 4-inch tile was laid.

Three concrete culverts was constructed with openings of 4-inch, 6-inch, 3-ft. and 3-ft.

This road is completed from the east city limits to lot 23, Con. D, Scarboro. The metal part of the road has an average width of 14 feet.

KENNEDY AND MARKHAM ROAD, UNIONVILLE.

Comprising parts of Division 34, Kennedy Road, No. 3, and Divisions 92 and 93, Markham side road No. 9.

Finished road extends on Con. VI., Markham, from lot 6 to lot 14, inclusive, also from G.T.R. track, Unionville, east to Con. VII. and a quarter-mile on Main Street, Markham Village.

This work was conducted by day labor, W. Huber in charge.

Total length of road finished 4 miles, varying from 10 to 16 feet in width, having a total area of 25,066 square yards.

This road is constructed of Kirkfield limestone, the material averaging 2 in. in size, waterbound with limestone screenings.

A large part of this work was done on a soft sub-grade, rendering satisfactory binding very difficult. Other difficulties were inability to secure sufficient stone to keep the work in progress, and much wet weather. In spite of these drawbacks, however, the cost of the road compares very favorably with those done by contract. Saved by doing the work by day labor as against contract prices. On this road a total of 5,100 feet of tile drain was laid at a cost of $300.

The total cost of material and labor was $15,000, being at the rate of less than 60 cents per square yard.

A total of 5,320 cubic yards of material was used, making the finished road cost at the rate of $2.82 per cubic yard. These figures clearly demonstrate the saving due to day labor methods.

WESTON ROAD.

Road No. 7, Divs. 72, 74, 75 and 76 (parts of).

The southern part of section 72 was built by contract.

Contractor, E. C. Lewis, Toronto, Ont.

The southern section of this road, the Black Creek Hill, receives very heavy traffic and as the hills were sandy it was thought best to use a concrete base with brick surfacing, and this has been done. At first the teamsters were afraid that this hill would be very slippery, but experience has shown that the brick has made an excellent road where, before, the highway was practically impassable.

From the Black Creek Hill north the work was done by day labor, James Gardhouse, Weston, Ont., being in charge.

The road is built of limestone waterbound with limestone screenings, average width 16 feet.

The Village of Weston are putting in a sewerage system, so that we could not build the road through the village.

From the North Boundary of Weston to the Etobicoke River, the road is built of limestone 13 feet wide.

The work in Divs. 75 and 76 was also done by day labor under Mr. Gardhouse.

The material used was an extremely hard granite from Coldwater, but the quarries on the C.P.R. were closed down for such a long period that very little work was accomplished in this section. There are three quarries opening at Coldwater this year, and it is possible that shipments during 1913 to Woodbridge will be more regular and satisfactory.

LAKE SHORE ROAD.

Road No. 4, Div. 41.

This road was built by contract.

Contractors, J. H. McKnight & Co., 152 Bay St., Toronto.

Dolarway Pavement, Lakeshore Road.

During 1911 no work was done on this road, but from the first it was recognized that the character of the traffic here was such as to require an exceptionally strong pavement.

In June, 1912, a contract was let for a pavement with a concrete base 7 in. thick and surfaced with a bituminous preparation. The contractors undertake to maintain this pavement for three years.

Owing to the impossibility of keeping the traffic off the concrete, and the damp season, a good surface was not secured; but from the experience of the contractors on other sections of similar road, I am confident that next season they will get a good surface on this concrete. I am persuaded that our experience on the Lake Shore Road will lead to the adoption of permanent construction on our leading highways.

The Lake Shore Road is completed from the west city limits to within some 400 feet of Church Street, Mimico. The concrete is 15 feet wide with 3-ft. earth and stone shoulders on each side.

VAUGHAN ROAD.

Road No. 6, Div. 61.

This road was built by contract.

Contractor, E. G. Law, 74 Glenwood Ave., Toronto.

When the work was commenced on this road the teaming had to be done from Downsview Station. Later arrangements were made to ship in on the Belt Line.

This road is built of limestone with an average width of 14 feet. Because of the impossibility of securing stone, the contractor was not working one-third of his time this season.

Div. 64.

Work was commenced here by day labor with Mr. D. Watson in charge.

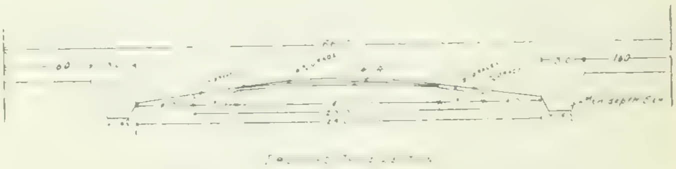
When work was commenced we were promised plenty of stone from Orillia, but the quarry was not well laid out and could only ship one car per day, and later only one car every other day. Arrangements are being made for the opening of three quarries on this line next year so that we should be able to get plenty of stone here in 1913.

SUMMERVILLE ROAD.

Road No. 5, Divs. 51 and 52.

Div. 51 was built by contract, Routly & Summers, Haileybury, Ont., being the contractors.

From the city limits to the Humber Bridge this road was built with an average width of 15 feet of limestone and waterbound with limestone screenings.



General Cross-Section of Improved Roads.

Before the traffic had used the road, the road was treated with Tarvia B., and I have no doubt that the splendid condition of this road is due to the prompt treatment it received. Although this road takes extremely heavy traffic, and although it is showing some wear, yet not a single rut has developed and the road is wearing uniformally smooth.

Div. 52.

This division was built by contract, the contractor being I. M. Scott, Lambton Mills, Ont.

This division being a continuation of the section of Dundas Street built by the T. Eaton Co., it was thought wise to build a section of road with a special binder. Rocmac was used for binding this road. The material used was limestone and our experience here has led us to believe that trap rock bound with Rocmac is going to give an excellent class of construction for leading highways.

DON MILLS ROAD.

Road No. 8, Divs. 81, 82 and 83.

This road was built by contract.

Contractor, B. F. Law, 143 Kingston Road, Toronto.

A small section of Division 81 was built of limestone.

The road in Divisions 82 and 83 was built of granite, waterbound with limestone screenings.

In the foregoing report I have outlined briefly the condition of work on the various roads.

Up to the present time we have given our attention to the roads near the City of Toronto, and, of course, because of the nature of the traffic, they have taken more time and more money to build than will the roads that remain.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

CONTENTS.

BOOK REVIEWS:

Transmission Line Construction: Reviewed by H. G. Acres 930
An Extension of the Dewey Decimal System of Classification 930
A Treatise on the Design and Construction of Roofs: Reviewed by C. R. Young 931
Water Supply and Drainage 931
The Indicator Handbook, Part II.: Reviewed by A. L. S. Barnes 931
Building Stones and Clay-Products: Reviewed by C. H. C. Wright 932
Successful Homes, and How to Build Them 932
Street Paving and Paving Materials: Reviewed by E. A. James 932
Fourth National Conference Proceedings 932
Boundaries and Landmarks 932
Bleaching and Dyeing of Vegetable Fibrous Material: Reviewed by H. P. Bell 933
Text Book on Roads and Pavements 933
Smoley's Tables 933
Publications Received 933
Catalogues Received 934

BOOK REVIEWS.

Reviewed by H. G. Acres.*

Transmission Line Construction. Methods and Costs. By R. A. Lundquist, E.E., Consulting Engineer, Minneapolis, Minn. New York: McGraw-Hill Book Co. Cloth; 5½ x 7¾ in.; 285 pages; 180 illustrations and diagrams. Price, $3.00 net.

The reading matter is divided into thirteen chapters having the following tables: Preliminary Work; Location of Line; Types of Construction; Wooden Pole Construction; Steel Pole Construction; Steel Tower Construction; Reinforced Concrete Construction; Special Structures; Cross-arms; Hardware; Pins and Insulators; Guying; Stringing Wire; Cost Data of Typical Transmission Lines; Organization and Tools; Standard Specifications for Line Apparatus and Material (Appendices).

The author's intention, as set forth in his preface, was to deal exclusively with the practical side of transmission line construction. This he has done to such good purpose that his book will form a timely and most acceptable addition to the engineer's library, the more so as such information as was heretofore available on this subject was in the form of miscellaneous articles in the technical press.

The outstanding feature of this book is the manner in which the author has supplemented his descriptions of the various stages of transmission line construction by an immediate reference to cost. His description of the method of distributing poles is followed by figures relating to the cost of distribution; a very clear and comprehensive description of various methods of setting steel tower footings is supplemented by a compilation of figures covering the cost of this class of work in various parts of the United States and Canada, and so on.

In the matter of costs, also, there is evidence of a conscientious effort on the part of the author to qualify his statements by reference to the variable factors affecting the same, such as labor rates, seasons, topographical and geographical conditions. Without these references the large amount of cost data which the book contains would be rather a source of danger than of benefit to the average reader

Chapters III., VI., IX. and XI. contain valuable data and descriptions, appropriately illustrated, in connection with the construction of modern high-tension steel tower transmission lines with suspension type insulators. In chapter IV. various methods of treating wood poles with preservative compounds are described and costs specified. Chapter VII. contains, among other things, a very interesting description of the manufacture of hollow reinforced concrete poles by the centrifugal process.

The text is interspersed with numerous useful references to articles that have appeared in the technical journals, and there is nothing in the book which could not be comprehended or put to practical use as well by the construction foreman as by the engineer.

The author is slightly in error in stating, with reference to Fig. 114, that "the towers are the standard anchor structures and the equipment the same as at regular strain tower installations." The middle tower in the illustration referred to happens, in this case, to be a transposition tower and not a standard anchor tower. A "typical" railroad crossing on the line in question would have two towers of the type shown in the foreground of the illustration. The "equipment" at these crossings differs from the regular strain construction in that the crossing conductors are doubled and tied every six feet, and a special form of double-strain clamp is used for supporting the doubled conductors.

Also on page 207 the author states that suspension type insulators must "necessarily" be attached to steel towers subsequent to their erection. It is quite feasible and in many cases much more economical, to attach the insulators to the towers before erection.

An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries. By L. P. Breckenridge and G. A. Goodenough. Originally issued as Bulletin No. 9 of the Engineering Experiment Station in 1906. Price 50 cents.

The filing and classification of engineering data has become a matter of much importance, and this bulletin was prepared for use as a guide in carrying out such work. The original edition of Bulletin No. 9 was subject to the usual gratuitous distribution, and the subsequent demands were such that a second edition was printed and ultimately distributed. Altogether 20,000 copies were sent out. The demand having continued, it was finally decided again to revise and to print a limited edition. This has now been accomplished and the revised bulletin, much extended as compared with the original edition, is ready for distribution. It presents subdivisions of subjects in such detail as to constitute a complete classification for most engineering industries, even though they are highly specialized. The revision has been made in accordance with the 1911 edition of "Decimal Classification," by Melvil Dewey.

---

* Hydraulic Engineer, Ontario Hydro-Electric Power Commission.

Copies may be secured on receipt of price from W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Reviewed by C. R. Young.*

A Treatise on the Design and Construction of Roofs. By N. Clifford Ricker, professor of architecture, University of Illinois; president, Illinois Board of Examiners of Architects, etc. New York: John Wiley and Sons; London: Chapman and Hall, Limited. Publishers' Canadian agents, Renouf Publishing Company, 25 McGill College Avenue, Montreal. Cloth; 6 x 9¼ in.; pp. xiii. + 419; 644 text figures. Price, $5.00, net, (21/- net).

The evident intention of the author in preparing this book was the assistance of junior designers and architectural draughtsmen, rather than the making of a notable contribution to the knowledge of structures. His work is, therefore, less valuable to the specialist in structural engineering than to the beginner. For those who require each step to be carefully indicated and each case treated specially, the guidance and instruction obtainable from this book will be invaluable. It is an excellent presentation in orderly and usable shape, of a large mass of information which, in the main, is available from other sources.

The author's method of treatment is very properly shaped to the purpose he has in view, in that instruction is given largely by numerous examples fully worked out, with each step carefully recorded. Considerable repetition thus characterizes the work, which perhaps will not be found objectionable by those who will use the book most.

As an introduction to the subject, three chapters are devoted to Graphostatics, Construction of a Trussed Roof, and Loads on Roof Trusses. The author then proceeds to obtain by graphical means the stresses in roof trusses of twenty-four different types of all grades of complexity, including combinations of cantilever trusses and monitors and an octagonal hip roof with lantern. For ease of reference there is assembled in Chapter V. outline and stress diagrams of a large number of roof trusses of both common and rare occurence. The method of moments is illustrated by one problem, thus affording to the student a comparison of graphical and analytical methods. An indication of the elementary character of much of the matter in the book is seen in chapter VII., in which 37 pages are devoted to the calculation of the lengths of members of roof trusses. Chapter VIII. concerns the stability of the supports of roofs under wind pressure, and contains a useful discussion of the resistance of walls to eccentric loading. Then, as a basis for the proportioning of truss members and details later, the simpler data of strength of materials and details of wood and steel construction are discussed in one chapter. Considerable valuable information in tabular form is given in chapter X., such as the safe loads on steel tension members of various make-up, safe loads on compression members of both steel and wood, properties of wooden beams, strength and weight of details, etc. The tables for the strength of wooden members would have been somewhat more useful if the net dimensions of the timber, after dressing, had been used. Dimensioning of members and the detailing of connections receive attention in chapters XI. and XII. Probably the one really bad feature of the book is the grotesque details of the steel roof trusses. Gusset plates of the most irregular shape and angles with all kinds of skew cuts are employed, with the result that trusses detailed according to the models set forth would cost more than their purchasers would care to pay for them and be no better than those conforming to the best bridge shop practice. The book is concluded by chapters on Deformations and Estimates of Weight.

Some rather unusual terms are employed in the text. For example, the author speaks of loads being "equilibrated," of balancing force as "antiresultant," of section "moduluses," etc.

Despite its somewhat high price, a large sale, among architects particularly, should be experienced for the book.

Water Supply and Drainage. By C. E. Housden. Published by Longmans, Green & Co., 39 Paternoster Row, London. Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal. Cloth; size, 4¾ in. x 7¼ in.; 28 pages. Price, 45 cents.

This small volume is a supplement to the same author's book on "The Precise Calculation of Pipe Drain and Sewer Dimensions," which was reviewed a few months ago in these columns. The idea of this little volume is to afford a ready means for ascertaining precisely the dimensions of pipes, drains or sewers to be used for a projected water supply or drainage system. With the original work and the tables therein, this book should form a very valuable adjunct to the library of the engineer interested in sewerage work.

Reviewed by A. L. L. Barnes.*

The Indicator Handbook, Part II. By Charles N. Pickworth. Fifth edition. Published by Emmatt & Co., 65 King Street, Manchester, England. Price, 90 cents, net.

When a small handbook such as this reaches its fifth edition it may be taken for granted that most of its earlier faults have been eliminated, and that it has satisfactorily supplied a want and proved its worth.

Part I of the book deals with the indicator itself, whilst the section now under review is devoted exclusively to the indicator diagram.

The subject is treated in a very concise and practical manner, leaving little to be desired, and illustrations show the peculiar curves obtained under faulty or abnormal conditions of working.

Chapter I. is explanatory and describes various methods of constructing theoretically perfect diagrams for saturation and adiabatic curves.

In chapter II. the different periods of the indicator diagram, viz., the admission, steam, expansion, release, exhaust and compression lines are severally discussed, while chapter III. deals with the effects of variations of lap and of valve travel, and defective valve setting, leakage, under and overloading of engines, etc.

Compound steam engine diagrams and those from gas and oil engines are taken up in chapters IV. and V., and in the next, diagrams from air compressors, pumps, etc. Very interesting are the diagrams given in the latter chapter illustrating faulty working of boiler feed pumps, etc.; leakage past the plungers, defective valve action, etc., can be readily detected from the shape of the diagram.

---

* Consulting structural engineer, 318 Continental Life Building, Toronto.

* With Ontario Hydro-Electric Commission, Continental Life Building, Toronto.

Chapter VII., the last, is headed "Diagram Calculation," and describes various methods which may be employed to ascertain all the information which a diagram is capable of supplying.

An appendix, containing several useful tables, and an index bring to a close a book which would be very serviceable to anyone whose duties require him to investigate the working of reciprocating plant.

Reviewed by C. H. C. Wright.*

Building Stones and Clay Products. A Handbook for Architects. By Heinrich Ries, Ph.D., Professor of Economic Geology in Cornell University. Published by John Wiley & Sons, New York. 428 pages; 6 x 9 in.; well illustrated; cloth. Price, $3.00.

This book will prove to be very valuable to the architectural profession for which it has been written. The author, Professor Ries, an eminent geologist, has realized our limited knowledge of mineralogy, geology and ceramico, and as a result his simple statements of facts, together with the necessary explanations, will be appreciated. His classification of the building stones has been made with the same desire for simplicity, and to further aid the reader he has provided a very complete index and an excellent glossary.

Throughout the book, whether in the chapters on the Rock Forming Minerals, the Granites, the Sandstones, Limestones, Marbles, or Clay Products, there is no sign of a desire on the part of the author to tell all he knows of these different materials, but always the plain intention to analyze the subject so as to give the architect the information he is looking for.

The second part of the book contains a complete and yet elementary description of the properties of clay, the methods of its manufacture into bricks, terra cotta, hollow-ware, tile, sewer pipe and sanitary ware, which will assist any architect to select and use these materials more intelligently.

It may be said by some that this book in Part I. is largely describing building stones that are quarried and manufactured in the United States, but the fact remains that at the present time there is imported into Canada a large amount of freestone, limestone and marble from Ohio, Indiana and Tennessee, etc.

The production of building stone in 1911 in Canada was $1,988,757; the stone imports were $1,140,846, of which most came from the United States.

Successful Homes and How to Build Them. By Chas. E. White, Jr. Published by The Macmillan Company, New York and Toronto. Cloth; 5 x 7¾ in.; 520 pages, including index; profusely illustrated with Photographs and line drawings. Price, $2.00, net.

This book, while written from the standpoint of the house-owner, will be found of considerable interest by the architect, the builder, and the engineer who contemplates a house for himself. The volume covers, authoritatively and completely, the entire field of building houses, large and small. The general make-up of the book is in line with the high standard of the Macmillan publications.

Each factor bearing on the erection and equipment of a house is taken up in order, beginning with the purchase of the site and the letting of the contract. The various building materials, arrangements of rooms, the different kinds of heating, ventilating and lighting systems, decorating inside, painting outside, are all fully treated. Consideration is devoted to city houses, town, country and farm houses, suburban houses and bungalows, camps, cottages, garages, barns and green houses. There are also several chapters on out-door accessories, such as terraces, walls, banks, sidewalks and pergolas.

Reviewed by E. A. James, B.A.Sc.*

Street Paving and Paving Material. By G. W. Tillson, C.E. Published by John Wiley & Sons, New York. Cloth; size, 6 in. x 9 in.; 650 pages; 97 figures. Price, $4.00.

This is the second edition of a manual on street pavement. It gives methods of construction and the materials suitable for the various classes of pavement. The publication is extremely useful, not only to students and engineers, but to city officials generally.

The first edition was published in 1900, when the author, after 20 years' experience, particularly in pavements, produced the book in order to show not only the evolution of the modern city streets, but also what was being done at that time in pavement construction. The following pavements are dealt with: Stone; Asphalt; Brick-Clays and the Manufacture of Paving-Brick; Cement, Cement Mortar and Concrete; Cobble and Stone-Block Pavements; Asphaltic Pavements; Brick Pavements; Wood Pavements; Broken-Stone Pavements; and Concrete Pavements.

In addition, the author deals with the theory of pavements; Plans and Specifications; the Construction of Street-Car Tracks in Paved Streets; Width of Streets and Roadways, Curbs, Sidewalks, etc.; Asphalt Plants.

Since this work was originally given to the public a number of new pavements have been introduced and the methods of constructing the old have been so modified as to render necessary a pretty complete revision of certain chapters and the addition of a new chapter on concrete pavements. No attempt has been made to deal with road construction.

A chapter has been added on the protection of pavements. This is a matter that must be given serious attention in this country, where it seems necessary to have a great deal of subsurface street construction. This chapter will be of benefit to engineers who are about to take this matter under consideration.

Fourth National Conference Proceedings. Published by the association, office of secretary, 19 Congress Street, Boston, Mass. Cloth; 6 x 9½ in.; 232 pages. Price, $2.00.

This volume includes the proceedings of the Fourth Annual Conference on City Planning, held at Boston, Mass., May 27-29, 1912. These volumes are published by subscription, but there are a limited number to be had at the above price of $2.00. The precedent of former volumes has been followed in presenting the chief papers read at the conference in full, and condensing or summarizing the discussions.

Boundaries and Landmarks. By A. C. Mulford. Published by D. Van Nostrand Company, 25 Park Place, New York. Cloth; size, 5¼ x 8¼ in.; 90 pages. Price, $1.00.

This manual is intended to familiarize the surveyor with the different types of old boundaries that exist throughout the United States. It is written to provide a useful treatise in connection with the conveyances of the Eastern States.

---

* Professor of Architecture, University of Toronto, Toronto.

* Engineer to the York County Highway Board

Reviewed by H. P. Bell.*

Bleaching and Dyeing of Vegetable, Fibrous Material. By Julius Hübner, M.Sc., Tech., (Manchester). Published by D. Van Nostrand Company, 25 Park Place, New York. Cloth; 5¾ in. x 9 in.; 434 pages. Price, $5.00.

Mr. Hübner's book is, as the author states, a practical handbook intended for the use of working dyers. The chemistry and physics of dyes and dyeing are touched on only so far as is necessary to explain the methods and machinery which are described. A large part of the book is devoted to lists of dyestuffs now in use and directions as to the methods with which the best results may be obtained with them. These directions are, as the author points out, largely taken from the books issued by the various makers of dyestuffs, but they are here placed together in a way which makes it easy to compare the methods and to select those which are best for particular materials or particular purposes. The newest forms of machinery are very clearly described, not only in connection with the processes in which they are used, but also in a separate chapter, and the illustrations which accompany the descriptions deserve special mention for their excellence. Instead of the photographs of machinery, which are too commonly used in technical books, the present illustrations consist of sectional drawings and sectional diagrams, many of which are printed in two colors, so that the cloth or yarns passing through the machines is distinguished by being printed in red.

Besides the processes of dyeing, Mr. Hübner deals with bleaching, washing and mercerizing, and there are chapters on the testing and softening of water, the testing of dyestuffs and fibres, and the chemicals and mordants in general use, for many of which the current English prices are given. The book also contains a number of useful tables and an excellent index, and is likely to be valuable, not only to dyers and students of dyeing, but to engineers who have to do with machinery for the processes referred to.

Text Book on Roads and Pavements. By Frederick T. Spalding, professor of Civil Engineering, University of Missouri. Published by the McGraw-Hill Book Company, New York. Fourth edition, 1912; cloth; size, 5 x 7½ in.; 408 pages; 51 figures. Price $2.00.

The size of this book has been increased about twenty per cent. with this edition. New chapters are added on bituminous, macadam and concrete pavements, and the chapters on brick, asphalt and wood pavements have been thoroughly revised. While the general character of the book has been very little altered, the advances in the method employed in the construction and maintenance of highways has rendered a number of changes necessary. The book has now been brought thoroughly up-to-date and in accordance with present practice.

Smoley's Tables. By Constantine Smoley, C.E. Published by McGraw-Hill Book Company, New York. Seventh edition, revised and enlarged; flexible leather; size, 4½ in. x 7 in. Price, $3.50.

These parallel tables of logarithms and squares, diagrams for solving right triangles, angles and logarithmic functions corresponding to given bevels, common logarithms of numbers and tables of logarithmic and natural trigonometric functions and other tables, for engineers, architects and students, are too well known to need much comment. The tables have with this issue reached the seventh edition. In this edition a special device has been added for solving right triangles of comparatively small dimension. The device is a diagram which will enable the user, after a little practice, to obtain almost at a glance results that are sufficiently accurate for most practical purposes.

---

* Technical chemist, 409 Kent Building, Toronto.

◆

PUBLICATIONS RECEIVED.

Annual Report of the City Engineer of Halifax, N.S. for the year 1911. City Engineer, F. W. W. Doane, Halifax.

Civil Service List of Canada, 1912. Arranged and prepared under the direction of the Secretary of State, Ottawa.

Route Map of Part of Nass River, B.C. Issued by the Geological Surveys Branch, Department of Mines, Ottawa. R. W. Brock, director.

A Study in Industrial Water Charges. Being booklet No. 2, issued by the Bureau of Water, Water Supply Educational Series, City Hall, Philadelphia, Pa.

Report of the Department of the Naval Service of Canada, for the year ending 31st March, 1912. J. D. Hazen, Minister of the Naval Service, Ottawa.

The "Mechanical World" Electrical Pocketbook for 1913. Published by Emmatt & Company, Limited, 65 King Street, Manchester, England. Price sixpence, net.

Canada Car and Foundry Company, Limited. The third annual report for the year ending September 13th, 1912. General offices, Transportation Building, Montreal.

Report on the Building and Ornamental Stones of Canada, Vol. I. By William A. Parks. Pp. 382, illustrated. Canadian Department of Mines, Mines Branch, Ottawa.

Progress Report of the Experiments with Dust Preventatives. Being Circular No. 89, Office of Public Roads, U.S. Department of Agriculture. Logan Waller Page, director.

Special Road Problems in the Southern States. By D. H. Winslow. Being circular No. 95, Office of Public Roads, U.S. Department of Agriculture. Logan Waller Page, director.

Business Prospects Yearbook, 1913. Edited by Joseph Davies and C. P. Hailey. Published by the Business Statistics Company, Limited, 12 James Street, Cardiff, S.W. Price, $2.50.

The Production of Iron and Steel in Canada, for the calendar year 1911. By John McLeish, B.A. Issued by the Mines Branch, Department of Mines, Eugene Haanel, Ph.D., director, Ottawa.

Summary Report of the Mines Branch of the Department of Mines of Canada for the Calendar Year Ending December 31, 1911. Pp. 208, illustrated. Canadian Department of Mines, Mines Branch, Ottawa.

Bureau of Mines of Ontario, 1912.—Being the twenty-first annual report. Vol. 21, Part 1. Published by the Department of Lands, Forests and Mines, Toronto. Thomas W. Gibson, Deputy Minister of Mines.

Report of the Sanitary State of the City of Montreal, also an account of the operations of the Board of Health and the vital statistics, for the year 1911. By Dr. Louis Laberge, Medical Health Officer, Montreal, P.Q.

Water Resources of California, Part I., Stream Measurements in Sacramento River Basin. By H. D. McGlashan and F. F. Henshaw. Pp. 411, illustrated. Water-Supply Paper 198, U.S. Geological Survey, Washington.

Surface Water Supply of the United States, 1910. Part IX., Colorado River Basin. By W. B. Freeman, E. C. La Rue and H. D. Padgett. Pp. 233, illustrated. Water-Supply Paper 289, U.S. Geological Survey, Washington.

Forest Fires. Their causes, extent and effect, with a summary of recorded destruction and loss. By Fred G. Plummer. Being Bulletin No. 117, Forest Service, U.S. Department of Agriculture. Henry S. Graves, forester.

Brooklyn Engineers' Club. The proceedings for 1911, including the constitution and by-laws and the annual report of the board of directors. Published by the Brooklyn Engineers' Club, 117 Remsen Street, Brooklyn, N.Y. Price, $2.00.

Production of Cement, Lime, Clay Products, Stone and Other Structural Material, in Canada. For the calendar year 1911. By John McLeish, B.A. Issued by the Mines Branch, Department of Mines, Eugene Haanel, Ph.D., director, Ottawa.

Methods and Apparatus for the Prevention and Control of Forest Fires. As exemplified on the Arkansas National Forests. By Daniel W. Adams. Bulletin No. 113, Forest Service, U.S. Department of Agriculture. Henry S. Graves, forester.

Saw-filing and Management of Saws.—By Robert Grimshaw, M.E. Third edition, revised and enlarged. Published by the Norman W. Henley Publishing Company, 132 Nassau Street, New York City. Cloth; 4 x 6½ in.; 130 pages. Price, $1.00.

Proceedings Western Railway Club.—Vol. 24, 1911-1912. —Being the Official Proceedings of the Western Railway Club for the Club Year 1911-1912. Published by the Western Railway Club, 390 Old Colony Building, Chicago. Cloth; 6 x 9 in.; 272 pages. Price, $2.00.

Syllabus of Mathematics. A symposium compiled by the Committee on the Teaching of Mathematics to Students of Engineering, accepted by the Society for the Promotion of Engineering Education at the nineteenth annual meeting held at Pittsburg, Pa., in June, 1911. The secretary, Henry Norris, Cornell University, Ithaca, N.Y.

CATALOGUES RECEIVED.

Cooling Towers.—Edwin Burnorn & Company, 71 Wall Street, New York City, forward catalogue illustrating their "Burnorn" and "Acme" cooling tower.

Water Meters.—The Buffalo Meter Company, 290 Terrace, Buffalo, N.Y., forward copy of their 1912 catalogue of American and New Niagara Water Meters.

Boilers.—Fraser & Chalmers, Limited, 4 Philips Place, Montreal, P.Q., forward catalogue illustrating installations of the Bettington Boilers (water tube) for atomized fuel.

Pipe.—The National Tube Company, Pittsburg, Pa., forward N.T.C. Bulletin No. 11, which describes the Spellerizing process used in the manufacture of their pipe.

Turbo-Alternators.—The Canadian Westinghouse Company, Limited, Hamilton, Ont., Railway and Lighting Department, forward Circular No. 1094, illustrating and describing Westinghouse turbo-alternators.

Dynamos.—The Engineering Works of Canada, Limited, New Birks Building, Montreal, forward catalogue illustrating dynamos manufactured by Societe Alsacienne de Constructions Mecaniques, Belfort, of which they are the Canadian agents.

Non-Pulsating Pumps.—The General Machinery Co., Limited, 22 to 26 Mulock Avenue, West Toronto, forward the last catalogue describing the Luitwieler System of Non-Pulsating Pumps, manufactured by the Luitweiler Pumping Engine Company, Rochester, N.Y.

Concrete.—The Canada Cement Company, Limited, Montreal, forward copy of book recently issued, entitled "What the Farmer Can Do With Concrete." Copies may be secured by addressing Mr. L. S. Bruner, Manager of Publicity, Canada Cement Company, Montreal.

Powell Wood Process.—The Powell Wood Process Syndicate, Limited, through their selling agents, Messrs. Boving & Co., Limited, 9½ Union Court, London, E.C., have forwarded a booklet describing the Powell wood process for rapidly seasoning, preserving and improving wood.

Motor Truck Tires.—The Dunlop Tire and Rubber Goods Company, Limited, Toronto, forward their catalogue K-3, entitled "Dunlop Quick Removable and Band Type Motor Truck Tires," which contains price list and description of their different types of tires.

Steel Reinforcement.—The Standard Concrete Steel Company, 413 East 31st Street, New York, forward copy of their pamphlet, entitled "System M," of which this is the second edition. The pamphlet describes the system developed by this company for the steel reinforcement of reinforced concrete buildings.

Sewage Sprinklers.—Jones & Attwood, Limited, of Stourbridge, England, manufacturers of the Fiddian waterwheel type of sewage sprinkler, have forwarded a booklet describing these sprinklers. This booklet is a special edition for municipal engineers. Copies may be secured from The Canadian Engineer, 62 Church Street, Toronto.

Steel Pipe.—The East Jersey Pipe Company, of 50 Church Street, New York City, forward their last catalogue, containing recent photographs and data of interest in connection with the use of their lock-bar pipe and riveted steel pipes. Copies may be secured by addressing the company.

Measuring and Mixing Machine.—W. J. Fraser & Company, Limited, Dagenham, Essex, England, the sole licensees and manufacturers for Great Britain and the colonies of the Trump Measuring and Mixing Machine and the Trump Concrete Mixer, forward catalogue describing the operation of these machines.

Blueprinting.—The C. F. Pease Company has issued a 32-page booklet, entitled "Everything for Blueprinting," describing and illustrating various types of the Pease peerless blueprinting machines and equipment, the Pease simplex and duplex paper-coating machines and washing and drying machines and other equipment for use in the handling of blueprints.

Hydro-Pneumatic Sewerage System.—Hughes & Lancaster, Limited, sole licensees and manufacturers of the "Shone" patent Pneumatic Automatic Ejector, forward catalogue, entitled "The Shone Hydro-Pneumatic Sewerage and Water System," illustrating different installations of their ejectors. Copies may be secured from Hughes & Lancaster, Limited, 16 Victoria Street, London, S.W.

Logging Machinery.—The Clyde Iron Works, of Duluth, Minn., forward their new catalogue of Clyde Self-propelling Logging Machinery. The book is 9 x 12 in. in size, and contains 92 pages. It is profusely illustrated with very fine half-tones, illustrating different types of logging machinery. The pamphlet is beyond question one of the most artistic which has come to this office. Copies may be secured from the Clyde Iron Works, Duluth, Minn.

IRON ORE PRODUCTION.

There has been a rapidly growing demand for iron and steel products in Canada during the past few years, accompanied by a corresponding increase in the output of Canadian iron and steel furnaces, although this output probably supplies not more than 30 per cent. of the tonnage of iron and steel consumed.

The increase in production was continued during 1911, notwithstanding abnormally low prices received for pig iron and steel products, states Mr. J. McLeish, chief of the division of mineral resources and statistics in his latest report. Manufacturers, generally, report a very strong demand, but claim that business has been carried on with a very low margin of profit in order to meet prices quoted on imported products.

At the same time extensive preparations are being made to increase the output and supply a larger proportion of the home market.

The total shipments of iron ore in 1911 from mines in Canada were 210,344 tons, whereas blast furnaces consumed 1,695,802 tons, and steel furnaces, 42,892 tons. The shipments from iron ore mines in 1911 were the lowest recorded in twelve years. The production of pig iron was 917,535 short tons, and of steel ingots and castings, 882,396 tons.

The rate of production of iron ore has shown practically no increase during the past twelve years, while the present production of pig iron is nearly ten times that of 1900. About 6 per cent. only of the iron ore used in Canadian blast furnaces during 1911 was of domestic origin. Of the coke used, 52 per cent. was either imported or made from imported coal, and 22 per cent. of the limestone flux used was from sources outside of Canada. In each instance the proportion of imported raw material used is higher than was the case in 1910.

The total production of iron ore in Canada to the end of 1910 has probably not exceeded 5,500,000 tons, while the total consumption of ore in iron and steel blast furnaces since 1886 has been over 13,500,000 tons. During 1911 the tonnage of imported ores used was 1,628,368 tons, which was derived chiefly from Newfoundland and the south shore of Lake Superior.

The assistance granted by the Federal Government to the iron and steel industries in the form of bounties ceased on December 31, 1910, with the exception of the bounty on steel rods, which was continued to June 30, 1911, and the bounty on pig iron and steel made in electric furnaces, which is available until the end of this month.

IMPORTANCE OF CANADA'S CEMENT INDUSTRY.

The production of cement in Canada during the past few years though all classed as Portland, has included an output of Puzzolan cement, made from blast furnace slag at Sydney, N.S., and a small production of "natural Portland" made at Babcock, Manitoba, 75 miles southwest of Winnipeg on the Canadian Northern Railway. The total quantity of cement made in Canada during 1911, as per reports received from the manufacturers, was 5,677,539 barrels of 350 pounds net each, or 993,569 tons, as compared with 4,396,282 barrels, or 769,349 tons, made in 1910—an increase of 1,281,257 barrels, or over 29 per cent, states the report of Mr. J. McLeish, B.A., chief of the division of mineral resources and statistics.

The total quantity of Canadian Portland cement sold in 1911 was 5,692,915 barrels, or 996,260 tons, as compared with 4,753,975 barrels, or 831,946 tons, in 1910, an increase of 938,940 barrels, or nearly 20 per cent.

The total production of Portland cement in 1911, including Canadian and imported cement, was 6,354,831 barrels of 350 pounds net, or 1,112,095 tons, as compared with 5,103,285 barrels, or 893,075 tons, in 1910—or an increase of 1,251,546 barrels or nearly 25 per cent.

The cement industry has been rapidly growing in importance, and its output is now exceeded in value amongst nonmetallic products by coal and clay products only.

An average of 3,010 men were employed in 1911, the total wages paid being reported as $2,103,838.

The increase in annual production since 1905 has been nearly four-fold. The production per capita in 1911 was about 278 pounds, as against only 79 pounds in 1905. The approximate consumption per capita has increased during the same period from 115 pounds to 310 pounds.

A similar rapid increase in both production and consumption has taken place in the United States, where the annual production now exceeds 75,000,000 barrels.

The production per capita in the United States was in 1910 about 332 pounds, as against 204 pounds in 1905.

The production of cement in 1911 was derived from 24 operating plants, having a total daily capacity of $28,281, the operating plants being distributed as follows: one in Nova Scotia, using blast furnace slag; one in Manitoba, making a natural Portland cement; one in British Columbia; three in Alberta; three in Quebec, using limestone and clay; and fifteen in Ontario, of which twelve use marl and three limestone.

Of the total quantity of cement made in 1911, 1,626,857 barrels were made from marl and 4,050,682 barrels from limestone and slag. In 1910, there were 1,214,479 barrels made from marl and 3,181,803 barrels from limestone and slag, and in 1909, 819,706 barrels were made from marl and 3,336,002 barrels from limestone and slag. Practically all of the newer plants erected during the past few years have been limestone plants. The proportion of cement made from marl in 1908 was about 45 per cent. of the total output, as compared with about 28 per cent. in 1911.

The consumption of cement is represented practically by the domestic production together with the imports, the exports being so comparatively small as to be negligible. The total consumption of Portland cement in Canada in 1911 was 6,354,831 barrels (1,112,095 tons), made up of 5,692,915 barrels (996,260 tons) of Canadian cement, and 661,916 barrels (115,835 tons) of imported cement; the Canadian cement representing 90 per cent. and the imported cement 10 per cent. of the total.

In 1910 the total consumption of cement was 5,103,285 barrels (893,075 tons), of which 93 per cent. was of domestic production and 7 per cent. imported. In 1901 the total consumption was 872,966 barrels (152,769 tons), of which only 36 per cent. was made in Canada and 64 per cent. imported.

The following is an estimate of the annual consumption of Portland cement in Canada during the past eleven years:—

Calendar Year.	Canadian		Imported.		Total.
	Barrels	%	Barrels	%	Barrels
1901	317,066	36	555,900	64	872,966
1902	594,594	52	544,954	48	1,139,548
1903	627,741	45	773,678	55	1,401,419
1904	910,358	54	784,630	46	1,694,988
1905	1,346,548	59	918,701	41	2,265,249
1906	2,119,764	76	665,845	24	2,785,609
1907	2,436,093	78	672,630	22	3,108,723
1908	2,665,289	85	469,049	15	3,134,338
1909	4,067,709	97	142,194	3	4,209,903
1910	4,753,975	93	349,310	7	5,103,285
1911	5,692,915	90	661,916	10	6,354,831

The effect of a by-law passed by the Cobalt town council is to repeal, in part, a previous $50,000 waterworks and sewerage system by-law. Of the $50,000 worth of debentures, only $6,500 were sold, when it was found unnecessary to dispose of the rest. The sanction of legislature will be applied for, for the cancelling of the other $43,500, as that had to be gained before the previous by-law was passed.

COAST TO COAST.

Winnipeg, Man.—It is probable that the University of Manitoba will establish, in the near future, a course of architecture.

St. Thomas, Ont.—A new system, costing $15,000, for washing out locomotive boilers, is now being installed in the Michigan Central Railway roundhouse here. The transfer table and turntable are now being operated with electricity.

Northern Ontario.—The Bell Telephone Company of Canada recently completed the extension of its long distance lines from North Bay to Mattawa. The circuit is branched in such a manner as to give connection with Bonfield and Rutherglen.

Victoria, B.C.—Mayor Beckworth, in an address to the ratepayers, stated that, in his opinion, the municipal council would have done better regarding the Sooke waterworks scheme to have the work completed under their own engineer by day labor.

Brantford, Ont.—The city engineer, Mr. F. H. Jones, has submitted to the city council a brief statement of the expenditures of the Board of Works for the present year, which totals $117,309; $73,141 was paid out for labor, while the cost of material was $29,368.

Montreal, Que.—The announcement is made that Mr. Farquhar Robertson and Lieut.-Colonel Labelle will be Montreal's new Harbor Commissioners. Mr. Robertson having declined the chairmanship, the third member of the board, who has not yet been appointed, will take that position.

Ottawa, Ont.—The report of the Transcontinental Railway Commission for the fiscal year has been submitted. It shows a total expenditure of $116,517,691 since the organization of the Commission in 1904. This does not include any interest on capital expenditure or any of the expenditure on the bridge approaches. For the fiscal year the expenditure was $21,221,997.

Niagara Falls, Ont.—It is proposed that a large shiplock be constructed in the Chippawa River, connecting it with the new Welland Canal, thus making Chippawa and this city accessable to the largest steamships on the lakes. A resolution was adopted by the City Council of Niagara Falls instructing Mayor Cole to appoint a Greater Niagara Falls Committee, composed of prominent citizens and officials, and also ask the officials of the surrounding townships to co-operate with the city in furthering the project. As originally planned, this lock, which will be large enough to receive any ship afloat on the Great Lakes, was to be placed near the town of Welland. City Engineer Gardiner, however, drafted a plan for the location of the lock in the Chippawa River. If this plan is finally adopted it will give the village of Chippawa and Niagara Falls the rating of a lake port; the largest ships would be enabled to come down the Canadian channel of the Niagara River and then up the Chippawa to the Welland Canal.

Hamilton, Ont.—The Hamilton Malleable Iron Company has been formed with a capital of $600,000, consisting of Toronto, Hamilton and Brantford capital. The names of the officials and directors of the company are withheld, but J. E. Hammond, formerly with Pratt & Letchworth Company, Limited, Brantford, will be one of the directors and assume management of the plant. The new concern will conduct a general malleable iron business, and the output will consist principally of malleable iron castings for railroad, agricultural and miscellaneous work for custom trade. The plant will cost in the neighborhood of one-quarter of a million dollars, and will employ about 500 hands, a large number of which will be skilled mechanics. The main foundry building will be 600 feet long and 200 feet wide. This building will be divided into two bays, with high-speed electric travelling cranes in each bay. In this building will also be located four melting furnaces with a capacity of 15 tons per heat. There will also be located in this building annealing furnaces sufficient to take care of the output; also the latest cleaning and finishing equipment. In addition to the main building will be an office building; also buildings for pattern storage, pattern shop, machine shop, core shop, carpenter shop and storehouse. Paralleling the main building will be an outside crane runway, by which all the raw material for the plant will be unloaded and stored. All the buildings will be of fireproof and modern construction throughout. The equipment will consist of the latest labor-saving devices, such as overhead cranes serving the entire foundry and yard, waste-heat boilers, moulding machines operated by compressed air, finishing equipment, including the latest type of sand blast installation, exhaust tumbling barrels, and all unloading of raw material and loading of finished product will be handled by electric power. The plant will be connected with the railways and have individual tracks leading to and serving the various buildings. The plans for the buildings are being prepared by Prack & Perrine, 36 James Street South, Hamilton, who will also have charge of the construction of the plans and installation of equipment. The plant is being designed in units, which will allow it to be enlarged to double capacity.

COMMON STANDARD LOCOMOTIVES.

Mr. H. H. Vaughan, assistant to the vice-president of the Canadian Pacific, in a discussion of a paper by Mr. O. S. Beyer on "Factors in the Selection of Locomotives in Relation to the Economics of Railway Operation," delivered before the American Society of Mechanical Engineers on December 5th, emphasized the importance of having standard locomotives and maintaining these standards until conditions change so much that it is possible to design another line of standard locomotives, making a distinct step in advance, rather than to modify the standard types from time to time. The time for standardization is before the equipment is built and not afterward. The Canadian Pacific now has about 865 standard locomotives out of a total of 1,800 or 1,900 on the system. It is always possible to introduce changes in the design of standard locomotives, bearing in mind that the new arrangement must be made so that it can completely take the place of the old part for renewals or repairs.

The advantage of standardizing the motive power may be summed up as follows: The standard locomotives can be transferred from one part of the road to another, when business becomes heavy on one section, without having to provide a new storehouse stock, or have the power crippled because of not having the proper parts in stock. It is also possible to keep the shop cost of the engines down because of fewer variations in the size and design of the parts. Where standard locomotives are used it has been found that the division officers are much more likely to offer suggestions as to improvements. Of course, the standardization has disadvantages, one of which is that it is not always possible to immediately take advantage of improvements in the permanent plant. The advantages of having common standards which can be used on any part of the system and with which the men over the entire system are familiar, greatly offset this, however.

VANCOUVER SEWAGE SYSTEM.

It is estimated that the carrying out of the work for the Greater Vancouver joint sewage system will entail an expenditure of $6,000,000. The Burrard Peninsula Joint Sewage System Committee have received the report of Mr. R. S. Lea, consulting engineer, which was practically a synopsis of the final report he anticipates being able to present before the end of the year.

In this report Mr. Lea, states in regard to the matter of population, that he estimates the city's population will have increased to 1,400,000 by the year 1950.

The report states that the most suitable points for discharge would be English Bay, off Imperial Street, about a mile out; Burrard Inlet, at any point except the shore of Coal Harbor between Brockton Point and Evans, Coleman & Evans' wharf; and the Fraser River, where it would be unwise, he states, to fix any point at the present time, but probably the most suitable point would be the low lying land near the Indian Reserve, for the area draining to the North Arm, and the flats near the mouth of the Brunette River for the area draining to that locality.

The lines of the proposed interceptors and trunk sewers are exhaustively dealt with, and refer to the English Bay and False Creek area, showing a foreshore line and an alternative tunnel line; the Balaclava, Bridge Street and Burrard Inlet areas; the Clark Drive, Stanley Park and Hastings Park outfalls; the Burnaby Lake and the Fraser River area.

On the subject of the constitution and powers of a joint board, Mr. Lea states as follows:

"In my final report I shall submit a draft of an act, together with methods of apportionment and assessment, etc., under the provisions of which I consider acceptable ways and adequate means may be found, for the inception, execution and operation of the Burrard Peninsula Joint Sewerage Scheme.

"I hope this preliminary report will give the committee such information as they desire at the present time. My final report, which will really only be an enlargement and elaboration of this present one, together with the data on which my conclusions are based, will be presented to you next month."

THE INTERNATIONAL ROAD CONGRESS.

Formation of a Traders' Committee.

The organization of the International Road Congress, to be held in London in June next, is in the hands of a committee formed of representatives of highway authorities, scientific institutions, learned societies, organizations of automobilists, cyclists, road users and others.

The Organizing Council received some time ago offers of practical assistance from firms and others engaged in the road industry, and it was decided to form a Traders' Committee.

This committee is composed of representatives of all branches of road-makers, including manufacturers of steam rollers and other heavy machinery, road-tarring appliances, stone paving and firms engaged in the construction of bituminous roads, wood-paved roads, quarry owners and others. The president of the committee is Lord Cowdray; the vice-president, Mr. Edward Hickman, J.P.; the chairman, Sir Herbert Praed, and the vice-chairman, Mr. E. B. Chittenden. Other members of the committee are: Messrs. J. W. Ashdown, H. K. Bamber, J. G. Barford, H. D. Blake, H. F. Berry, F. E. Bristowe, F. M. Bond, A. Brooks, W. Chappell, S. Constable, D. G. Comyn, L. Cooper, A. E. Dalzell, J. Duffy, H. T. Elliston, H. Grace, W. T. Graves, W. Penrose Green, T. J. Jennings, J. Mackay, W. Manuelle, T. Milne, P. Morris, H. Pitts, J. Purdy, Gibson Thompson and John Ward. The honorary secretaries are Messrs. H. Beadle and H. L. Wetteim.

The Executive Committee of the Congress will be glad to welcome any further offers of assistance, and to make any additions which may be necessary to secure that all branches of the industry are adequately represented.

AMERICAN ASSOCIATION OF MANUFACTURERS OF SAND-LIME PRODUCTS.

The ninth annual convention of this organization was held on December 3rd and 4th at the King Edward Hotel, Toronto. President S. O. Goho, of Harrisburg, Penn., occupied the chair. There was a large attendance. Among the technical papers presented were "The Results of Testing Sand-lime Brick," by Warren E. Emley, of the United States Bureau of Standards, Pittsburg; "The Present Condition of the Industry," by W. H. Crane. The delegate made an inspection of the local plants of the Toronto Sand-lime Brick Company and the Toronto and Harbor Brick Company, and declared the bricks equal to those manufactured in the large American cities. The election of officers resulted as follows: President, S. O. Goho, Harrisburg, Penn.; vice-president, F. B. Allan, Toronto, Ont.; secretary, W. G. Plummer, Jr., Buffalo, N.Y.; treasurer, John L. Jackson, Saginaw, Mich. Harrisburg, Penn., was chosen as next place of meeting.

CANADIAN MINING INSTITUTE (OTTAWA BRANCH) MEETING.

At a meeting held in Ottawa, December 4th, a branch of the Canadian Mining Institute was organized. The following officials were elected: Chairman, W. R. Askwith; secretary, George L. Burland; executive committee, J. McLeish, G. C. McKenzie, Dr. A. D. Cairns, Robert Harvey and W. J. Dick. Dr. A. E. Barlow, president, and H. Mortimer-Lamb, secretary of the Canadian Institute, gave addresses on the work and aims of the organization.

PERSONAL.

JOHN ROOKE-CROOWELL has been appointed manager of the Cordova mine, in Hastings County, Ont. He was formerly in California and more recently in Mexico.

W. P. NEAR has been appointed city engineer for the municipality of St. Catharines, Ont. For some time he has been resident engineer of the main drainage works, Toronto.

J. P. FORDE, of Revelstoke, for the past two years resident provincial engineer for this district, has been appointed resident federal government engineer for the whole of Kootenay electoral riding in succession to Hon. F. W. Aylmer.

ARTHUR N. JOHNSON, M. Am. Soc. C. E., State Highway Engineer of Illinois, on December 13th delivered an illustrated lecture on "Cement-Concrete Highway Bridges" before the graduate students in Highway Engineering at Columbia University.

FRANCIS P. SMITH, M. Am. Soc. C.E., Chemical and Consulting Paving Engineer, New York City, on December 20th, delivered an illustrated lecture on "The Mining and Refining of Asphaltic Oils" before the graduate students in Highway Engineering at Columbia University.

D. J. ROBERTS, of Montreal, general manager of the Napierville Junction Railway, and general manager and general freight and passenger agent of the Quebec, Montreal and Southern, has been elected president of the United States Express Company, with headquarters at New York, which office has been vacant since the death of the late Thomas C. Platt. Mr. Roberts is fifty-nine years old. He is well known to American railway men, having been in the service of the Pennsylvania Lines and the Erie from 1873 to 1901. For the ten years from 1891 to 1901 he was general passenger agent of the Erie.

OBITUARY.

WILLIAM JOHNSON BARCLAY, general manager of the Canadian Northern Quebec, the Quebec and Lake St. John, the Halifax and Southwestern and the Inverness Railway and Coal Company, with headquarters at Montreal, Quebec, died on December 13th, at Riverside, Cal., at the age of sixty-one.

COMING MEETINGS.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Annual Meeting will be held on Jan 28th, 29th, and 30th, 1913, at the Society's new headquarters, 176 Mansfield St., Montreal. Secretary, C. H. McLeod.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor [illegible]; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, [illegible]; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy: Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers: Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only, unless otherwise noted, at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
1-18	—Trunk Sewer Extension, Edmonton, Alta. (P. & S.)	12-19

◆

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to

Place of Work.	Tenders Close.	Issue of.	Page
Aylmer, Ont., public building	Dec. 30.	Dec. 12.	65
Edmonton, Alta., trunk sewer extension	Jan. 18	Dec. 19.	74
Hamilton, Ont., harbor improvements	Dec. 30.	Dec. 12.	74
Kamloops, B.C., electric lights	Dec. 26.	Dec. 19.	65
Kerrisdale, B.C., valves, special castings and hydrants	Jan. 6.	Dec. 12.	74
Kelowna, B.C., school building	Jan. 3.	Dec. 12.	65
Ottawa, Ont., machinery for dredge	Dec. 30.	Dec. 5.	65
Ottawa, Ont., Indian supplies	Jan. 7.	Dec. 12.	65
Ottawa, Ont., steel hopper scows	Jan. 7.	Dec. 19	65
Quaco, N.B., wharf	Dec. 30.	Dec. 19	65
Regina, Sask., steam engine and turbine pump	Jan. 29.	Dec. 19.	74
St. Joseph, N.B., extension of college	Dec. 31.	Nov. 28.	65
Sarcee Indian Reserve, school buildings	Jan. 3.	Dec. 12.	65
St. John, N.B., post office building	Dec. 30.	Dec. 12.	65
Toronto, Ont., erection of school	Jan. 7.	Nov. 28.	65
Ville-Marie, P.Q., wharf	Jan. 7.	Dec. 12.	66
Winnipeg, Man., plans for city hall	Feb. 15.	Sept. 26.	68

◆

TENDERS

Halifax, N.S.—E. H. Armstrong, Commissioner of Public Works and Mines, will receive sealed tenders up to noon December 31st, 1912, for the construction of a wood bridge at Waverly Bog, Waverly, Halifax County. Plans, specifications, forms of tender, and all information, may be seen at the office of the Road Commissioner at Halifax, and also by application to the following parties: Parker Archibald, County Clerk, Halifax; James Murphy, merchant, Waverly, S. W. Lydiard, Road Inspector, Dartmouth

Ottawa, Ont.—R. C. Desrochers, Secretary, Department of Public Works, will receive sealed tenders for the construction of a lock, dam, regulation sluices and approach piers and the excavation of a raceway and channel in the East River, near New Glasgow, N.S., up to 4 p.m., January 20th, 1913. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of J. L. Michaud, Esq., district engineer, Merchants Bank Building, Montreal; A. R. Decary, Esq., district engineer, Post Office, Quebec; F. G. Goodspeed, Esq., district engineer, St. John, N.B.; C. E. W. Dodwell, Esq., district engineer, Halifax, N.S., and on application to the postmaster at New Glasgow, N.S.

Ottawa, Ont.—R. C. Desrochers, Secretary, Department of Public Works, will receive sealed tenders for the construction of six steel hopper scows, 300 yards' capacity each, up to 4 p.m., Tuesday, January 7th, 1913. Plans, specification and form of contract can be seen and forms of tender obtained at this Department and at the offices of T. H. Schwitzer, Esq., Mechanical Superintendent, Birks Building, Ottawa, Ont.; J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.; C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S., and H. H. Donnelly, Esq., Superintendent of Dredges, St. John, N.B.

Ottawa, Ont.—Alex. Johnson, Deputy-Minister of Marine and Fisheries, Ottawa, will receive sealed tenders up to noon, January 31st, 1913, for the construction of a first-class, single-screw, steel, steam lightship, 114 feet in length. Plans, tender forms and specifications of this lightship can be seen at the office of the Purchasing Agent of the Marine and Fisheries Department, Ottawa; at the offices of the Collectors of Customs, Toronto, Collingwood and Port Arthur, Ont., and at the Agencies of the Department of Marine and Fisheries at Montreal, Quebec, St. John, N.B., and Halifax, N.S.

Ottawa, Ont.—Tenders for the construction of six 300 cubic yards' capacity steel hopper scows, will be received at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until January 7th, 1913. (See advertisement elsewhere in The Canadian Engineer).

Ottawa, Ont.—P. E. Ryan, Secretary. The Commissioners of the Transcontinental Railway, will receive sealed tenders up to noon on February 13th, 1913, for machines, tools, appliances, motors, furnaces, cranes, etc., required for the equipment of the car department shops at Transcona, Manitoba. Specifications and forms of tender may be seen at the offices of Mr. W. J. Press, Mechanical Engineer, Ottawa.

Ottawa, Ont.—G. J. Desbarats, Deputy Minister of the Naval Service, Ottawa, will receive sealed tenders up to noon January 15th, 1913, for a schooner conforming to the following dimensions.—Length over all about 98 ft. 6 inch; length of water line, 80 ft.; beam, 20 ft.; mean draft, 8 ft. Schooner to be delivered alongside wharf at H.M.C. dockyard, Esquimalt, B.C. Copies of the design and specification can be obtained on application to the above, or to the Naval Store Officer at H.M.C. Dockyard, Esquimalt.

Saskatoon, Sask.—Mr. G. H. Clare will receive sealed tenders for the construction of the Presbyterian College to be erected on the grounds of the University of Saskatchewan at Saskatoon. Plans may be seen at the Builders' Exchange at Winnipeg and Regina, and at the office of Brown and Vallance, Saskatoon

Saskatoon, Sask.—Tenders for the construction of buildings on the Forest Nursery Station, Saskatoon, Sask., will be received at the office of R. C. Desrochers, secretary, Department of Public Works, Ottawa, until January 8th, 1913. Plans, etc., can be obtained at the office of the Clerk of Works, Regina, Sask., or on application to the Superintendent of the Nursery Station, Saskatoon, Sask., and at the Office of Public Works, Ottawa.

Vancouver, B.C.—The management of the Investors' Guarantee Corporation are calling tenders for the erection of a 15-story office building. Messrs. Russell, Babcock and Rice are the architects.

Vancouver, B.C.—The Bridges and Railways Committee will receive sealed tenders up to January [illegible]th, [illegible] m., for the construction of the proposed new Georgia-Harris concrete bridge.

Victoria, B.C.—W. Galt, city purchasing agent, will receive sealed tenders up to 4 p.m. Monday, January 27th, 1913, for supplies such as general supplies (hardware), brass goods, lead pipe, castings, hydrants, valves, sewer bricks, sewer pipe (vit.), Portland cement, cluster light globes, tungsten lamps, carbons, as required by the municipality. Plans and specifications may be obtained at the city purchasing agent's office.

Windsor, Ont.—R. C. Desrochers, Secretary, Department of Public Works, Ottawa, will receive sealed tenders up to 4 p.m., January 13th, 1913, for the construction of a wharf at Windsor, Ont. Plans, specifications and form of contract can be seen and forms of tender obtained at this Department and at the offices of H. J. Lamb, Esq., District Engineer, Windsor, Ont.; and J. G. Sing, Esq., District Engineer, Confederation Life Building, Toronto, Ont.

Winnipeg, Man.—Sealed tenders addressed to the Chairman, Board of Control, and endorsed on the envelope "Tender for Stepdown Transformers," will be received at the office of M. Peterson, Secretary, Board of Control, Winnipeg, up to 11 a.m. on Friday, January 24th, 1913, for the manufacture and installation in the Terminal Station, Winnipeg, of three 2,700 K.W. Stepdown Transformers with oil and accessories complete. Plans, etc., at the Civic Light and Power Department, 54 King St., Winnipeg.

Winnipeg, Man.—Tenders addressed to the Chairman, Board of Control, Winnipeg, for the supply of from 500 to 1,000 electric flat irons, will be received until noon, January 6th, 1913. Full instructions may be obtained at the office of the City, Light and Power Department, 54 King Street. M. Peterson, secretary, Board of Control office, Winnipeg.

Woodlands, Man.—Maj. J. Proctor, Secretary-Treasurer Rural Municipality of Woodlands, will receive sealed tenders up to January 6th, 1913, for the construction of drains. The estimated amount of excavation is 140,000 cubic yards. Plans and specifications may be seen at the office of the above, or at Department of Public Works, Winnipeg.

◆

CONTRACTS AWARDED

Big Bay Point, Ont.—Wharf with stone approach: Contractor, Henry Hickey, Peterborough, Ont.

◆

RAILWAYS—STEAM AND ELECTRIC.

Eastern Canada.—A deputation will proceed to Ottawa to urge the government to double track the Intercolonial Railway, or, if not, to hand the same over to a private company.

London, Ont.—It is reported that the Canadian Northern Railway will increase its offer to this city regarding the London and Port Stanley Railway. At present a graduated scale of rental which would average $34,000 a year for the road—$14,000 higher than any rental the city has received—is being offered. The terms asked is 83 years, but it is stated that the new offer will reduce the term of rental.

Nelson, B.C.—The Dominion Railway Board have ordered the Great Northern Railway to erect a depot at Salmo, near this point.

Port Arthur, Ont.—The street railway operating here now have 19 first-class passenger cars in operation; these are in addition to several old cars.

◆

LIGHT, HEAT AND POWER

Halifax, N.S.—A lighting contract between the municipal council and the Halifax Tramway Company has been signed for a term of three years.

◆

GARBAGE, SEWAGE AND WATER.

Calgary, Alta.—Dr. Mahood, civic health officer, has advised the citizens to boil all water used for domestic purposes.

Regina, Sask.—It is made quite evident, from the report of the commissioners, that Regina will have to depend upon flowing wells for a water supply for some time to come.

Toronto, Ont.—A sewage pumping plant to cost $43,000 has been authorized by the Board of Control. It will be erected at the foot of Morley Avenue.

BUILDINGS AND INDUSTRIAL WORKS.

Arrowhead, B.C.—Mr. T. C. Southworth, president of the Minnesota Pulp and Fibre Mills of Minneapolis, is considering the erection of a branch plant in this section during the coming spring.

Berlin, Ont.—The special committee appointed to select a site for a new Y.W.C.A. building has decided upon the Kaufman property on Water Street north at $10,000. Plans for the new structure will be drawn immediately to cost $25,000.

Calgary, Alta.—The Canadian Inspection and Testing Laboratories, Ltd., of Montreal, will locate a cement testing plant in the Lougheed Building, Calgary.

Halifax, N.S.—It is reported that the Canadian Pacific Railway will erect a large hotel in this city.

Hamilton, Ont.—The Hamilton Malleable Iron Company, with a capital of $600,000, controlled by Canadians, will erect a plant in this city at an early date. Mr. J. E. Hammond will be managing director. They will employ about 500 men at the start.

Hamilton, Ont.—The management of the Mercury Mills, Limited, are considering the establishment of a plant here for the manufacture of hosiery and underwear. John Penman, Paris, Ont., is interested in the project.

Lethbridge, Alta.—The management of the Lethbridge Creamery Company, Ltd., will erect a modern creamery in this city. Messrs. A. and L. A. Rigimbal are interested.

Medicine Hat, Alta.—It is reported that the B. Scragge and Metal Company, of Winnipeg, will erect a plant in this city.

Moose Jaw, Sask.—Mr. H. C. Struchen, of Saskatoon, will develop a large gravel pit located 26 miles south of this city. He will spend $45,000 on this work.

Moose Jaw, Sask.—Mr. L. Thomas, of Messrs. Thomas and Company, is interested in a project calling for the erection of a $650,000 hotel.

Ottawa, Ont.—It is reported that a substantial sum will be voted by the Federal Government, after Christmas, in order that a start may be made on the long-talked-of Georgian Bay Canal.

Port Arthur, Ont.—The Port Arthur Club has decided to erect a new club house on Cameron St., to cost not less than $60,000; J. J. O'Conner, President.

St. Thomas, Ont.—Messrs. Thomas Brothers are considering the enlargement of their factory at on expenditure of $30,000.

St. Thomas, Ont.—The management of the Sterling Diamond Cut Glass Company of Ottawa are negotiating with the council of this municipality regarding the establishment of a factory at this point.

Toronto, Ont.—It is reported that the ice dealers of this city will erect a plant for the artificial manufacture of ice capable of turning out 100 tons per day.

Vancouver, B.C.—Dr. J. W. Powell has taken out a permit for the erection of a $47,000 apartment house.

Victoria, B.C.—It is reported that work will start on the depot of the Great Northern Railway, to be erected at False Creek, in about six months' time. Mr. Hogeland is arranging the preliminary details.

◆

BRIDGES, ROADS AND PAVEMENTS.

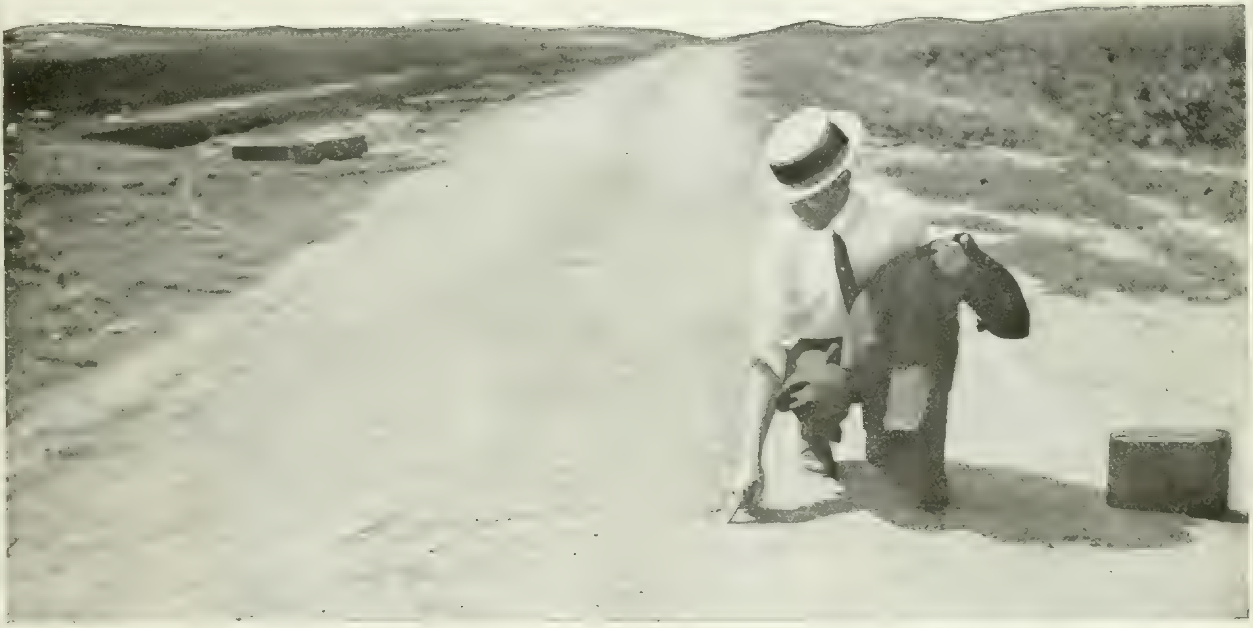
London, Ont.—The Municipal Park Commissioners have adopted a scheme calling for a boulevard drive around the city. Commissioner Hamilton is the originator of the idea.

Port Arthur, Ont.—A representative of the Ontario Department of Lands, Forests and Mines has been in this city preparing a report on the needs of the surrounding country regarding good roads.

Slocan City, B.C.—The provincial government will erect a bridge across the creek at Appledale. J. H. Forde, government engineer.

Tarvia

Preserves Roads
Prevents Dust~



Country Club Road, Greenvil S.C. Built with Tarvia X.

What the Government Found Out About Tarvia

THE Office of Good Roads, U.S. Department of Agriculture, built an experimental road at the country club at Greenville, S.C., in 1909, following very closely our specifications for two-coat penetration work, using "Tarvia X."

After two years the above photograph of the road was taken at a point where it adjoins a stretch of plain macadam. The intention of the Department was to find out just how much difference the Tarvia treatment made.

The picture tells the story. The plain macadam in the foreground is *worn out*. The tarviated surface is in *perfect condition*, and the difference is so great that a clear division line is seen in the above photograph.

This is a typical instance of the success of Tarvia as a road binder. A tarviated road is automobile proof, waterproof, dustless and mudless. It is so much cheaper to maintain that the cost of using Tarvia in the construction is more than compensated for.

Tarvia is made in three grades:

- "Tarvia X" for use in constructing roads and pavements.
- "Tarvia A" for hot surface applications.
- "Tarvia B" (applied cold) for dust prevention and road preservation.

Tarvia Booklet mailed free to anyone interested. Address our nearest office.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N.B. HALIFAX, N.S.

FIRES.

Toronto, Ont.—The premises of the Rudd Harness Works, 791 King Street West, were damaged by fire to the extent of $30,000.

◆

CURRENT NEWS.

Calgary, Alta.—The municipal commissioners are considering engaging the services of an electrical expert to supervise the additions to the power plant that are to be made during the next few months, also the services of a water expert to take charge of the municipal supply.

Kincardine, Ont.—In his report to the council the Medical Health Officer, Dr. J. McCrimmon, requests a public abattoir, an isolation hospital, and a municipal system of garbage collection.

New Westminster, B.C.—Actual work on the municipal gas plant will be started in the spring, and before the end of 1913 the city of New Westminster will have municipal water, electric light and gas to supply to its citizens.

◆

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the Office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending December 9th, 1912:—

A North of England firm producing green slates wish to get into touch with firms at Montreal, Toronto, Quebec and Ottawa, having connections with architects, builders and slate merchants, and open to undertake their representation.

A Swedish importer desires to enter into business relations with a Canadian firm of flour millers.

From the branch for city trade inquiries, 73 Basinghall Street, E.C.

A Midlands firm are anxious to get into touch with Canadian shippers of spruce to Bristol, who can quote for their requirements.

An Italian manufacturing association wish for the addresses of first-class Canadian manufacturers' agents who import cotton yarns and cotton tissues.

A Midlands firm manufacturing waterproof motor covers, aprons, and rugs, and also carriage rugs of various descriptions, wish to be placed in communication with Canadian importers.

◆

A NEW REFRACTORY CEMENT THAT WITHSTANDS 3100 DEGREES FAHR.

Until within the last few years, fire-clay has been most generally used for laying up brick walls, cementing joints, patching and lining of furnaces, kilns, retorts, etc., where high temperatures are encountered. In spite of its exceedingly short term of usefulness, and the consequent necessity for repeatedly patching and repairing, founders and furnace men have until recently continued to use this material because there has been no substitute which could be generally used. Oft-times the fire-clay was mixed with certain other materials to serve as "binders." Of course, this "mixing" or compounding entailed considerable trouble and labor, but there had apparently been no alternative than to follow precedent.

[illegible] whose [illegible] known in recent years, has recently put on the market what they term "J M High Temperature Cement No. 31," which it is said can be used practically whenever working temperatures range between 1500° and 3100° Fahr.

This new material is a dry powder mixture composed of asbestos and other materials of secret preparation. It is mixed with water to the proper consistency (say about 18 to 20 lbs. of water to 100 lbs. of powder) for working like mortar or tamping around molds.

When used for setting up fire-brick for boilers and furnaces, lining and roofing furnaces of various kinds, or moulded into door jambs, lining fire doors, repairing side walls of [illegible] mechanical strength. When air dried, it will withstand a crushing strain of 883.5 lbs. per square inch. It vitrifies at the comparatively low temperature of [illegible] Fahr., and has a high melting point (3182° Fahr.). Being semi-acid in character, it can be used with chrome bricks, silica bricks and fire-clay bricks. It is claimed that experiments conducted with this cement show that it can be successfully used in building doors of angle iron framework without backing, or for making one-piece linings for gas or oil burning crucible furnaces.

◆

MERCURY MILLS, LIMITED.

A company of approximately a million dollars capital, has been formed and will manufacture fine hosiery and underwear, which will be sold to the retail trade.

The officials and directors of the company are: Mr. John Penman, the founder of the Penman Company, Paris, Ontario, who retired in 1906 upon the reorganization of the corporation. Mr. Richard Thompson, formerly general manager of the Penman's Limited and Mr. H. G. Smith, who was in charge of the fine hosiery mill of this company.

A four-story and basement brick building on Park Street, North formerly occupied by the Princess Underwear Company, has been purchased from the Eagle Knitting Company. This plant, however, will be of a temporary nature for it is the purpose of the organizers to purchase property and erect a mill embodying the most up-to-date ideas in construction and equipment. They expect to commence operations early in the new year and will employ 100 hands at the start. When the new factory is erected they will employ between 400 and 500 hands.

◆

HAMILTON MALLEABLE IRON COMPANY.

The Hamilton Malleable Iron Company, has been formed with a capital of $600,000 consisting of Toronto, Hamilton and Brantford capital. Although the company has not definitely decided on a site, they have three sites under option in the east and west end of the city. The names of the officials and directors of the company are withheld in the meantime, but Mr. J. E. Hammond, formerly with Pratt and Letchworth Company, Limited, Brantford, for 12 years as manager will be one of the directors and assume management of the plant. The new concern will conduct a general malleable iron business and the output will consist principally of malleable iron castings for railroad, agricultural and miscellaneous work for custom trade. The plant will cost in the neighborhood of ¼ of a million dollars and will employ about 500 hands, a large number of which will be skilled mechanics.

The plant will be in operation by July 1st, 1913, and the temporary office of the company is in the Sun Life Building.

◆

ORDERS RECEIVED BY MESSRS. ROYCE, LIMITED.

Messrs. Royce, Limited, of Trafford Park, Manchester, the well-known Electrical and Mechanical Engineers, have been favored with the following orders.

> To construct and erect Twenty-five Electric Gantry Cranes for the Hull Joint Dock Committee, and Four similar cranes for the Alexander Dock, Hull, also, Sixteen Electrically Actuated Jib Cranes for South Australia, and Two Cantilever Loading Stages, with Two 15-ton Cranes for South America.
>
> In addition they have orders for: A number of Capstans of both their Ordinary and "Royce" Patent Free Bollard Types.

Messrs. Royce, Limited, are celebrated for their first-class productions, which comprise—Electrically-operated cranes (of the jib, overhead and "Goliath" types): electrical capstans (of the ordinary fixed Bollard and "Royce" Patent Free Bollard types); electric transporters, to run on a single joist, electric pulley blocks, winches, dynamos, motors, switchgear, etc., and their illustrated liaerature will be supplied to bona fide enquirers.

48 in. CONTINUOUS STAVE LINE.

Manufacturer of

Galvanized Wire Machine Banded

WOOD STAVE PIPE

CONTINUOUS STAVE PIPE

RESERVOIR TANKS

For City and Town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc.

Full particulars and estimates furnished.

PACIFIC COAST PIPE COMPANY, LTD.

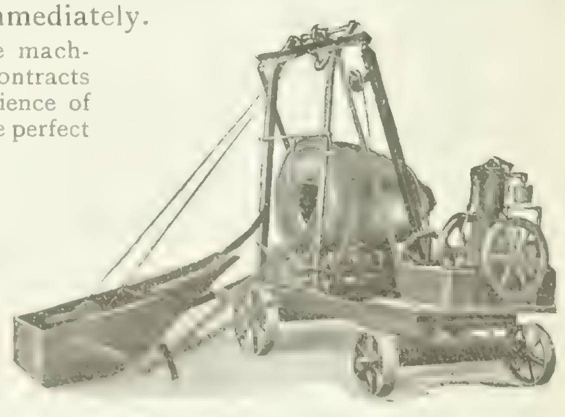
Factory : 1551 Granville Street, VANCOUVER, B.C. P.O. Box 563.

WETTLAUFER MIXERS

are carried in stock in all sizes; if you need a mixer quickly to finish that work before the really cold weather, telephone or telegraph us, and we will place it on your work immediately.

We have manufactured concrete mixers and concrete machinery of all kinds for many years; also previously had taken contracts for concrete work of all kinds, and have had the actual experience of just what a concrete mixer should do. Wettlaufer Mixers are perfect to-day through the help of the hundreds of contractors who purchased the Wettlaufer Mixers in past years. We have gone personally to them and watched these machines working on all classes of work, asked the contractors their opinions, and so have evolved the present perfect mixer.

If you expect ever to purchase a concrete mixer, write now for our catalogue. Compare the simplicity of our mixer with other makes. The main points in favor of our mixer are its thoroughness, simplicity and durability. The Wettlaufer Mixer is of the heart-shaped drum type; this means quick and positive mixing, also the saving of power.



Wettlaufer No. 1 Heart-shaped Mixer

Ask for our catalogue.

NAYSMITH & LOWE,
545 Bastion Street, Victoria, B.C.

HOOTON & MOORE,
613 Ashdown Block, Winnipeg, Man.

WETTLAUFER BROS.
316 Lagauchetiere St., W.,
Montreal, Que.

WETTLAUFER BROS.

Head Office and Warerooms

**178 SPADINA AVENUE
TORONTO**

LAVALLE-ROSS, LIMITED.
Alexander Block, Edmonton, Alta.

A. R. WILLIAMS MACH'Y CO.,
15 Dock Street, St. John, N.B.

FACTORIES :
Mitchell, Ont. Buffalo, N.Y.
Detroit, Mich.

NEW HAVEN-GRAND TRUNK DEAL.

The New Haven-Grand Trunk deal continues to evoke considerable discussion in the United States, and especially in New England. Questions have been put by the Boston Post to Mr. Charles S. Mellen, president of the New Haven. They and the answers thereto are as follow:

Who first suggested the traffic agreement between the New Haven and Grand Trunk, yourself or President Chamberlin of the Grand Trunk? A. I do not recall. Impossible to say.

Did President Chamberlin refuse to sign the agreement? A. Yes.

Is there any secret understanding which does not appear in the text of the agreement made public by the New Haven? A. None whatever, neither now or at any previous time.

Why did you fight so hard to keep the Grand Trunk out of Providence and Boston? A. We never have been opposed to the Grand Trunk extensions. We have only fought to keep the use of our tracks and terminals to ourselves, as they are insufficient for our own business, and to allow another to use them would force us to secure new capital for their accommodation.

Did you suggest that the Grand Trunk should cease work on its New England extensions? A. No, never.

Would you be willing to have the Grand Trunk as an active competitor, owning its own rails to Boston? A. If it will come without taking our tracks and terminals, yes.

Would the Grand Trunk entering Boston on its own rails, give New England better transportation facilities than would be provided by the New Haven-Grand Trunk traffic agreement? A. I do not think it would.

Do you ever think of quitting the fight in Boston? A. I have no fight with the people of Massachusetts. I am fighting for them. I am looking, not to the immediate present, but to the future, when the result of my work will secure their support and approbation.

Commenting upon the Grand Trunk Railway's movements in New England, the New York Journal of Commerce says:—

"At the close of the hearing before the House Rules Committee on the question of investigating the alleged agreement between the New York & New Haven and the Grand Trunk railroads, the text of the alleged agreement was submitted to the committee by the vice-president of the New Haven road. As we have already said, this was a traffic agreement proposed by President Mellen and not accepted by the president of the Grand Trunk, who wished to have some changes made in it. It makes no reference to the abandonment of the independent connections of the Grand Trunk with terminals at Boston and Providence, but it is a fair inference that it had much to do with the sudden suspension of work on the latter, notwithstanding the pretense that this was due to financial reasons. It contains nothing to incriminate Mr. Mellen and takes all force out of his offer to waive any right to immunity in testifying about it, as nothing was accomplished.

"Whatever the effect of the agreement might be if it were to be adopted, there is no violation of law in making the proposal. There is nothing unusual in the terms offered. It was proposed to establish certain through routes, joint rates and through billing by an arrangement for each railroad to run trains over certain lines belonging to the other, which would doubtless be of advantage to both and might under proper regulation be of advantage to the public. It ought to be of advantage to avoid duplication of facilities and expense, and to provide continuous service and through rates on routes belonging to different companies, always provided that the facilities be sufficient, the service adequate and the rates just and reasonable.

"There lies the difficulty. As the two systems through New England lie, there is more or less competition between them, and with the contemplated extensions of the Grand Trunk that competition would be materially increased. If those extensions were completed and an agreement should then be made, whereby the competition was suppressed, there is hardly a doubt that this would be held to be a violation of the anti-trust law. There are plenty of precedents to indicate that. If the proposed agreement were to be effected it would stop such competition as may exist and prevent that which was contemplated by the proposed extensions. There is little doubt that it would prevent the extensions from being made or that such was the intention in proposing it. The exposure caused by the suspension of work on the line to Providence has probably prevented the adoption of an agreement which would have been in violation of law, but we do not see how the Grand Trunk can be compelled to make the extensions and establish a competition which does not now exist."

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

18226—December 5—Recommending to the Governor-in-Council for sanction the Indenture of Lease, dated October 2nd, 1912, between the Alberta Central Railway and the C.P.R. Company.

18227—December 3—Authorizing C.P.R. to construct spur for the Alex. Bremer, Limited, on Lot Cadastral No. 125, Parish of St. Felix de Valois, Co. Joliette, Que., mileage 14.83 from Lanoraie, St. Gabriel Subdivision.

18228—December 4—Approving C.L.O. and W. (C.P.R.) plan 'A' showing details of structure to be constructed across road between Cons. 7 and 8, Tp. Hichinbrooke, near Parham, mileage 32.54.

18229—December 5—Authorizing C.N.R. to construct Craven Northeasterly Line across Eight (8) highways in Saskatchewan

18230—December 5—Authorizing C.N.R. to construct Maryfield Branch across Fourteen (14) highways in Prov. Saskatchewan.

18231—December 5—Authorizing G.T.P. to construct siding for the Dunnville Brick and Tile Company, Tp. Moulton, Co. Haldimand, Ontario.

18232—December 5—Authorizing Tp. of Palmerston, North and South Canonto, Co. Frontenac, Ont., to divert and construct road across K. and P. Ry. near Mississippi Station, Co. Frontenac, Ontario.

18233—December 5—Authorizing C.P.R. to construct spur for Calgary Terra-Cotta Company, Limited, on N.E. ¼ Sec. 18, Tp. 24, R. 1, W. 5 M., near Calgary, Alberta.

18234—December 5—Authorizing C.P.R. to construct spur to Baynes Lake across Government Highway in Lot No. 6235, Kootenay Dist., B.C., at mileage 1,22 (mileage 0 of said spur equalling mileage 5.34 of Waldo Branch).

18235—December 6—Amending Order No. 18105, dated November 20th 1912, by striking out the figures and words, "500 feet eastward from their tipple, as now constructed along the said branch line, or spur," in 2nd and 3rd lines of clause (c) of Paragraph 2 of Order, and substituting figures and words, 650 feet easterly from the westerly end of the said spur shown on plan dated November 10th, 1911, approved by said Order No. 16460;" and rescinding paragraph 3 of Order.

18236—December 7—Approving by-law of the British America Express Co., authorizing H. J. Herrold, Gen. Agent of the Co. to prepare and issue tariffs of tolls to be charged for all traffic carried by the company.

18237—December 7—Approving location C.N.R. through Tps. 22 and 21, Rges. 20-10, W. 2nd, Sask.

18238—December 7—Authorizing C.P.R. to construct bridge No. 120.05.

18239—December 4—Authorizing the Toronto Power Co. to carry its transmission line across the tracks of the G.T.R. and Wabash Railway Companies, Tp. of Thorold.

18240—November 23—Dismissing application of the village of North Edmonton and others for the opening up of Kelly Avenue, Edmonton, Alta.

18241—November 18—Authorizing the city of Brandon, Man., to carry its Municipal St. Railway across the tracks of the C.N.R. at Thirteenth St., Brandon, by means of a single track.

18242—November 19—Authorizing the city of Brandon to carry its Municipal St. Ry. across the tracks of the C.N.R. at First Street, Brandon, Manitoba.

18243—December 9—Authorizing the C.P.R. to construct its Swift Current S.E. Branch across the highway adjoining the north boundary of Sec. 27, Tp. 12, Rge. 13, W. 3rd, Sask.

18244—November 29—Refusing application of Tees & Persse, et al, to rescind Order No. 17398.

18245—November 22—Ordering the C.N.R. to erect suitable shelter and platform at Legal, Alta.

18246—December [illegible]—Dismissing complaint of the Vancouver & Nanaimo Coal Mining Co., that the Esquimalt and Nanaimo Ry. refuse to handle private coal cars over main line of said railway.

18247—November 28—Dismissing application of the Corporation of Delta, B.C., for an order rescinding Orders of the Board relating to the River Road, Delta.

18248—November 29—Dismissing complaint of the Pacific Machinery & Supply Co., against the first-class rating of the Canadian Freight Classification for Band Saws.

18249—December 2—Authorizing the Esquimalt & Nanaimo Ry. Co. to erect, maintain and operate gates at the Esquimalt Road, Victoria, B.C., where same is crossed by tracks of the E. & N. Ry. Co.

18250—November 28—Permitting British Columbia Transport Co. to cross the tracks of the G.N.R. opposite water lots 94 and 97, New Westminster, B.C.

18251—November 29—Dismissing application of Imperial Rice Milling Co., Vancouver, B.C., for reductions from present freight rates on rice and rice products from Vancouver to points east of and including Calgary, Alta., to Winnipeg, Man., inclusive.

18252—November 28—Extending time for completion of station ordered to be constructed by Order 17306 for five months from date of this Order.

18253—November [illegible]—Extending time within which the B.C. Electric Ry. Co. be allowed to appeal from Order No. 17840, for a period of two months from date of this Order.

18254—November [illegible]—Authorizing the Edmonton, Dunvegan and British Columbia Ry. to lay their rails across line of the C.N.R. at point of intersection of the two railways on Sec. 33, Tp. 55, Rge. 25, W. 4th, pending installation of permanent crossing authorized by Order No. [illegible].

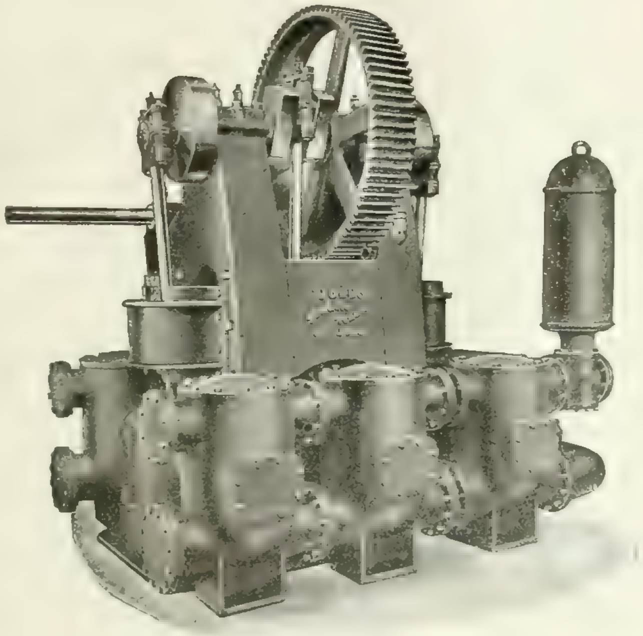
18255—November 29—Ordering the G.N.R. to extend siding at the mill of the Western Paper Mills, Ltd., Sapperton, B.C., one hundred feet.

18256—December [illegible]—Extending time to C.P.R. to file Telegraph Tolls west of Sudbury, Ont., on D.A. Ry.

18257—December [illegible]—Approving platform of the Windsor Plaster Co. at Brooklyn, N.S., to June, 1913.

Goulds Fig. 1590 Triplex Pump

For General Water Supply, Fire Protection, Elevator, Condenser and other General Services.



This pump is of the double-acting type and will deliver nearly twice as much water as a single acting pump of the same cylinder diameter and stroke.

It is furnished regularly in capacities ranging from 10,500 to 91,500 gallons per minute, for pressures up to 150 pounds or 350 feet elevation.

It is suitable for all services where large capacities are required.

Our line includes all types of Goulds Single and Double-Acting Triplex Pumps for all services. They are suitable for belt or direct connection to any type of driver.

ASK FOR BULLETINS.

SALES AGENTS:

The Canadian Fairbanks-Morse Company, Limited

MONTREAL ST. JOHN OTTAWA TORONTO
WINNIPEG SASKATOON CALGARY VANCOUVER VICTORIA

[illegible] Ont.

[illegible] which the G.T.R. are required to install gates at King and Sherbrooke Sts., Peterborough, Ont.

[illegible] cross with double track the spur track of the C.P.R. known as J. Y. [illegible]

[illegible] Gage's Creek, near Port Hope, Ont.

[illegible] posed to be constructed at mileage 157.47 and 157.75, Tp. East Whitby.

18264—December 10—Authorizing C.P.R. to construct spur into [illegible]

18265—December 9—Authorizing C.P.R. to construct highway diversion [illegible] W. [illegible] M.

18266—December 9—Authorizing C.P.R. to cross highways on Weyburn-Lethbridge Branch, Sask., mile 112.1 to 131.43.

18267—December 9—Authorizing C.P.R. to construct extension to siding already constructed on premises of city of Calgary, in Victoria Park, and an additional spur on said property of city of Calgary.

18268—December 9—Authorizing the C.P.R. to construct for the Fenton Elevator Company extension to branch line in block 12, city of Fort William.

18269—December 9—Authorizing C.P.R. to construct additional track across St. Louis St., Farnham, Que.

18270—December 10—Recommending to Governor-in-Council for sanction, agreement between G. B. & S. Ry. and C.P.R.

18271—December 9—Authorizing C.P.R. to construct temporary track for one year on its Virgin N.E. Branch across East Kildonan Road and Winnipeg Elec Ry., parish of Kildonan, Man.

18272—December 10—Ordering the C.P.R. to provide farm crossing for S. Y. Brockman in Blocks 15 and 16, Tp. Roseberry, B.C.

18273—December 11—Approving plan No. 48849 of C.P.R. showing extension to bridge No. 45.8, McAuley Subdivision, Man.

18274—December 7—Authorizing C.N.R. to construct the Beinfait-Estevan Branch across the C.P.R. Soo Line in N.W. ¼ Sec. 13-2-8, W. 2 M.

18275—December 7—Approving station grounds of C.N.O.R. at Meadowside, Ont.

18276—December 7—Approving location of C.N.O.R. through town of [illegible]

18277—December 10—Authorizing C.N.Q. Ry. to construct across public road in Lot 27, Con. 3, Tp. Arundel, Co. Argenteuil, Que.

18278—December 12—Authorizing G.T.R. to reconstruct bridge No. 73 over Cheshire Creek, mileage 136.56, 15th District, Middle Division.

18279—December 11—Authorizing Can. Nor. Pacific Ry. to construct across Esquimalt & Nanaimo Ry. Co.'s Cowichan Lake Branch, mileage 74.5, Station [illegible]

18280—December 12—Approving C.P.R. plan showing details of trestle on extension to spur for Spanish River Pulp & Paper Mills Co., at Sturgeon Falls, Ontario.

18281—December 9—Establishing the collection and delivery limits of Express Companies in Montreal, Westmount and Maisonneuve; and rescinding Order No. [illegible]

18282—December 11—Authorizing C.L.O. & W. (C.P.R.) to divert road allowance at mileage 91.18 from Glen Tay, between Cons. 1 & A, Tp. Murray; and construct across said diversion, by a grade crossing, in Lots 14 and 15, Con. A, at mileage 91.30.

18283—December 12—Amending Order 17784, dated October 17th, 1912, by striking out words [illegible] in second, third, and fourth lines of operative part of Order.

18284—December 12—Authorizing C.N.O.R. to construct bridge over the [illegible]

[illegible] public [illegible]

[illegible] chandise," C.R.C., No. 1, to take effect January 1st, 1913.

[illegible] ft. west of existing private crossing.

18285—December 9—Approving location Montreal and Southern Counties Ry. Co. from [illegible] Parish St. Antoine de Longueuil, to a point on the Central Vermont Ry. on Cadastral, Lot No. 203, said Parish of St. Antoine de Longueuil, Que., a distance of 2¼ miles.

[illegible]

18296—December 13—Amending Order No. 18106, dated Nov. 22nd, 1912, by striking out words, "Vancouver, Westminster and Yukon Railway Company," in the second line of operative part of Order, and substituting therefor the words, "Vancouver, Victoria and Eastern Railway and Navigation Company."

18297—December 13—Approving, temporarily, Kootenay and Alberta Ry. Co.'s Standard Passenger Tariff of Maximum Local Passenger Fares, C.R.C. No. 1, to take effect Jan. 1st, 1913.

18298—December 14—Directing G.T.R. to file, for the approval of the Board, on or before May 1st, 1913, plans of proposed new station and facilities at Jordan, Ontario.

18299—December 14—Directing C.P.R. to appoint a permanent agent at Niverville Station on or before the first day of February, 1913.

18300—December 14—Authorizing C.P.R. to open for traffic its second main line track from a point north of the diamond crossing of G.T.R., at St. Johns, Que., to St. Johns Station, a distance of one mile.

18301—December 14—Authorizing C.P.R. to cross with its extra track (third track), West St., Chatham, Ont.; and reserving for further consideration the question of installation of gates at said crossing.

18302—December 14—Authorizing Edmonton, Dunvegan, and B.C. Ry. Co. to construct across twenty (20) highways, mileage 68.30 to mileage 130, Alberta.

18303—December 14—Authorizing C.N.O.R. to construct across public road between Lots 8 and 9, Con. 2, Tp. of Gibbons, Dist. of Nipissing, Ontario.

18304—December 14—Approving location Edmonton, Dunvegan, and B.C. Ry., from North boundary of Sec. 23-62-27, W. 2 M., mileage 68.30, to East [illegible] Alberta.

18305—December 16—Approving location Alberta Central Ry. Co. from [illegible]

18306—December 14—Authorizing Edmonton, Dunvegan and B.C. Ry. Co. to construct across three (3) highways, mileage 111.35 to mileage 129.8, Alberta.

18307—December 14—Authorizing C.N.Q. Ry. to construct siding for the Donnacona Paper Co., Ltd., in Lot 80, Parish of Les Ecureuils, Co. Portneuf, Que., and to cross public road on Lot 80.

18308—December 16—Approving C.N.R. plans showing Standard Trestle work proposed to be used on its lines west of Port Arthur.

18309—December 14—Approving location G.T.P. Ry. Co.'s station at mileage 404, East of Prince Rupert, Sec. 4-10-5, Coast District.

18310—December 14—Authorizing C.P.R. to construct spur for the Guelph Stove Co., Ltd., on Lot 1, R. 3, Division F, Tp. of Guelph, Co. Wellington, Ont.

18311—December 14—Authorizing C.P.R. to construct spur for the Alberta Linseed Oil Mills, Ltd., Medicine Hat, Alta.

18312—December 16—Approving Esquimalt & Nanaimo Ry. Co.'s detail plans of Bridge No. 39.9, over Trent River, B.C.

18313—December 16—Approving Esquimalt & Nanaimo Ry. Co.'s detail plans of bridge No. 8.5.

18314—December 16—Authorizing Esquimalt & Nanaimo Ry. to construct Bridge No. 3.4 over French Creek, Vancouver Island, B.C.; and Bridge No. 15.5 over Big Qualicum River, Vancouver Island, B.C., Comox Extension.

18315—December 14—Authorizing C.N.O.R. to construct across and divert public road between Cons. 1 and 2, Tp. Pembroke, Co. Renfrew, Ontario, at mileage 83.10 from Ottawa.

18316—December 18—Establishing collection and delivery limits of the Dominion Express Co., in Blind River, Ontario.

18317—December 16—Authorizing C.N.R. to construct across and divert public road between Sec. 34, Tp. 28, R. 7, and sec. 3, Tp. 29, R. 7, W 4 M., on Goose Lake Extension, Alberta.

18318—December 16—Authorizing the Provincial Natural Gas & Fuel Co., of Ontario, Ltd., to lay gas pipe under G.T.R., at the second crossing east of Stevensville Station, Ontario.

18319—December 16—Authorizing Edmonton, Dunvegan and B.C. Ry. Co. to construct across three (3) highways, Prov. Alberta.

18320—December 16—Authorizing Edmonton, Dunvegan and B.C. Ry. Co. to construct across thirteen (13) highways, Prov. Alberta.

18321—December 16—Authorizing C.P.R. to revise grade of existing main line track at approaches to the grade crossing of its railway with Melville-Regina Branch of G.T.P. Branch Lines Co., in E. ½ Sec. 23-17-20, W. 2 M., city of Regina, Alta., at mileage 94.5, on Moose Jaw Subdivision.

18322—December 17—Amending Order No. 18002, dated Nov. 13th, 1912, by adding the following clause: "2. That the rights of the Canadian Pacific Railway Company as senior company to present and future tracks be preserved."

18323—December 16—Authorizing construction of proposed subway at Eleventh Ave., Moose Jaw, Sask.

18324—December 16—Approving location C.P.R. Suffield-Kipp Branch from a point in Sec. 29-13-13, W. 4 M., to a point in Sec. 9-13-17, W. 4 M., from mileage 32.85 to mileage 57.45 of said Branch, in Prov. Alberta, and authorizing construction of said Suffield-Kipp Branch across twenty-four (24) highways, mileage 32.85 to mileage 56.44.

18325—December 16—Authorizing C.P.R. to construct Lacombe-Easterly Branch across seven (7) highways, mileage 149.2 oto mileage 153.69, Alberta.

18326—December 16—Authorizing the Municipal Council of Tp. Clarence, Co. Russell, Ontario, to construct a road allowance across Montreal and Ottawa Branch of C.P.R., between Cons. 1 and 2, mileage 58.86, Tp. Clarence.

18327—December 16—Authorizing G.T.R. to construct two sidings for the De Laval Dairy Supply Co., Ltd., Peterborough, Ontario.

18328—December 16—Authorizing C.P.R. to open for traffic its second main line track on Cascade Subdivision, B.C., between Vancouver, mileage [illegible]

18329—December 14—Authorizing C.P.R. to construct its Pheasant Hills Branch across highways in town of Sutherland, from mileage 296.11 to mileage 317.15, Sask.

18330—December 16—Authorizing Edmonton, Dunvegan and B.C. Ry. Co. to construct across and divert highway in Sec. 10-54-24, W. 4 M., by [illegible]

18331—November 18—Authorizing the city of Saskatoon, Sask., to carry Municipal Street Ry. across tracks of C.P.R., at Avenue "H."

BINDING SECT. MAR 20 1972

TA
1
C34
v.23

The Canadian engineer

~~Physical &~~
~~Applied Sci.~~
~~Serials~~

Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE